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	Engineering and Design ENGINEERING AND DESIGN FOR CIVIL WORKS PROJECTS	
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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.C. 20314-1000

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Regulation
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31 August 1999

Engineering and Design
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This regulation will supersede ER 1110-2-1150, dated 31 March 1994.

APPENDICES

[Help make this a better guidance document. Submit suggestions for improvements to HQUSACE (CECW-EP), Washington, DC 20413-1000.]

DEPARTMENT OF THE ARMY ER 1110-2-1150
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Engineering and Design
ENGINEERING AND DESIGN FOR CIVIL WORKS PROJECTS

1. Purpose

This regulation defines engineering responsibilities, requirements, and procedures during the planning, design, construction, and operations phases of civil works projects. The regulation provides guidance for developing and documenting quality engineering analyses and designs for projects and products on time and in accordance with project management policy for civil works activities.

2. Applicability

This regulation is applicable to all HQUSACE elements, major subordinate commands (MSC), districts, laboratories, and field operating activities having civil works engineering and design responsibilities. The guidance included in the regulation is applicable to all civil works engineering products including work to design new projects, work to modify existing projects, and work for others.

3. References

References are listed in Appendix A.

4. Abbreviations and Acronyms

A list of abbreviations and acronyms is included as Appendix B.

5. Distribution

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6. Policy

The chief of the Engineering organization in a command is responsible for the technical content and engineering sufficiency of all Engineering products produced by the command. This regulation provides policy guidance to be used with professional engineering judgement in the development of engineering products.

6.1. *Policy Structure.* This regulation uses the five phases (reconnaissance, feasibility, preconstruction engineering and design, construction, and operation and maintenance[1]) of a major civil works project requiring specific congressional authorization to present the engineering and design policy and process that applies to all projects and products. This includes projects and products that do not follow the

[1] Operations and Maintenance is used in this regulation to include both “Operations and Maintenance (O&M)” and “Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R)”

normal authorization procedures. When the normal authorization process is not followed, one more of the project phases may be modified or deleted and report titles may change. While the regulation tracks a flood control project, the process is equally applicable to all Civil Works projects and products.

6.2. *Engineer Members of Project Development Team.* The roles and responsibilities of engineer team members and their relationships to team members from other functional elements are provided in the project management regulation (ER 5-1-11).

6.3. *Project Phases.* Projects will be developed as stated in the Management Plan and this regulation. There are five phases in the process for developing a fully authorized project. The phases are listed in paragraph 11 of this regulation and defined in paragraphs 12 through 16. The Engineering activities and products developed in the various phases are also discussed in paragraphs 12 through 16.

6.4. *Major Policy Changes.* The major change in this regulation is in the types of Engineering documents used in the project development process. The old system of General Design Memorandum (GDM) and Design Memorandum (DM) following a Feasibility Report is replaced by a system of Engineering Appendices to the Feasibility Report, Design Documentation Reports (DDR), and Engineering Documentation Reports (EDR). GDM's and DM's are obsolete document types. GDM's will not be prepared for any project. If a project requires reformulation or other sufficient major revisions, then a General Reevaluation Report (GRR) or Limited Reevaluation Report (LRR) with an Engineering Appendix shall be prepared. If a GDM is being prepared on the date of this regulation and the District desires to continue with a GDM in lieu of a GRR or LRR, the District shall submit a written request through the MSC to CECW-E for approval to continue the GDM. An Engineering Appendix shall also be prepared for all Feasibility Reports. In place of formal DM's, the District shall prepare Design Documentation Reports (DDR's) which are implementation documents. When an Engineering document is needed to supplement a Feasibility Report (or GRR or LRR) to support a Project Cooperation Agreement (PCA), an Engineering Documentation Report (EDR), which is also an implementation document, shall be used. The EDR, may contain engineering changes, project descriptions, and cost estimates. Since the EDR is not a decision document, it should not include changes in project formulation or other information requiring a Washington level decision. The annual Programs conference on Congressionally added projects may direct that a EDR with some additional data be used as the sole document to support a project authorized by Congress without a Chief's or other report.

6.5. *Impact of Oversight and Review Comments.* All MSC and Washington-level engineering functional elements will consider the impact their oversight has on design quality, overall project schedule, and project cost when conducting quality assurance activities and policy compliance reviews of decision and implementation documents. Only comments that add value to the product shall be forwarded for resolution.

6.6. *Vertical Communications.* The Management Plan for projects and products shall stress that communications with the MSC and HQUSACE are important during the preparation of decision and implementation documents. Such communications shall be oriented toward insuring the potential comments are resolved at the lowest possible level and as early during the preparation of documents as possible, not after the analytical work and the document are completed. This can be accomplished through starting the Independent Technical Review (ITR) early in the process and including other conferences and reviews in the schedule. Also, every effort shall be made to resolve issues that impact design quality, schedules and costs before requesting schedule and costs changes in accordance with prescribed project management procedures.

7. Project Delivery Team

A Project Delivery Team (PDT) is established for all projects (products) in accordance with ER 5-1-11. The PDT consists of a Project Manager and the technical personnel necessary to develop the project. When more than one individual from the Engineering organization is on the PDT, the technical chief shall designate a "lead engineer". The lead engineer may change as the project moves through the different phases of development. The PDT may include personnel from the local sponsor's staff and from other Federal agencies. Partnering with the local sponsor is a key element during the design of a project and our partners are key members of the PDT. Partnering shall occur in all phases of project development.

8. Engineering Documents

The basic Engineering Documents used in the development of projects are the Engineering Appendix to Feasibility Reports, Design Documentation Reports, Engineering Documentation Reports, and Plans and Specifications. Other Engineering documents are prepared to document construction and provide guidance for project operations.

8.1. *Engineering Appendix to the Feasibility Report.* The engineering and design effort during project formulation is documented in the Engineering Appendix to the Feasibility Report. The length and complexity of the Engineering Appendix shall be appropriate with the size and complexity of the project being formulated. When a project must be reformulated or estimated costs updated, an Engineering Appendix shall be prepared as part of a GRR or LRR. The content and format for the Engineering Appendix to the Feasibility Report is discussed in Appendix C. (For additional information on planning documents see the Guidance for Conducting Civil Works Planning Studies (ER1105-2-100) (also known as the Planning Guidance Notebook)).

8.2. *Design Documentation Report.* The design documentation report (DDR) is a record of final design effort after the feasibility phase. A DDR is required for all engineering design products. The DDR provides the technical basis for the plans and specifications and serves as a summary of the final design. The DDR covers the preconstruction engineering and design phase and the construction phase of the project. It is used by the ITR team and for future reference. The DDR is not totally completed until after the plans and specifications and construction are completed. The approval level for a DDR, which is an engineering implementation document, is at the District command. The content and format for the Design Documentation Report is discussed in Appendix D.

8.3. *Engineering Documentation Report.* An engineering documentation report (EDR) is prepared to support the Project Cooperation Agreement (PCA) when there are minor changes in design and costs from the authorizing reports. The EDR may also be used in lieu of a GRR to document other information not included in a decision document when project reformulation is not required and the changes are only technical changes. An EDR may also be prepared for individual projects, which have been authorized as part of a large system study. In these cases the EDR serves to define the specific design concept and to firmly establish the baseline cost estimate. The EDR can also be used in lieu of a decision document for projects authorized by Congress without a feasibility report when only technical decisions are required. The approval level for an EDR, which is an engineering implementation document, is at the District command. The content and format for an Engineering Documentation Report are discussed in Appendix E. The EDR will generally be included as an enclosure or appendix to the DDR for the project feature described in the EDR.

8.4. *Plans and Specifications*. Plans and Specifications (P&S) shall be prepared in accordance with ER 1110-2-1200 and ER 1110-1-8155. They shall contain all the necessary information required to bid and construct the plan detailed in the engineering appendix or in the DDR.

8.5. *Independent Technical Review.* All engineering documents require an Independent Technical Review (ITR). A copy of the ITR documentation along with a Statement of Independent Technical and Legal Review must be submitted with all documents forwarded to HQUSACE for approval.

9. Budgeting for Engineering and Design

In order for sufficient engineering to be included in a project, the engineering members of the project delivery team (PDT) are responsible for preparing budget estimates for the engineering and design funding required for the project. These estimates shall be based on a realistic schedule for accomplishing the necessary work and show direct labor, other direct costs, private sector contracting costs, and all indirect costs. These estimates are an important part of, and must be incorporated into, the Management Plan. This budget estimating responsibility is most critical for the feasibility and PED phases but is also necessary for the other the phases of the project. Consequently, it is necessary for engineers on the PDT to work with the Project Manager, planning, real estate, and construction team members, along with local interests, to develop a scope of work sufficient to prepare sound budget estimates. In addition to working within the PDT, the engineers must coordinate the scopes and schedules with the engineering functional chiefs.

10. Technical Coordination

The District engineering functional chief is responsible for the technical coordination, execution, and review of all engineering work. Districts shall conduct analyses and investigations in accordance with approved engineering criteria and guidance, coordinate engineering activities, and seek advice on problems encountered during project development from appropriate MSC, HQUSACE, and other engineering staffs. For analysis of special areas, such as hazardous, toxic, and radioactive waste (HTRW), hydropower, and other functions, assigned to centers of expertise, the districts shall coordinate as needed and comply with the regulation of use of centers of expertise. For unprecedented, complex problems, districts shall consider the use of special consultant teams, which may include engineers from the MSC, HQUSACE, other Districts, other agencies, academia, or private industry. The non-Federal sponsor's engineers shall be invited to actively participate in all phases of the design, including attendance at all formal meetings.

10.1. *Mandatory Requirements.* ER's and EM's contain mandatory requirements for engineering procedures and design standards, as discussed in paragraph 19 of this regulation. Districts shall forward requests to deviate from published Corps of Engineers criteria to the MSC for review and approval. Where required by regulations, MSC shall forward requests to deviate from these mandatory requirements to CECW-E for review and approval.

10.2. *Independent Technical Review Team.* All products produced by the District require an ITR. The members of the ITR team may be District personnel, contract personnel, non-Federal sponsor's personnel, or engineers from other sources. The District may use the ITR team in the coordination of special and complex problems as long as such action does not compromise the independence of the ITR team.

11. Phases of a Civil Works Project

Engineering involvement in Civil Works project development is continuous, although the level of intensity varies with progression through the different phases of project development and implementation. The Engineering staff fully supports the Project Manager (PM) in coordinating the engineering and design activities with local interests. Deviations from the process described in paragraph 12 through 16 and in paragraph 18 are possible. Each of the following phases of a project is discussed in more detail in the paragraph on the specific phase. All products have all phases; however, the scope, length, and level of effort can vary from one type project to another. The detail in this regulation discusses the process for large complex projects. In some other cases, such as Continuing Authority projects, some of the phases are combined.

The five phase are the Reconnaissance phase, the Feasibility phase, the Preconstruction engineering and design phase, Construction phase, and Operation and Maintenance phase.

12. Engineering During Reconnaissance Phase

The purpose of the reconnaissance is to identify a problem and potential solutions, or define a project, to address a specific public need. All projects and products have some type of reconnaissance phase where the initial definition of the follow-on work is developed.

12.1. *Formal Reconnaissance Study.* When a formal study has been authorized, the reconnaissance phase commences with the obligation of appropriated reconnaissance funds, and ends with a signing of the Feasibility Cost Sharing Agreement (FCSA) or a decision that no Federal interest exists or the failure to identify a cost sharing partner. During the Reconnaissance Phase, a limited scope WRDA 1986 Section 905(b) Analysis is prepared. Target for completion of the phase (signing of FCSA) is 6-12 months after initial obligation of reconnaissance funds. The formal reconnaissance phase study is 100% Federally funded. The cost of an expedited reconnaissance effort, the preferred process, is typically limited to $100,000. This includes $20,000 to cover all investigation and coordination activities necessary to produce a Section 905(b) Analysis. The remaining $80,000 is intended for completion and negotiation of the Management Plan and the Feasibility Cost Sharing Agreement (FCSA). Some reconnaissance studies may be authorized at a cost greater than $100,000 due to unusual scope or complexity.

12.2. *Scope of Reconnaissance Phase.* The reconnaissance phase is general in scope. However, all functions outlined in this paragraph must be addressed with sufficient engineering involvement as part of the PDT at this early stage to identify the existing conditions, the future without project conditions, the problem to be solved, and the preliminary plans that will ultimately lead to an engineering solution. The team must define the engineering and other efforts required for the feasibility phase, identify potential HTRW, and/or other environmental concerns, develop conceptual designs with reasonable estimates of costs, and support negotiating the FCSA and the Management Plan.

12.3. *Development of Management Plan.* The Management Plan is the blueprint for conducting the following phase of the project. Sufficient detail must be included to define the design criteria to be used for all major components of the project, to identify necessary tests and model studies, and to prepare a preliminary cost estimate. When the detail is lacking problems with funding and timing can arise during the next phase of the project. The format for a Management Plan that is prepared during the reconnaissance is shown in the ER 1105-2-100. The lead engineer on the PDT must insure that sufficient engineering detail is included in the Management Plan.

12.4. *Objectives of a reconnaissance phase.* The four objectives of a reconnaissance phase are:

12.4.1. Determine that the problem(s) warrant Federal participation in feasibility studies,

12.4.2. Define the Federal interest based on a preliminary appraisal consistent with Army policies, costs, benefits, and environmental impacts of identified potential project alternatives,

12.4.3. Prepare a Management Plan, and

12.4.4. Assess the level of interest and support from non-Federal entities in the identified potential solutions and cost sharing of feasibility phase and construction.

12.5. *Engineering assessment of alternatives.* Detailed engineering studies and analyses are generally not required during the reconnaissance phase. The engineers on the PDT must participate in assessing one or more potential alternatives to only determine whether they will function safely, reliably, efficiently, and economically. Effort shall be applied only to alternatives considered to have potential. In addition, PDT members shall jointly assess whether potential alternatives adequately address environmental and HTRW issues to determine if the alternatives are practical. Engineering assessment shall be based on knowledge of standard analyses and operating experience, and on sound engineering judgment. Senior engineering staff must be involved to provide experienced judgment in selection of alternatives. Appropriate outside specialists shall be consulted whenever the in-house engineering staff is not sufficiently trained or lacks experience in the type work being studied. Although only existing informational floodplain hydrology is usually used for reconnaissance phase studies, such data shall be verified. Engineering as well as all members of the PDT must have input in the decision process for the final recommendation.

12.6. *Development of engineering effort required for the feasibility phase.* The engineering effort and its associated costs required for the feasibility phase must be identified in cooperation with the PDT during formulation of the Management Plan and FCSA. This shall include the initial preparation of the quality control plan portion of the Management Plan. The engineering members of the PDT will support, participate, and provide technical assistance in the development and negotiation of FCSA's. The engineering work items, required for a feasibility phase, are listed in paragraph 13. Engineering studies and analyses, including physical and numerical model investigations, shall be scoped to the level needed to establish project features and elements that will form an adequate basis for the project construction schedule and a baseline cost estimate. Non-Federal sponsor requirements, prudent engineering practice, and risk, as reflected in the contingencies, are factors that shall be taken into consideration. Contingencies for engineering costs during the feasibility phase shall be limited to the maximum extent possible; however, good engineering judgement shall be used in developing these contingencies.

12.7. *Cost estimate and schedule.* The cost estimate for the plans that are recommended in the reconnaissance phase shall be developed to the same level as the other data used to support the recommendation. The estimate shall include estimates of total costs for real estate, mitigation, construction, facility and utility relocation, engineering and design, environmental and HTRW concerns, project management, contingencies, and inflation. Historical data, models, or unit prices are acceptable methods for developing costs at this stage, but the method used must establish reasonably supportable costs for determining whether a project is continued into the feasibility phase. Initial design, land acquisition and construction schedules are required to support the development of total project costs.

12.8. *Independent Technical Review for Reconnaissance Phase.* The independent technical review shall concentrate on evaluation of the overall project plans, on the initial cost estimates and on the Management Plan. Because the plans are largely based on experience and on extrapolation of limited data, it is essential that expert technical reviewers verify that the plan represents a reasonable solution. The review shall be consistent with the level of the reconnaissance phase and shall verify that the plan will be safe and functional, will comply with engineering criteria, and will be able to satisfy requirements for project authorization. Reviewers shall also evaluate the schedule, budget, and work plan proposed in the Management Plan for the feasibility phase. A Statement of Independent Technical and Legal Review will be prepared as described in Appendix F and accompany any reconnaissance report submitted to CECW-AR for policy compliance review. These statements are not necessary for Section 905(b) analyses under the expedited reconnaissance study process.

12.9. *Technical Review Conference (TRC).* At the determination of the district, a TRC may be held prior to the end of the reconnaissance phase, with appropriate senior district staff, and if required, MSC and HQUSACE staff. The purpose of the TRC is to resolve any outstanding technical issues on the scope and detail of the engineering development of alternative plans to be accomplished during the feasibility phase, as documented in the Management Plan, which have not been resolved by the ITR process.

13. Engineering During Feasibility Phase

The purpose of the feasibility phase is to formulate a solution to address a specific public need. The work includes studying potential solutions, evaluating costs and benefits, preparing initial designs, and recommending a plan to solve the problem. All projects and products have some type of feasibility phase where a decision is made concerning the product to be designed and constructed.

13.1. *Formal Feasibility Studies.* A formal feasibility study investigates and identifies solutions to water resources problems and recommends either for or against Federal authorization or implementation of a project. Feasibility studies, except for some navigation studies, are cost-shared 50/50 with a non-Federal sponsor and are the basis for congressional authorization. Typical studies are completed in three to four years. The feasibility phase begins with the allocation of feasibility funds for fully Federal-funded projects or the execution of a Feasibility Cost Sharing Agreement (FCSA) for cost-shared projects. At least 50 percent of a non-Federal sponsor's share (25 percent of the total feasibility phase) will be in cash. The remainder of the non-Federal sponsor's share (up to 25 percent of the feasibility cost) may be in-kind products and services. In addition to the preparation of the feasibility report with an engineering appendix, a Preconstruction Engineering and Design (PED) cost-sharing agreement is prepared during the feasibility phase.

13.2. *Engineer Elements of a Feasibility Study.* The engineering effort during feasibility shall include, but not be limited to,

13.2.1. Hydrology and hydraulic studies,

13.2.2. Development of data for the environmental assessment,

13.2.3. Establishment of the preliminary design,

13.2.4. Development of surveying and mapping information in conjunction with the real estate division,

13.2.5. Identification and design of utilities and facilities proposed for relocation,

13.2.6. Determination and design of the improvements required on lands to enable the proper disposal of dredged or excavated material,

13.2.7. Development of geotechnical information,

13.2.8. Development of HTRW information,

13.2.9. Design of project alternatives,

13.2.10. Structural, electrical, and mechanical design analysis,

13.2.11. Development of construction procedures

13.2.12. Identification of construction materials including borrow and spoil areas, and

13.2.13. Identification of O&M (OMRR&R) requirements and costs.

13.3. *Plan formulation Support.* To support the plan formulation during the Feasibility Phase, engineering shall establish project features, elements, induced flooding impacts, environmental concerns and opportunities, and real estate requirements. Engineering will also develop conceptual designs, assess available data, and collect necessary new data. The engineering aspects of feasibility studies must be developed to the level that will result in a baseline cost estimate within which the project can be designed and constructed. The engineering effort during the early feasibility study stage consists of evaluating plan alternatives, including the existing and future without-project condition. The engineering members of the PDT will also identify other alternative solutions and verify the amount and level of detail of the engineering studies and field investigations to be accomplished as previously established in the Management Plan. Sufficient engineering and design are performed to enable refinement of the project features, prepare the baseline cost estimate, develop a design and construction schedule, and allow detailed design on the selected plan to begin immediately following receipt of PED funds. The objective is to allow the project to proceed through the PED phase without need for reformulation, or post-authorization changes. Engineering must also provide support to the PM in developing the Management Plan for the selected plan.

13.4. *Evaluation of Alternatives.* Engineering staff shall assist in the evaluation of alternatives to identify those that are constructible and the degree to which safety, reliability, and functional requirements and objectives are met including operations and maintenance. The type and extent of HTRW contamination shall be determined and alternatives and costs for remedial action developed. Proposed alternatives that do not satisfy the constructibility, reliability, safety, or functional requirements shall be recommended for withdrawn from further consideration. This recommendation shall be discussed and agreed upon by the full PDT.

13.5. *Engineering objectives.* The engineering objectives during the feasibility phase are:

13.5.1. Provide engineering data and analyses sufficient to develop the complete project schedule and cost estimate. This is the primary engineering objective during the feasibility phase.

13.5.2. Assist the PM in the development of a complete project schedule for the Management Plan. Identify and schedule funds needed for final design and construction.

13.5.3. Develop conceptual plans and costs for an evaluation and comparison of alternatives and selection of a recommended plan.

13.5.4. Develop the design of the recommended plan to the level required to ensure that it can be implemented without the need for major revisions, and that the baseline cost estimate is adequate.

13.5.5. Determine the relative engineering performance and costs for the various structural and non-structural alternatives for providing a decisive comparison of characteristics between alternatives.

13.5.6. Develop design studies and operations plan requirements.

13.5.7. Determine the value and acceptability of any subsequent in-kind engineering and design services that the non-Federal sponsor may provide in accordance with the Feasibility Cost Sharing Agreement.

13.5.8. Evaluate the functional benefits, acceptability, and the value of any existing features which the non-Federal sponsor proposes to incorporate into and function as part of the project; e.g., highway embankment, storm sewer system, channel, and levee.

13.5.9. Assess risk and uncertainty for safety and functional objectives clearly estimating and displaying the probable performance of the selected plan in accordance with current risk and uncertainty analysis policy and criteria.

13.5.10. Provide preliminary design drawings to establish real estate requirements. Identify other property requirements necessary to protect project features, such as high ground between floodwall segments.

13.5.11. Identify facilities and utilities proposed for relocation.

13.5.12. identify borrow and disposal sites and determine the improvements required including lands, easements and rights-of-way for the proper disposal of dredged or excavated material.

13.5.13. Develop a baseline project performance for project authorization and subsequent design efforts. Adequate engineering analysis must be undertaken in the feasibility phase to assess and document the intended project performance. This information is needed to coordinate the safety and the functional aspects of the project with the non-Federal sponsor and with the district operational staff. The baseline project performance becomes a standard to monitor changes during detailed design affecting the intended performance of project features.

13.5.14. Identify and assess potential areas of HTRW contamination including the effects on project lands, worker health and safety, and material disposal; develop alternatives for addressing HTRW contaminated materials; and develop regulatory compliance strategies.

13.5.15. Develop the baseline cost estimate to be used for project authorization and setting the amount of allowable cost increases without reauthorization.

13.6. *Engineering studies and investigations.* Engineering data and analyses in the feasibility phase shall be sufficient to develop the complete project schedule and baseline cost estimate with reasonable contingency factors for each cost item or group of cost items. Results of engineering evaluations of planning alternatives will be documented in an engineering appendix to the feasibility report. An outline of

the engineering appendix is given in Appendix C. Engineering analysis shall integrate sound environmental engineering principles and procedures into all phases and features of the project. The feasibility level engineering data and analyses shall include, but are not limited to:

13.6.1. Hydrology and Hydraulics. Hydrologic and hydraulic studies facilitate the evaluation of economic and environmental impacts of alternatives. These studies are required to determine the functional design and requirements of water resource projects and to establish channel capacities, structure configurations, levels of protection, interior flood-control requirements, residual or induced flooding, etc. Engineering assumptions shall be consistent with plan formulation assumptions, the without project conditions, and the project economic analyses. For flood reduction projects, it is equally important to address internal flood-control requirements and residual flooding when evaluating alternatives. Physical and numerical modeling may be required in the feasibility phase to demonstrate that the proposed alternative(s) can be designed to satisfy project objectives and to determine project costs within the required level of accuracy. For navigation projects, ship-simulation investigations shall be completed in accordance with established guidance, unless a waiver is obtained. Modeling not required for project formulation, such as modeling that provides only information required for preparation of plans and specifications may be deferred to PED. However, all such modeling shall be identified in the Management Plan and scheduled for the PED phase.

13.6.2. Surveying, Mapping, and other Geospatial Data. Surveying, mapping, and other geospatial data information should be obtained to support all feasibility phase requirements. At this level, existing surveying, mapping, and other geospatial data available through in-house sources or through other federal, county, local, commercial, or private sources may be adequate. Additional information on finding these sources is available in EM 1110-1-2909. The data source, i.e., compilation scale, contour interval, control data and datum, etc., should be verified to assure it meets accuracy requirements to support the level of detail required. Otherwise, new surveying, mapping, and other geospatial data may need to be developed. If sufficiently scaled topography is not available to support the level of detail required, then it shall be developed during the feasibility phase to eliminate the possibility of large quantity errors (e.g., real estate, reservoir volumes, etc.). Detailed guidance on photogrammetric mapping surveys is provided in EM 1110-1-1000. Survey control methods and if possible the actual control points shall be established in the field at this phase of study to avoid rework and errors and to maintain continuity during subsequent phases of the project. Detailed site-specific mapping may be deferred and developed during the PED phase unless it is required to develop an accurate baseline cost estimate. The Geographic Information System (GIS) for the project should be established during this phase in accordance with EM 1110-1-2909 and ER 1110-1-8156.

13.6.3. Preliminary Project Layout. Preliminary design drawings, as defined in paragraph 13.6.6 below, shall be furnished to the Real Estate Division to establish real estate requirements (estates, rights-of-way, etc.) and to prepare the Real Estate Appendix or Real Estate Plan for the feasibility report. These drawings shall also be furnished to the environmental planning team members for use in impact analysis and mitigation planning.

13.6.4. Data and Document Management. Data and document management is as important as project management and must be a “cradle to grave” activity on each project. It is important to maintain continuity and effective resource and time management on the project. One element of the data management on a project is the GIS. The GIS starts being developed (at least a plan or outline of what kinds of data sets are likely to be developed and what the GIS will look like) in the reconnaissance phase and shall be used to maintain data in the feasibility phase. This is required to insure that all data used is maintained and available for use in the later phases of the project. In order to achieve maximum cost savings and system

flexibility, it is important that the GIS is developed in accordance with the District's Geospatial Data and Systems Implementation Plan.

13.6.5. Subsurface Exploration. Sufficient geologic and soils information shall be obtained, analyzed, and presented to support the site selection, type of foundations, and selection of structures. Subsurface investigations necessary to support the project design and baseline cost estimate, are to be performed. Additional foundation exploration and testing required during the PED and construction phases shall be identified. Subsurface investigations shall also include investigations of potential borrow and spoil areas.

13.6.6. Project design. Engineering must establish all design criteria for the project, including functional requirements, non-Federal sponsor requirements, technical and procedural design criteria, and environmental engineering considerations. Engineering must also present technical results of alternative studies leading to selection of project site, configuration and features, including main structures, major appurtenances, and major electrical and mechanical features. To establish a realistic comparison of costs, these studies shall include field tests, evaluations of HTRW, stability analyses, structural material tests, and initial seismic, thermal and conventional stress evaluations. Adequate coordination is required to obtain and process survey, hydrologic, hydraulic, structural, geotechnical, and operations and maintenance information for these studies. Studies shall address site restrictions, cofferdams and dewatering, diversion plans, and environmental restrictions or enhancements, In addition to the planned testing program for the project, special testing may be required to assess unique situations such as unusual sites, materials, structural configurations, operational plans, or extreme loadings. Because of the costs, field tests during feasibility shall be described in the Management Plan and should be limited to the alternatives most likely to be selected as the recommended plan. Any additional studies or tests planned for later phases of the design, including potential impacts on project costs must also be described and included in the Management Plan. To address the requirements of PL 89-670 with respect to authority for structure clearances over navigable waters, the U.S. Coast Guard shall be contacted to determine requirements for permits for any structures to be constructed or relocated over a river, embayment, or tributary thereto of navigable waters of the United States in connection with development of the project.

13.6.7. HTRW. Projects shall be designed to avoid HTRW contamination. Where HTRW cannot be avoided, investigations must be conducted to establish the nature and extent of HTRW contamination, if any, and the impact and cost of needed remedial action. The HTRW investigations shall address the impacts of any suspected HTRW contamination identified in the Preliminary Assessment, including development of Data Quality Objectives, Remedial Action alternatives and all associated costs of characterization and remediation. On cost-shared projects, the investigations to determine the extent and nature of contamination are cost shared the same as the cost sharing for the current of the project. The non-Federal sponsor is responsible for 100% of the cost to develop the clean-up procedures (remedial action plan) and to treat the contaminate in place or relocate the material. If the sponsor requests assistance developing the remedial action plan, the PDT shall discuss using an approved HTRW design district for the work. An engineer member of the PDT shall coordinate the studies and monitor the analysis when a HTRW design district provides assistance. The clean-up procedures must comply with the appropriate HTRW Laws and Regulations governing the site and must be approved by the appropriate Regulatory Agencies.

13.6.8. Environmental Engineering. Project design shall seek to avoid adverse environmental impacts. When avoidance is not possible, projects shall be designed as much as practical to minimize adverse environmental impacts and when possible be in concert with the surrounding environment. Mitigation shall be considered only after all practical environmental design alternatives have been considered. The non-Federal sponsor shall be a partner in the decision to mitigate in lieu of preserving or enhancing the

existing environment. When environmental restoration or enhancement is the primary project purpose, the design standards used shall acknowledge this purpose. Temporary mitigation measures required during construction must also be considered when developing the project design.

13.6.9. Construction Materials and Procedures. Potential sources and suitability of concrete materials, earth and rock borrow materials, and stone slope protection material as well as potential disposal sites shall be identified. Preliminary construction procedure, construction sequence and duration, and control of water for each step of the proposed plan shall be developed. The control of water plan shall address dewatering and surface water bypass during construction to confirm that the plan is feasible. Construction equipment and production rates that are used as the basis for the estimate shall be identified for major items. When developing the construction procedures, efforts shall be coordinated with the construction member of the PDT.

13.6.10. Consideration of Human Factors. Human judgement and reactions are equally important to physical design criteria in the performance of many civil works features, most notably deep-draft navigation channels and floodgate closure structures. Coordination with potential users and/or operators of facilities, such as ship pilots or local emergency response authorities, is required to insure that human factors are accounted for in the overall workability of civil works projects. For those features of a project where human interaction or intervention is needed, a validation of the workability of the design must be obtained from operators or users of these features during the feasibility phase.

13.6.11. Design of Non-Life Safety Critical Structures. For the purposes of this regulation, non-life safety critical structures are those small features whose failure would not result in loss of life, or significant economic loss or liability. For design of these structures (e.g., those related to environmental restoration projects), cost efficiency will be considered as a primary factor when determining appropriate design criteria.

13.7. *Engineering Review Conferences.* Not later than 18 months into the feasibility study the lead engineer on the PDT shall assess the status of the engineering portion of the study. This assessment shall include a review of the independent technical review comments, if available, and the adequacy of the field investigations and design studies identified in the Management Plan. If necessary, the engineer may request an Engineering Review Conference (ERC). The PM will coordinate with the non-Federal sponsor and encourage their participation in the ERC. If additional field investigations or design studies, beyond those identified in the Management Plan for accomplishment during the feasibility study, are required a request shall be submitted to the PM in accordance with project management guidance. The engineering appendix to the feasibility report may present the major items of discussion from an ERC, and describe the results on project formulation and design. In addition, the engineers on the PDT may participate in Issue Resolution Conferences (IRC) to resolve technical or policy issues between the independent technical review team, the non-Federal sponsor, the MSC, and/or HQUSACE.

13.8. *Operation and Maintenance Considerations.* An operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) plan for the project, including detailed estimates of the Federal and non-Federal costs, shall be developed during the feasibility phase. Budgets and schedules for the preparation of the necessary O&M or OMRR&R manuals must be included in the Management Plan. The specific requirements for the O&M or OMRR&R plan are stated in regulations and pamphlets dealing with specific types of projects. Some of the regulations dealing with O&M and OMRR&R plans are 33 CFR 208.10, ER 1110-2-401, ER 1110-2-1404, ER 1110-2-1405, ER 1110-2-1407, ER 1110-2-2902 ER 1130-2-500, and EP 1130-2-500.

13.9. *Baseline Cost Estimate.* The baseline cost estimate, based on the project schedule and the design developed for the recommended plan, becomes a major product upon which the project is authorized, developed, and completed. Adequate engineering data must be obtained and analyzed. Sufficient design must be performed to define the level of risk with associated contingencies and to ensure that reasonable costs can be developed for the identified project features based on the baseline design and construction schedule.

13.9.1. MCACES is the required software for the preparation of the final feasibility cost estimate. Specific details and guidance are covered in ER 1110-2-1302. Flexibility is provided to permit development of comparative cost estimates to be developed outside the MCACES software for the evaluation and elimination of project alternatives. The final cost estimate supporting the National Economic Development (NED) or recommended plan within the feasibility report must be prepared using the MCACES software and the established Work Breakdown Structure (WBS). The baseline estimate is the fully funded project cost estimate developed for the recommended scope and schedule established in the feasibility report. It includes all Federal and non-Federal costs for lands and damages, all construction features, planning, engineering and design, and supervision and administration, along with the appropriate contingencies and escalation associated with each of these activities through project completion. The level of cost detail may vary according to the design information/detail established to support the feasibility report. Contingencies shall be developed based upon the risks related to the uncertainties or unanticipated conditions identified by the investigation data and design detail available at the time the estimate is prepared. Contingencies will vary throughout the cost estimate and could have a significant impact on overall costs being high when lack of design data is associated with critical cost items. Part of the PDT overall project evaluation shall be whether to perform additional investigations or studies in order to reduce the uncertainties and refine the cost estimate or to proceed with the higher estimate and contingencies.

13.9.2. The final product must be a reliable, accurate cost estimate that defines the non-Federal sponsor's obligations and supports project authorization within the established WRDA86, Section 902 limits.

13.10. *Project Design and Construction Schedule.* As part of the PDT, the engineers shall provide schedules for design, performance of utility/facility relocations, provision of disposal area improvements, and construction for preparation of the Management Plan in accordance with project management guidance. These schedules shall be based on engineering judgement and indicate the optimum schedule for completing design and construction. The PM shall coordinate schedule adjustments based on funding availability and local sponsor requirements. The adjusted schedules will be used in the development of the baseline cost estimate.

13.11. *Engineering Support for Project Cooperation Agreement and PED Agreement.* During the feasibility study the PM reviews the provisions of the PCA and cost-sharing requirements with the sponsor, using the model PCA. The PM and the non-Federal sponsor negotiate their differences and agree on a final draft PCA to be included in the feasibility report. The engineering members of the PDT participate and provide technical support to the PM in defining the project scope, preparing the project description, developing the cost estimate, and providing critical considerations affecting project performance in the PCA. The engineering members of the PDT also work with the PM and the non-Federal sponsor to develop and negotiate the PED agreement. The PED agreement includes scopes of work for the final design and the plans and specifications for the first contract. It also outlines the division of design responsibilities between the Government and the non-Federal sponsor.

13.12. *Independent Technical Review for Feasibility Phase.*

13.12.1. An independent technical review for the feasibility phase must, as a minimum,

13.12.1.1. Verify that the recommended plan satisfies engineering and functional criteria,

13.12.1.2. Verify that the plan meets the customers needs consistent with law and existing public policy,

13.12.1.3. Verify that design assumptions and calculations are correct, and

13.12.1.4. Verify that the level of engineering is sufficient to substantiate both the screening level comparative cost estimates and the baseline cost estimate with contingencies to support selection of the recommended plan and to establish the baseline cost estimate with contingencies.

13.12.2. The district should include a technical review certification, as described in Appendix F, and findings with the final feasibility report documentation. The findings will summarize any changes made to the draft report made as a result of the review. Appendix F also provides guidelines for objectives and procedures appropriate for technical review of project decision documents.

13.13. *Engineering policy review and assessment of feasibility reports.* The Washington-level Policy Compliance review, combined with the feasibility phase conference report(s), is intended to produce one objective and comprehensive review of feasibility reports that can be used as a basis for forming recommendations by the Chief of Engineers and Assistant Secretary of the Army (Civil Works) for project authorization. The policy compliance review considerations are available from the Policy Review Branch (CECW-AR).

13.14. *Value Engineering.* A value engineering study shall be performed on the earliest document available that satisfies the functional requirements of the project and includes a MCACES cost estimate. The PDT shall determine if the initial value engineering study shall occur during the feasibility phase or be delayed until the PED phase. The study shall follow the guidance in paragraph 14.7.

13.15. *Engineering by the Non-Federal Sponsor.* Current policies and cost sharing agreements allow the non-Federal sponsor to perform work in-kind. When the non-Federal sponsor proposes work in-kind, an engineer from the sponsor's staff shall be on the PDT. The sponsor's work shall be reviewed as part of the ITR process. The District engineering organization shall provide the same level of oversight on the sponsor's work, as is provided on other contract engineering work. If a non-Federal entity submits a complete feasibility report for authorization, the District engineering element shall review the report for compliance with Corps of Engineers guidance. Engineering judgement shall be applied when the report varies from Corps standards and waivers shall be granted where appropriate.

14. Engineering During Preconstruction Engineering and Design Phase (PED)

The Preconstruction Engineering and Design Phase (PED) is the phase during which the design is finalized, the plans and specifications (P&S) are prepared, and the construction contract is prepared for advertising. Under current appropriations the budget definition of PED includes only the first set of P&S; however, the activities discussed in this paragraph occur for each set of P&S prepared for a project.

14.1. *Forma/ PED Phase.* On a project following the full normal project authorization process, the PED phase begins when the MSC Commander issues the public notice for the feasibility report and PED funds

are allocated to the district. On projects, which require cost sharing, PED new starts require the execution of the PED cost-sharing agreement prior to the start of PED. The non-Federal sponsor must provide 25 percent of the cost of PED during this phase. The actual cost-sharing for PED shall be the same percentage as project construction costs with adjustments, if necessary, being made after the start of the construction phase. PED generally requires a period of up to two years, depending on the complexity of the project, and ends with completion of the P&S for the first construction contract or as otherwise defined in the PED cost-sharing agreement. Engineering functions shall be prepared to begin an intensive effort immediately upon notification from the Project Manager that PED funds are available.

14.2. *Project Reformulation.* If circumstances require project reformulation, a GRR shall be prepared. For minor design changes an EDR may be prepared to support the PCA. The EDR may, also, be prepared for individual projects authorized as part of a large system study or authorized by Congress without a feasibility report, However, in these cases the EDR will only be use when engineering technical decisions only are required (see paragraph 8.3. for the EDR). DDR's will be required to properly document the engineering and design work performed during the PED and construction phases. The requirement for DDR's can not be waived; however, the content of the DDR may be reduced if the project is not complex, sufficient engineering detail is contained in the feasibility report engineering appendix, and no further detailed documentation is necessary. When a minimum DDR is used, the content of the engineering appendix must be more comprehensive, and shall contain full documentation of the completed design. When the design is an adaptation of a similar design from a previous project, a justification for adaptation shall be included in the DDR and the previous design document referenced.

14.3. *Documentation of Design.* The requirement for DDR's and their related ITR's can not be waived; complete design documentation must always be produced. However, the DDR where appropriate to avoid duplication, may refer to a detailed Engineering Appendix if that appendix contains full documentation of the completed design.

14.3.1. For a large or complex project, which may have multiple construction contracts, after the feasibility phase it may be appropriate to prepare an initial DDR for the overall project, including initial design of all major features of the project. This initial DDR could then be referenced by separate DDR's for the features in each contract. Production of the DDR and related P&S shall proceed concurrently as one unified design phase. The design should shall be completed and documented in the DDR, in accordance with Appendix D, Content and Format of Design Documentation Report.

14.3.2. Engineering efforts must be in accordance with the current Management Plan with respect to schedule, cost of design, and, more importantly, estimated construction cost. The engineering members of the PDT shall analyze the current design efforts and the estimated construction costs for conformance with the design parameters, assumptions, and costs in the baseline cost estimate. Any proposed revisions in the estimated cost or schedule of design work for this and subsequent phases of engineering must be submitted to the PM in accordance with project management guidance.

14.4. *Technical Review Conference.*

14.4.1. Early in PED, before substantial work is accomplished, technical review conference (TRC) may be held to insure that all PDT members understand the scope of work to be completed during the PED phase in accordance with the PED cost-sharing agreement. A site visit will normally be included as part of the first conference. Complex projects may require several TRC's. The PM may conduct the TRC or designate an engineering member of the PDT to conduct the meeting.

14.4.2. The purpose of the initial TRC is to discuss the current project plan, project background, objectives, schedules, costs, design options, major issues, problem areas, and the type of documents which must be prepared and the level of detail in those documents. The objective of the initial TRC will be oriented toward the design of the current project plan.

14.4.3. The lead engineer on the PDT will document the proceedings and results of the initial TRC as part of their Quality Control programs. Appropriate MSC staff may attend as part of the MSC Quality Assurance responsibilities.

14.5. *Design Documentation Reports.* A DDR shall contain but is not limited to the applicable items outlined in Appendix D. Format of a DDR shall follow that also shown in Appendix D.

14.6. *Permit applications for structures over navigable waters.* Application shall be made to the U.S. Coast Guard for any permits determined during the feasibility phase to be required for structures to be constructed or relocated over navigable waters in connection with the project. The engineer member of the PDT shall coordinate this action with the PM.

14.7. *Value Engineering.*

14.7.1. Public law and Office of Management and Budget directive require value Engineering (VE). It application has been the subject of a number of Corps of Engineers wide audits. As such, the Corps current VE Policy is to provide VE studies on Construction General projects with estimated cost of $2,000,000 and greater, and Operations and Maintenance projects with estimated cost of $1,000,000 and greater. In unusual cases where the district determines a VE study is not cost effective, the district shall prepare a formal waiver request for approval by the division engineer, with a copy of the approved waiver forwarded to CEMP-EV.

14.7.2. The PM, acting for the commander of the district, shall establish a multi-disciplinary team for each VE study on a project. This team may be made up of in-house staff, A-E contractors, or a group consisting of Corps employees outside of the immediate field office, such as the Office of the Chief of Engineers Value Engineering Study Team. Project studies will incorporate the following guidance:

14.7.2.1. A VE study shall be performed on the earliest document available that establishes the functional requirements of the project and includes a MCACES cost estimate.

14.7.2.2. If, for some reason as discussed in paragraph 8.3 above, a future project requires an EDR (or similar concept document) and final design is proceeding concurrently with the EDR review, the VE study may be started prior to its approval.

14.7.2.3. Standard criteria and designs normally incorporated into the project may be studied prior to the receipt of the approved EDR or similar document.

14.7.2.4. A representative of the sponsor will be invited and encouraged to participate on this VE review team.

14.7.2.5. The cost and schedule for VE will be included in all cost estimates and the Management Plan.

14.7.3. Each district commander will certify, based on the recommendations of the project VE team, that the design achieved is the most cost effective found by the VE study. The cost analysis shall address life cycle and deferred risk costs as well as first costs, in accordance with ER 1110-2-8159. The certification statement will accompany the document that was the basis for the VE study, or if the document has already been submitted, the certification statement will be included in a separate letter and submitted to

HQUSACE (CECW-E). Any cost savings resulting from the cost effectiveness review will be identified in the certification statement.

14.8. *HTRW.* For non-cost-shared water resource projects where HTRW cannot be avoided, the design of a plan for remediation of the HTRW is required. This effort shall be undertaken by a Geographic HTRW design district, but technical assistance will be needed to coordinate and incorporate the response work with the project plan and construction. Where the remediation action levels cannot be reached before scheduled construction, a risk assessment shall be conducted to determine what actions are warranted to allow construction to start. For cost-shared water resource projects, the sponsor is responsible for the design and implementation of the remediation, but that work effort must be coordinated with the design and construction schedule of the civil works project.

14.9. *Relocations.* Relocations are a local responsibility and cost, and in many cases are a major consideration in Civil Works projects. They need to be emphasized, and given proper consideration. The local sponsor shall be part of the PDT when relocations are being considered. During PED decisions must be made on who will accomplish relocation designs and how relocations will be coordinated with the other elements of the PDT.

14.10. *Physical model studies.* Any physical model studies or ship simulation studies required, but not previously performed during feasibility, shall be conducted during the PED phase. The need for these studies must be determined during the feasibility phase and the schedule and cost for conducting such studies must be incorporated into the Management Plan.

14.11. *Approval authority and distribution of documentation reports.* The procedures for distribution and approval of a DDR's and EDR's are as follows:

14.11.1. Design documentation reports (DDR's) are implementation documents, which undergo independent technical review and approval at the district level. A statement of the independent technical review, Appendix F, will be completed for all DDR's, and placed in the project file. DDR's are not to be submitted for a Washington-level approval. DDR's shall not be used to support the PCA. If the project has changed since approval of the decision document (feasibility report) then an EDR shall be prepared to describe the changes.

14.11.2. Engineering Documentation Reports (EDR's) are implementation documents, which undergo an independent technical review and approval at the district level. EDR's are, also, supplements to decision documents. Districts shall provide 12 copies of a final EDR to Policy Review Branch (CECW-AR), to support the PCA. One copy of the EDR shall be sent to Engineering and Construction Division (CECW-EP). The MSC will receive a copy of EDR's for information and/or quality assurance activities.

14.11.3. Design centers or other districts performing work on a project shall perform an independent technical review and approval of their work. The geographic district shall be on the review team.

14.11.4. Districts will send one copy each of DDR's to the MSC and HQUSACE, respectively, for informational purposes and project file. There will be no review or reply by higher headquarters.

14.11.5. The originating district shall furnish one complete copy of each approved DDR on a major feature of a project to the Waterways Experiment Station, ATTN: Research Library. Copies of DDR's filed at the Research Library shall be used as a source of data for model and prototype tests and investigations conducted by the Waterways Experiment Station and will be available for loan to other USACE installations. The library shall periodically announce to other USACE offices what DDR's are available for loan.

14.12. *Engineering Support for Preparation of the Project Cooperation Agreement.* The draft PCA is refined during PED. This refinement is based on continual communication between the PDT members, the PM, and project sponsor concerning project requirements. Engineering shall update the project description and cost estimate prepared during the feasibility phase. The project report to support the PCA shall be a Feasibility Report with Engineering Appendix, a general reevaluation report (GRR), or a document that updates the changes since approval of the feasibility report. An EDR may serve as to supplement the supporting decision document. The engineer team members of the PDT will work with the PM to determine the appropriate report to support the PCA. In any case, the report must document that the project to be built under the PCA is the same as that presented in the document previously approved by the Administration. If the project has been changed, the report must document the changes and reasons therefor. Engineering shall assist the PM during negotiations, as needed.

14.13. *Preparation of plans and specifications (P&S).* P&S shall be prepared in accordance with ER 1110-2-1200. P&S shall also be prepared in accordance with the Architect/Engineer/Construction CADD Standards and the Tri-Service Spatial Data Standards. They shall contain all the necessary information required to bid and construct the plan detailed in the engineering appendix and documented in the DDR. Reviews shall be made for biddability, constructibility, operability and environment (ER 415-1-11). Contract duration and liquidated damage amounts shall be estimated in coordination with the construction organization. The submittal register (ENG Form 4288), which forms a part of the specifications package, shall be prepared, and the contractor submittals to be reviewed by engineering shall be indicated on this form (ER 415-1-10 prescribes Form 4288). P&S shall be reviewed and approved by the district commander or his designated representative. Either contract or Government personnel can accomplish the review of P&S prepared by a contractor.

14.14. *Independent Government estimates (/GE).* A formal, approved construction cost estimate is prepared to support the award of each construction contract. This estimate is required for all contracts of $100,000 or more (FAR). It often represents the first detailed cost estimate based upon specific contract documents (P&S) and conditions (schedule, phasing, and constraints). This estimate serves as the document for evaluating contractor bids as a fair and reasonable cost to the Government. It further provides a mechanism through the cost item related bid abstract to collect costs for historical purposes and to compare costs with the baseline cost estimate for the project. This estimate covers the contract construction features only and does not include contingencies or profit on civil works projects. All estimates shall be prepared in accordance with ER 1110-2-1302.

14.15. *Engineering considerations and instructions for field personnel.* In preparation for the beginning of each major construction contract, engineering shall prepare a report outlining the engineering considerations and providing instructions for field personnel to aid them in the supervision and inspection of the contract. This effort must be included in the Management Plan. The report will summarize data presented in the engineering document and include informal discussions on why specific designs, material sources, construction plant locations, etc. were selected. This information shall assist field personnel by providing the insight and background needed to review contractor proposals and resolve construction problems without compromising the design intent. The discussions must not conflict with the P&S. In all

cases, the P&S will govern. The report shall be reasonably short and organized for quick reference in field situations. An outline to aid in preparing the engineering considerations and instructions for field personnel is presented in Appendix G.

14.16. *Review of A/EPA document.* In accordance with ER 200-2-2, the PDT shall review the NEPA document during PED to determine if changes to the project will require preparation of a revised or supplemental NEPA document.

14.17. *Independent Technical Review.* The products produced during the PED phase (DDR's and P&S's) are subject to an independent technical review, which is a continuing process from the start to the completed of the PED phase. The ITR team will issue periodic reports in coordination for the engineer member of the PDT.

14.17.1. The district independent review team or contractors ITR team shall verify or ensure the following:

14.17.1.1. That the design conforms to proper criteria,

14.17.1.2. That the design conforms to the plan recommended in the feasibility report,

14.17.1.3. That any deviations from criteria or the recommended plan are properly justified,

14.17.1.4. That appropriate design methods have been followed,

14.17.1.5. That the design office has completed an internal check of the design and has so indicated on drawings and computation sheets, and

14.17.1.6. That the completed project design is adequately documented in the DDR

14.17.2. The ITR team may be in-house personnel, personnel from another district, or contractor personnel. The review effort should concentrate primarily on issues related to safety and function of the project. All critical portions of the design shall be addressed in the original DDR. A statement of independent technical and legal review, Appendix F, will be completed for all DDR's and P&S's.

15. Engineering During Construction Phase

Engineering effort during construction includes completion of DDR's, modification of P&S (where appropriate), and preparation of engineering considerations and instructions to field personnel. Additional effort is needed to review selected contractor submittals, conduct site visits, and prepare construction foundation reports and concrete reports. Other plans and reports prepared during construction are the initial reservoir filling plan, the embankment surveillance plan, and the HTRW documentation report. The engineers must also provide support for contract claims and modifications, development of operation and maintenance (O&M or OMRR&R) manuals, emergency action plans (including inundation maps), and review of as-built drawings.

15.1. *Engineering funding for Construction Phase.* Engineering shall review the budget established in the baseline cost estimate for engineering work during the construction phase to ensure it is current. Any revisions needed shall be provided to the PM in accordance with project management guidance. Engineering must monitor and account for its staff expenditures during this phase to ensure adherence to

the Management Plan. The following engineering support shall be provided and included in the budgets of the Management Plan.

15.2. *Complex projects.* For complex projects with multiple contracts, the work under the first contract will be in the Engineering During Construction phase while work on other future contracts will be in the PED phase as described in paragraph 14. Preparation of DDR's and P&S's for additional contracts is handled using the PED phase guidance.

15.3. *Preconstruction conference attendance.* Appropriate engineering personnel shall attend preconstruction conferences to develop an awareness of any contractor construction concerns and assist with any technical questions that may arise.

15.4. *Review of selected contractor submittals.* The shop drawings, samples, letters of certification, tests, and/or other engineering information identified for review by engineering on ENG Form 4288 shall be processed in a timely manner (ER 415-1-10).

15.5. *Site visits.* Site visits shall verify that conditions match the assumptions used in designing the project features. Site visits may also be necessary to brief construction division personnel on any issues affecting the construction, including aesthetic considerations, which cannot be conveyed via the report on engineering considerations and instructions for field personnel. All field visits shall be well documented and scheduled.

15.6. *Engineering support for c/aims and modifications.* Engineering shall provide design and cost-estimating assistance for claims and modifications when requested and be knowledgeable of all claims and modifications arising on a project as they relate to the designs produced in the P&S. Engineering input into this process is essential to ensure continuity of the design process through construction, to help improve the viability of future designs, and to provide feedback and advice to the cost engineer and the PM.

15.7. *Development of O&M or OMRR&R manual and Water Control manual.* The O&M (or OMRR&R) and water control manuals are the responsibility of the engineering element and shall be completed and fully coordinated with the PM, the Operations element, and the non-Federal sponsor (if any) during this phase of the project. These manuals can be prepared either by in-house personnel or by a contractor.

15.8. *As-built drawings.* Final as-built drawings will be reviewed and approved by the engineering organization. The construction contractor as a contract requirement shall generally perform the preparation of as-built drawings. In certain special cases engineering division may prepare as-built drawings from marked up drawings prepared by the construction contractor. The District office shall maintain the original as-built drawings in electronic format. Copies of final as-built drawings to be maintained at the site will be presented to operations personnel or the local sponsor upon turn over of the project or functional element for operations.

15.9. *HTRW.* Engineering shall assist the construction field office in the preparation of an HTRW documentation report, which shall serve as a permanent record of all HTRW-related activities at the project during construction. The local sponsor shall furnish a section for this report documenting the HTRW actions taken on their behalf prior to construction. This HTRW documentation report does not remove the requirement to preserve all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) environmental restoration actions performed for civil works funded components and non-DOD agencies.

15.10. *Post Construction Reports.* To fully document the project, the post construction reports, which are required by other regulations shall be completed and referenced in the Design Documentation Report. Examples of post construction reports include (but are not limited to) the Project Geotechnical and Concrete Materials Completion Report for Major USACE Projects.

16. Engineering During Operations Phase

Operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of a completed project shall be accomplished by either the non-Federal sponsor or by the Federal government. Responsibilities shall be as set forth in the project authorization(s) and as described in a Project Cooperation Agreement (PCA) for cost-shared projects. The Corps shall periodically inspect the project, and shall review and approve owner-proposed structural or operational modifications, and recommend repair, rehabilitation, and/or replacement of components. Under the Federal Guidelines for Dam Safety, the Corps continues to have a liability for all dams it designed and/or constructed as long as the structure is in service. For other local protection projects, the Corps liability is more limited.

16.1. *Support of Operations Activities.* Engineering support shall be provided for those maintenance activities that require P&S and for major rehabilitation projects. For new construction, engineering shall provide support during the project turnover phase. Depending on the project purpose and subject to the terms of the PCA, engineering support shall be provided to modify as-built drawings, review operational deviations, identify and address project deficiencies, and evaluate replacement plans.

16.2. *Periodic inspections.* Periodic inspections shall be conducted to assess and evaluate the performance and safety of the project during its operating life in accordance with ER 1110-2-100, ER 1110-2-111, ER 1110-2-1156, and ER 1130-2-530. For projects operated by local sponsors, the Corps shall conduct the first and second periodic inspections, and the first filling inspection. After these inspections are completed, the Corps may participate in the periodic inspections that are conducted by the sponsor in accordance with the OMRR&R manual.

16.3. *As-built drawings.* Modifications to the features of a project, which occur during the operating life of a project, shall be reflected in the as-built drawings. The status of as-built drawings shall be a subject of each periodic inspection. For projects operated by local sponsors, the OMRR&R manual shall require an electronic file copy of modified as-built drawings to be furnished to the District office.

16.4. *Operational deviations from the p/an.* Any deviations from the use or function of any portion of a project shall be reviewed and approved by engineering. Changes to the O&M manual shall be made as required.

16.5. *Existing project deficiencies.* Noted deficiencies of a project or evidence of distress exhibiting potential failure shall be identified and reported in accordance with ER 1165-2-119 and ER 1110-2-101, respectively. A plan for correcting such deficiencies shall be developed as required.

16.6. *Evaluation and design of scheduled replacement features.* Support for evaluation and design of scheduled replacement features may be provided as required.

16.7. *Design and Construction of Project Maintenance and Other Contract Work.* When maintenance or other work requires the design, preparation of plans and specifications, and engineering during construction, the applicable portions of paragraphs 14 and 15 shall apply. The non-Federal sponsor may request the Corps to perform this work on a reimbursable basis.

16.8. *Emergency Action Plans.* Engineering shall assist the project operators in the preparation, maintenance, and testing of Emergency Action Plans.

17. Design Quality

Product quality is the responsibility of everyone on the PDT. Execution of design and technical quality is the responsibility of engineering. Technical quality must be achieved while conforming to schedules, budgets, and customer expectations. To ensure these goals are met simultaneously, it is essential that coordinating and planning the work effort occur at the earliest stage of project development, through preparation and execution of the Management Plan. Engineering must provide input for development of the plan. Engineering in conjunction with project management must ensure that the work is properly defined and schedules are attainable. Technical quality shall be achieved mainly through the a process that includes development of realistic comprehensive work plans, definition of functional and technical criteria, adequate coordination among the project team and technical disciplines, and continuous coordination with the PM and non-Federal sponsor. In addition proper oversight by senior design experts, and full participation in constructibility and other feedback sessions is required. Quality is further achieved by participation in value engineering studies and thorough internal checking and review by qualified engineers. Application of lessons learned during current planning and design work can enhance quality of future work. To take advantage of an opportunity for improvement, designers shall document any problems experienced and effective solutions developed during the design and other processes. These may occur in any aspect of design, such as coordination, scheduling, criteria, design methods, regulations, or other areas. Written lessons learned reports shall be forwarded through the command so the entire Corps can benefit from experiences with each project. Specific guidance on design and technical quality is contained in ER 1110-1-12.

18. Continuing Authorities Program.

District staff will use judgment to perform the appropriate level of detail of analyses to produce a quality project and meet Continuing Authorities Program time and cost targets. The level of detail should be minimized to that which is necessary to determine the recommended plan. This does not authorize commanders to deviate from legislative or regulatory requirements. However, districts and divisions are encouraged to be innovative and develop their own time and cost saving measures. Issues that arise over appropriate level of detail should be elevated to the MSC for resolution.

Specific instructions for level of detail are not possible due to the variation in type, scope and extent of problems and the issues surrounding recommended solutions, The Continuing Authorities Program procedures allow the Corps of Engineers to bring expertise and experience to bear to solve identified water resource problems of a more limited scope than those projects, which are pursued under congressional authorization. This mission works best when the program is used to solve the problems for which it was designed, leaving complex projects to the specifically authorized program and very small projects to non-Federal entities. Successful performance on the Continuing Authorities Program's limited funding and time targets requires significant reliance on professional judgment and prudent engineering practices. The Continuing Authorities Program process requires staff skilled in the principles and practices of engineering, economic and environmental evaluation, real estate, and contracting procedures.

19. Published Criteria Mandatory Requirements.

Engineering policy for civil works projects is issued in the form of official publications, primarily engineer regulations (ER's) and engineer manuals (EM's). Engineer circulars (EC's); engineer pamphlets (EP's);

and engineer technical letters (ETL's) are also used. Generally, ER's have been viewed as conveying mandatory policy requirements for management of the engineering function. However, the engineering requirements contained in EM's and other publications have been considered as mandatory standards by some offices, while being treated as mere suggested methods by other offices. This difference has resulted in inconsistent application of engineering requirements throughout USACE, sometimes not in accordance with HQUSACE intent. This intent has not always been clearly stated in the publications; however, many specific provisions have been intended as mandatory. For example, minimum safety factors and minimum clearances to ensure functional adequacy are intended to be mandatory requirements. These mandatory engineering standards ensure reasonable uniformity throughout USACE, and are intended to ensure project safety and functional adequacy.

19.1. *Publications*

19.1.1. Engineer Regulations. ER's contain policy requirements for engineering management. All ER requirements will be considered mandatory unless otherwise indicated within the regulation or as clarified by official correspondence from CECW-E.

19.1.2. Engineer Manuals. EM's contain policy standards for uniform engineering practice related to civil works projects. Existing EM's contain some mandatory requirements to ensure project safety and function. These requirements shall be identified annually in an ETL. These interim annual lists of mandatory requirements will be in effect until individual EM's are updated. In all new EM's and future revisions of each EM, the HQUSACE proponent shall ensure that the mandatory engineering requirements are specifically identified.

19.1.3. Engineer Technical Letters. ETL's contain information similar to EM's, and the above policies for EM's are also applicable to ETL's. However, ETL's are intended for temporary use. Their content should be incorporated into appropriate EM's as soon as practical.

19.1.4. Engineer Circulars. EC's are used for temporary publication of draft content of ER's or EM's, All EC's will clearly state which provisions are mandatory.

19.1.5. Engineer Pamphlets, EP's are used to distribute general information within USACE or to the public. EP's never establish requirements; this is done other publications. EP's may include discussion of specific mandatory standards.

19.1.6. Guide Specifications. Each design district is responsible for producing contract specifications for each project. The project specifications must conform to engineering policies established in any of the above types of publications. Guide specifications are useful tools for producing these project specifications, but do not, by themselves, set any mandatory requirements for civil works projects. Where there is a conflict between a guide specification and another publication (ER, EM, EC or ETL), the other publication will govern.

19.2. *Proponent Office Symbol.* Each official publication identifies the HQUSACE proponent by including an office symbol in the heading. This symbol is primarily for administrative purposes. It shall not be interpreted to limit the applicability of the publication. The scope and applicability of the publication are described within the body of the publication.

19.3. *Exceptions.*

19.3.1. Mandatory Standards. No standard can be considered universally applicable, but published USACE engineering standards are appropriate for most civil works projects. When a mandatory standard is not appropriate for a project, the district shall request a waiver of that requirement from CECW-E. This request shall be submitted through the MSC and shall explain the reasons for the request, and the consequences if it is not granted. Such waivers should be initiated early in the design or evaluation process to minimize possible impacts on execution. The MSC shall forward the waiver request to CECW-E where it shall be approved or rejected within 30 days of receipt.

19.3.2. Non-mandatory Standards. Decisions to deviate from the non-mandatory provisions of official publications can be made by the districts as part of the design or evaluation process, subject to normal quality control and independent technical review. Deviations are subject to approval by the Engineering chief and shall be clearly identified in the engineering documentation. Since our official publications ensure reasonable uniformity by establishing the general standard for engineering practice within USACE, deviations should be infrequent and subject to a disciplined decision process. Use of stricter standards to increase safety or reliability is usually not justifiable because of the higher costs. When more conservative standards are proposed for use, the project cost-sharing partner should be consulted.

19.4. *New Technology.* USACE engineering standards are based on our traditional projects and practices. When new technologies are utilized, appropriate standards for design might not be contained within our publications. In such circumstances, the district shall determine appropriate design standards by consulting with appropriate experts within USACE, experts in the broader engineering community, and CECW-E proponents. These proposed standards shall be subject to final approval by CECW-E.

19.5. *Architect-Engineers.* The above requirements apply to all projects, whether the engineering is performed by in-house personnel or by architect-engineers.

19.6. *Design-Build.* The above requirements also apply to design-build contracts. The contract documents must clearly identify the engineering standards, which govern the design, and the procedures for obtaining approval of changes to those standards.

20. Internal Management Control of Engineering and Design

Each engineering organization shall establish sufficient internal management controls to ensure that all engineering functions are conducted in a cost-efficient manner in accordance with the requirements of this regulation. The internal management control review checklist for engineering and design of civil works projects is included as Appendix H to this regulation. This checklist shall be used as a guide in establishing local internal management control programs. Completion of the checklist is mandatory on a five-year cycle as published in the annual Army Management Control Plan.

FOR THE COMMANDER:

RUSSELL L. FUHRMAN
Major General, USA
Chief of Staff

8 Appendices
(See Table of Contents)

APPENDIX A
REFERENCES

A-1. P.L. 86-645, Section 207(a), (74 Stat. 480), Land Acquisition Policy Act of 1960.

A-2. P.L. 87-874, Section 208, (76 Stat. 1173), River and Harbor Act of 1962-Flood Control Act of 1962.

A-3. P.L. 89-670, Department of Transportation Act.

A-4. P.L. 94-168, Metric Conversion Act of 1975.

A-5. P.L. 99-662, Water Resources Development Act of 1986.

A-6. P.L. 100-418, Omnibus Trade and Competitiveness Act of 1988.

A-7. 33 C.F.R. Part 208, Paragraph 208.10.

A-8. Federal Acquisition Regulation.

A-9. Executive Order 12770, 25 July 1991, Metric Usage in Federal Government Programs.

A-10. TM 5-853-1, Security Engineering Project Development.

A-11. TM 5-853-2, Security Engineering Concept Design.

A-12. TM 5-853-3, Security Engineering Final Design (For Official Use Only).

A-13. TM 5-853-4, Security Engineering Electronic Security Systems

A-14. Engineer Federal Acquisition Regulation Supplement (EFARS)

A-15. ER 5-1-10, Corps-wide Area of Work Responsibility.

A-16. ER 5-1-11, Program and Project Management.

A-17. ER 11-1-30, USACE Internal Management Control Program.

A-18. ER 37-1-24, Operating Budgets.

A-19. ER 37-2-10, Accounting and Reporting Civil Works Activities.

A-20. ER 200-2-2, Procedures for Implementing NEPA.

A-21. ER 200-2-3, Environmental Compliance Policies.

A-22. ER 405-1-12, Real Estate Handbook.

A-23. ER 415-1-10, Contractor Submittal Procedures.

A-24. ER 415-1-11, Biddability, Constructibility, Operability.

A-25. ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies.

A-26. ER 1105-2-101, Risk-Based Analysis for Evaluation of Hydrology/ Hydraulics, Geotechnical Stability, and Economics in Flood Damage Reduction Studies.

A-27. ER 1110-1-12, Quality Management.

A-28. ER 1110-1-1300, Cost Engineering Policy and General Requirements.

A-29. ER 1110-2-1201, Specifications.

A-30. ER 1110-1-8156, Policies, Guidance, and Requirements for Geospatial Data and Systems.

A-31. ER 1110-1-8158, Corps-Wide Centers of Expertise Program.

A-32. ER 1110-2-100, Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures.

A-33. ER 1110-2-101, Reporting of Evidence of Distress of Civil Works Structures.

A-34. ER 1110-2-109, Hydroelectric Design Center.

A-35. ER 1110-2-111, Periodic Safety Inspection and Continuing Evaluation of USACE Bridges.

A-36. ER 1110-2-112, Required Visits to the Construction Sites by Design Personnel.

A-37. ER 1110-2-240, Water Control Management.

A-38. ER 1110-2-401, Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors.

A-39. ER 1110-2-1155, Dam Safety Assurance Program.

A-40. ER 1110-2-1156, Dam Safety – Organization, Responsibilities, and Activities.

A-41. ER 1110-2-1200, Plans and Specifications for Civil Works Projects.

A-42. ER 1110-2-1302, Civil Works Cost Engineering.

A-43. ER 1110-2-1404, Deep Draft Navigation Project Design.

A-44. ER 1110-2-1405, Hydraulic Design of Local Flood Protection Projects.

A-45. ER 1110-2-1407, Hydraulic Design for Coastal Shore Protection Projects.

A-46. ER 1110-2-1460, Hydrologic Engineering Management.

A-47. ER 1110-2-1806, Earthquake Design and Evaluation of Civil Works Projects.

A-48. ER 1110-2-2902, Prescribed Procedures for the Maintenance and Operation and Shore Protection Works.

A-49. ER 1110-2-8154, Water Quality and Environmental Management for Corps Civil Works Projects.

A-50. ER 1110-2-8156, Preparation of Water Control Manuals.

A-51. ER 1110-2-8157, Responsibility for Hydraulic Steel Structures.

A-52. ER 1110-2-8159, Life Cycle Design and Performance.

A-53. ER 1130-2-500, Partners and Support (Work Management Policies)

A-54. ER 1130-2-530, Flood Control Operations and Management Policies.

A-55. ER 1165-2-119, Modifications to Completed Projects.

A-56. ER 1165-2-131, Local Cooperation Agreements for New Start Construction Projects.

A-57. ER 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects.

A-58. EP 11-1-4, Value Engineering: A Profitable Partnership.

A-59. EP 37-1-3, Budget Officer's Handbook.

A-60. EP 200-2-3, Environmental Compliance Guidance and Procedures.

A-61. EP 1105-2-10, Six Steps to a Civil Works Project.

A-62. EP 1110-2-9, Hydrologic Engineering Study Design.

A-63. EP 1130-2-500, Partners and Support (Work Management Guidance and Procedures).

A-64. EP 1165-2-1, Digest of Water Resources Policies and Authorities.

A-65. EM 200-1-2, Technical Project Planning Guidance for HTRW Data Quality Design

A-66. EM 1110-1-1000, Photogrammetric Mapping

A-67. EM 1110-1-1005, Topographic Surveying

A-68. EM 1110-1-1804, Geotechnical Investigations

A-69. EM 1110-1-2909, Geospatial Data and Systems.

A-70. EM 1110-2-1003, Hydrographic Surveying.

A-71. EM 1110-2-1411, Standard Project Flood Determinations.

A-72. EM 1110-2-2300, Earth & Rock-Fill Dams General Design & Construction Considerations

A-73. PGM 99-01 -- Reconnaissance Phase Guidance

APPENDIX B
ABBREVIATIONS AND ACRONYMS

A-E	Architect-Engineer
AR	Army Regulation
CECW-AR	Policy Review Branch, Policy Division, Civil Works Directorate
CECW-E	Engineering and Construction Division, Civil Works Directorate
CECW-EP	General Engineering Branch, Engineering and Construction Division, Civil Works Directorate
CEGS	Corps of Engineers Guide Specification
CEMP-EV	Value Engineer Office, Military Programs Directorate
CFR	Code of Federal Regulations
DDR	Design Documentation Report
DM	Design Memorandum (Obsolete)
EC	Engineer Circular
EDR	Engineering Decision Report
EM	Engineer Manual
ENG Form	Corps of Engineers Form
EP	Engineer Pamphlet
ER	Engineer Regulation
FCSA	Feasibility Cost-Sharing Agreement
FRC	Feasibility Review Conference
GDM	General Design Memorandum (Obsolete)
GFR	Government Furnished Property
GRR	General Reevaluation Report
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HTRW	Hazardous, Toxic, and Radioactive Waste

IDC	Initial Design Conference
IPR	In-Progress Review
IRC	Issue Resolution Conference
ITR	Independent Technical Review
LRR	Limited Reevaluation Report
MCACES	Microcomputer Aided Cost Engineering System
MFR	Memorandum for the Record
MP	Management Plan
MSC	Major Subordinate Command
NEPA	National Environmental Policy Act
NED	National Economic Development
O&M	Operation and Maintenance (generally used in reference to Pre-WRDA 1986 projects with Federal operations and maintenance)
OMRR&R	Operation, Maintenance, Repair, Replacement and Rehabilitation (generally used in reference to Post-WRDA 1986 projects with sponsor operations and maintenance)
P.L.	Public Law
P&S	Plans and Specifications
PCA	Project Cooperation Agreement
PDT	Product Delivery Team or Project Delivery Team
PED	Preconstruction Engineering and Design
PES	Project Executive Summary
PM	Project Manager
PMP	Project Management Plan (obsolete, see Management Plan)
PSP	Project Study Plan (obsolete, see Management Plan)
PRB	Project Review Board

RRC	Reconnaissance Review Conference
SACCR	Schedule and Cost Change Request
TM	Technical Manual
TRC	Technical Review Conference
USACE	U.S. Army Corps of Engineers
VE	Value Engineering
WBS	Work Breakdown Structure
WRDA86	Water Resources Development Act, 1986

APPENDIX C
CONTENT OF ENGINEERING APPENDIX TO FEASIBILITY REPORT

C-1. General

The engineering appendix to the feasibility report shall include applicable items in the following paragraphs and any additional information required for the specific project concerned. Comparative studies, field investigations, design, and screening level cost estimates shall be in sufficient detail to substantiate the recommended plan and the baseline estimate. The level of design shall be consistent with engineering plan presented in the Management Plan. Prior to generating any geospatial data, a check of the National Geospatial Data Clearinghouse shall be made to determine if data required by the project already exists. Geospatial data created in-house or by contract needs to be documented using the Federal Geospatial Metadata Standards and post on the Internet as outlined in EM 1110-1-2909.

C-2. Hydrology and Hydraulics

C-2.1. Present the basis and results of hydrologic and hydraulic studies required for determining the functional design requirements of all water resource projects. Explain the methods used, why the methods were selected, and the basic assumptions on which these studies are based. Provide basic data as appropriate and discuss the limitations of the collected data. Present results and conclusions and explain how they apply to design and real estate requirements. In the event only a minimum design documentation report (DDR) is to be prepared, the hydrologic and hydraulic information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S. As appropriate for the specific type of project under development and to the extent necessary to support plan formulation and the project cost estimate, hydrologic studies shall include:

C-2.1.1. Consequences of flows exceeding discharge capacity of the project.

C-2.1.2. Project-induced changes obligating mitigation.

C-2.1.3. Discharge-frequency relationships.

C-2.1.4. 0.2% chance of exceedance flood or SPF (0.5 probable maximum flood).

C-2.1.5. Stage-discharge relationships.

C-2.1.6. Flow duration.

C-2.1.7. Flood inundation boundaries and flood stage hydrographs.

C-2.1.8. Reservoir yields.

C-2.1.9. Risk and uncertainty analysis for sizing of the project under study.

C-2.1.10. Water quality conditions.

C-2.1.11. Groundwater conditions.

C-2.1.12. Preliminary project regulation plan.

C-2.1.13. Preliminary Real Estate taking line elevations.

C-2.1.14. Criteria for facility/utility relocations.

C-2.1.15. Criteria for identification of flowage easements required for project function.

C-2.1.16. Criteria in support of project OMRR&R requirements.

C-2.1.17. Environmental engineering considerations incorporated into the design and regulation plan.

C-2.2. In a separately identified section, present information about residual flooding; i.e., flooding from any source which will occur as a result of project capacity exceedance. This information shall identify, as a minimum, the following:

C-2.2.1. Warning time of impending inundation.

C-2.2.2. Rate of rise, duration, depth, and velocity of inundation.

C-2.2.3. Delineation on the best available mapping base the extent of inundation for the 1% and 0.2% chance of exceedance floods for the project being designed. When appropriate include analyses of historic floods.

C-2.2.4. Access and egress problems created by flooding.

C-2.2.5. Potential for loss of life as a result of C-2.2.1 through C-2.2.3.

C-2.2.6. Identification of any potential loss of public services.

C-2.2.7. Potential physical damages.

C-2.3. In a separately identified section, present information about flooding which will be induced by the project, if any; i.e., flooding caused by project construction or operation as determined by comparing without-project to with-project conditions. This information shall identify, as a minimum, the following:

C-2.3.1. Information categories required by C-2.2 above.

C-2.3.2. Anticipated frequency of induced flooding.

C-2.4. Based on the design flood, also provide inundation risks during project life for an array of chance of exceedance floods up to the 0.2% chance flood.

C-2.5. Hydraulic studies shall include the following:

C-2.5.1. Hydraulic roughness determinations.

C-2.5.2. Water surface profiles.

C-2.5.3. Stage-discharge relationships.

C-2.5.4. Head loss.

C-2.5.5. Flow and velocity.

C-2.5.6. Structural sizing needed to meet design capacities including riprap or other slope protection.

C-2.5.7. Water control facilities.

C-2.5.8. Energy dissipating facility features.

C-2.5.9. Erosion control requirements.

C-2.5.10. Existing and post-project sedimentation.

C-2.5.11. Water control and order of work during construction.

C-2.5.12. Criteria for facility/utility relocations.

C-2.5.13. Other special facilities needed to meet project operation, water quality and environmental requirements.

C-2.5.14. Instrumentation and monitoring.

C-2.6. *Coastal studies.*

C-2.6.1. ER 1110-2-1407 prescribes the design procedures and rationale for the hydraulic design of coastal shore protection projects. In most cases, the design of these projects shall be carried out to the extent that they are adequate to serve as the basis for P&S with minimal associated post-authorization studies.

C-2.6.2. Coastal navigation projects at the entrance to the mouth of any river or at any inlet must be assessed with respect to their effects on the adjacent shores. Particular reference shall be made to erosion and/or accretion for a distance of not less than 10 miles on either side of the entrance. Most of the studies, pertaining to coastal processes, are required by ER 1110-2-1407 and shall be used to assess the adjacent shore characteristics before and after the entrance modifications.

C-2.7. *Navigation projects.* ER 1110-2-1404 prescribes the design procedures and rationale for the hydraulic design of navigation projects.

C-3. Surveying, Mapping, and Other Geospatial Data Requirements

C-3.1. Develop sufficient surveying, mapping, and other geospatial data information to support preparation of the feasibility report and the Real Estate Appendix thereto. The initial work shall include a check of the National Geospatial Data Clearinghouse to determine if any data required for the project is already available. A brief outline of additional surveying and mapping required for design, plans and specifications, construction, and operations shall also be developed. In the event only a minimum design documentation report (DDR) is to be prepared, the surveying and mapping information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S.

C-3.2. When new mapping or other geospatial data are required obtaining the products in a timely manner is often a problem. New mapping is generally derived from aerial photography, which in snowbelt and forested areas of the country can only be accomplished during two short time periods in the year. Advanced planning is required to insure that funding is available to obtain the services when required; otherwise a delay in obtaining the data of a year or more could occur.

C-4. Geotechnical

C-4.1. Develop, describe, and present sufficient geotechnical information to verify the project plan, site selection, foundation design, selection of all structures, and cost estimates. In the event only a minimum design documentation report (DDR) is to be prepared, the geotechnical information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S. This information shall include studies, methods, reasons for selection, and conclusions and recommendations as follows:

C-4.1.1. Regional and site geology.

C-4.1.2. Completed exploration, which shall include the number, size, and type of exploratory borings; the number of pressure tests and pumping tests; and the number, size, and type of exploratory excavations and the type of equipment used. Describe results of exploration and tests.

C-4.1.3. Selection of preliminary design parameters.

C-4.1.4. Geophysical investigations.

C-4.1.5. Groundwater studies, which shall include present conditions, anticipated changes, and the effects of those changes.

C-4.1.6. Recommended instrumentation.

C-4.1.7. Earthquake studies which shall include regional and site earthquake history, fault studies, recommended preliminary design seismic motions or coefficients. Initial selection of defensive design measures shall be presented.

C-4.1.8. Preliminary foundation design and slope stability analysis.

C-4.1.9. Excavatability analysis with possible blasting constraints and controls.

C-4.1.10. Anticipated construction techniques, limitations, and problems.

C-4.1.11. Potential borrow sites and disposal sites.

C-4.1.12. Potential sources of concrete materials and results of materials investigations.

C-4.1.13. Describe potential sources and indicate suitability of concrete materials and plant, earth and rock borrow material, and stone slope protection.

C-4.2. For projects where soils strongly influence the design and selection of structures and project features perform sufficient physical property testing and discuss selected design values. Conduct probabilistic analyses when appropriate. Where leakage or seepage through, under, or around water retention structures is indicated, adequate pumping or pressure tests shall be conducted and their results presented. Preliminary performance thresholds (seepage quantities, uplift, internal phreatic levels, and movement) shall be described. For coastal projects where structural changes could have regional impacts, geomorphologic studies shall be performed to identify the cause and effect of long-term historic changes and the processes, past and present, which caused those changes. Drawings shall include, but not be limited to, a plan of exploration, bedrock and groundwater contour maps, geologic sections (with interpretations), exploration records (logs of borings, exploratory excavation maps, etc.), and plans and sections of foundation design (founding elevations, excavation limits, reinforcement, and treatment).

C-4.3. A summary of any additional exploration, testing, and analysis required for preparation of the DDR and P&S shall be provided.

C-4.4. A summary of the laboratory-testing program completed and a description of the evaluations made in the selection of the design parameters shall be included in the appendix.

C-5. Environmental Engineering

The following environmental engineering factors shall be incorporated into each aspect of the project.

C-5.1. Use of environmentally renewable materials.

C-5.2. Design of positive environmental attributes into the project.

C-5.3. Inclusion of environmentally beneficial operations and management for the project.

C-5.4. Beneficial uses of spoil or other project refuse during construction and operation.

C-5.5. Energy savings features of the design.

C-5.6. Maintenance of the ecological continuity in the project with the surrounding area and within the region.

C-5.7. Consideration of indirect environmental costs and benefits.

C-5.8. Integration of environmental sensitivity into all aspects of the project.

C-5.9. The perusal of the Environmental Review Guide for Operations (ERGO) with respect to environmental problems that have become evident at similar existing projects and, through foresight during this design stage, have been mitigated/addressed in the project design.

C-5.10. Incorporation of environmental compliance measures into the project design.

C-6. Civil Design

C-6.1. *Site selection and project development.* Discuss the selection of the project site and evaluation of alternative layouts, alignments, components, aesthetics, relocation of facilities, etc., and describe components and features, including the improvements required on lands to enable the proper disposal of dredged or excavated material. In the event only a minimum design documentation report (DDR) is to be prepared, the site selection information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S.

C-6.2. *Real Estate.* Develop and describe the engineering requirements relating to the determination of what lands, easements, right-of-ways, and borrow and disposal sites are necessary for the construction, operation, and maintenance of the project. Prepare preliminary design drawings depicting such engineering requirements for use by Engineering and Real Estate in jointly determining the project land requirements.

C-6.3. *Relocations.* Describe the facility/utility relocations required as a result of the project. Discuss the methods proposed for accomplishing the relocations and the land requirements related thereto.

C-7. Structural Requirements.

The following structural data shall be presented in the engineering appendix. In the event only a minimum design documentation report (DDR) is to be prepared, the structural information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S.

C-7.1. Identify all functional design requirements and technical design criteria for the structural elements of the project. Include references, loads, load combinations, load factors, safety factors, and assumed or calculated uplift pressures.

C-7.2. Identify appropriate survey, hydrologic, hydraulic, and geotechnical data used as the basis for structural design. Also identify key design data obtained through coordination with other disciplines (e.g., machinery loads).

C-7.3. Provide the structural basis for site selection studies. Include descriptions of any structural measures to maintain or enhance environmental quality.

C-7.4. Provide the technical basis for selection of type and configuration of main and major appurtenant structures for all of the alternatives studied.

C-7.5. Describe evaluation and selection of substructure alternatives based on economy and performance.

C-7.6. Describe site restrictions, probable construction techniques and sequence, and plans for dewatering and care of water. Indicate how these considerations affected evaluation of the alternatives.

C-7.7. Provide results of stability analyses to show application of stability criteria, methods of analysis, and assumptions for each type of structural monolith. The analysis summary for all monoliths should be sufficient to reduce cost contingencies to an acceptable level.

C-7.8. Provide results of initial stress analysis to show application of strength criteria, methods of analysis, assumptions, and key dimensions of components of each major structural system. The analysis summary for all structural elements should be sufficient to reduce cost contingencies to an acceptable level.

C-7.9. Provide results of initial seismic analysis to show application of seismic criteria, methods of analysis, assumptions, and key dimensions of components of each major structural system required too meet seismic requirements. The seismic analysis summary for structural systems should be sufficient to determine if seismic loading controls the design of the structures and should be sufficient to reduce cost contingencies to an acceptable level.

C-7.10. Summarize results of initial thermal stress analyses of massive concrete monoliths.

C-7.11. Describe results of any other analyses, laboratory tests, or field tests, which were necessary to evaluate unprecedented site conditions, operating environment, materials, or load level.

C-7.12. Identify plans for further studies, tests, and analyses after the feasibility phase. This shall include identification of any significant unresolved design issues, an evaluation of how these issues affect current cost contingencies, and how they may impact design costs and schedule.

C-8. Electrical and Mechanical Requirements.

Identify all functional design requirements and technical design criteria for the electrical and mechanical systems and equipment of the project. Provide the technical basis for selection of type and configuration of electrical and mechanical equipment. A letter from the Federal Power Agency indicating marketability of any hydroelectric power to be produced by the project shall be included in the feasibility report. This section of the appendix shall include appropriate technical information supporting the estimates of hydropower production for the proposed plan. In the event only a minimum design documentation report (DDR) is to be prepared, the electrical and mechanical information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S.

C-9. Hazardous and Toxic Materials.

When, based on previous land usage, the potential for the presence of hazardous and toxic materials exists, perform and report upon sufficient investigations and testing to identify the nature and extent of such materials. Include the estimated cost for remediation design and/or treatment and/or removal/disposal of these materials in the baseline cost estimate. In the event only a minimum design documentation report (DDR) is to be prepared, the hazardous and toxic waste information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S.

C-10. Construction Procedures and Water Control Plan

Briefly describe the construction procedure and water control plan for each construction stage of the proposed plan. Sufficient hydraulic and hydrologic data, hydrographic and topographic information, structural information, geologic and soils information, and environmental information shall be included to support the general features of the water control plan. The plan should also discuss erosion and sedimentation control.

C-11. Initial Reservoir Filling and Surveillance Plan

For projects involving dams and reservoirs, briefly describe the initial reservoir-filling plan. Include information on the preferred filling rate, the available options to control it, the consequences of sole purpose operation to control the rate, water quality requirements for the initial filling, and the most probable types of problems that might develop during initial filling. Describe the proposed hydrologic data collection and transmission system and the plans for reading and evaluating instrument data and making visual inspections of the dam and downstream areas, both related to increments of pool level. Also describe the organization that will be responsible for decisions and implementation of emergency plans in the event of need. Outline guidelines on conditions requiring notification of personnel in that organization and implementation of emergency plans.

C-12. Flood Emergency Plans for Areas Downstream of Corps Dams

Flood emergency plans will be developed for areas downstream of a Corps dam that would be affected by sudden failure of the dam. Plans shall include development of a flood warning system, inundation maps, notification procedures, etc. The organizations that will be responsible for decisions and implementation shall be described. The plans shall be closely coordinated with the appropriate Federal, State and local agencies. Reference ER 1130-2-530.

C-13. Environmental Objective and Requirements.

Develop sufficient environmental information to support preparation of the feasibility report and the Real Estate Appendix thereto. A brief outline of additional environmental objectives and requirements for design, plans and specifications, construction, and operations shall also be developed. In the event only a minimum design documentation report (DDR) is to be prepared, the environmental information in the engineering appendix to the feasibility report shall be sufficiently detailed to support the development of project real estate requirements and preparation of P&S.

C-14. Reservoir Clearing

Include a brief description of clearing limits, acreage and costs involved, and a discussion of proposed methods of disposal of cleared material.

C-15. Operation and Maintenance

Describe the plan proposed for operation, maintenance, repair, replacement, and rehabilitation of all features (Federal and non-Federal) of the project, including detailed estimates of the Federal and non-Federal costs and a chart of the proposed Federal and non-Federal organizations.

C-15.1. For projects to be maintained and operated according to regulations prescribed by 33 CFR Part 208, Paragraph 208.10, describes the necessary operation and maintenance requirements to be included in the O&M manual furnished to local interests.

C-15.2. For projects involving channel and/or debris basin clean out, include the anticipated frequency and equipment requirements.

C-15.3. For complex projects, such as multiple-purpose projects with power production, an analysis will be included covering the staffing recommended for each project function, such as power, navigation, flood control, reservoir operation, etc. Such analysis will include a comprehensive description of the operational requirements the marketing agency foresees for the power facilities, the number of transmission lines terminated in the project switchyard and such other data and operating criteria as may affect project staffing. The proposed location and size of facilities (space) for the use of administrative, supervisory and maintenance personnel will be included and justified in the staffing analysis. Provision of separate structures for administrative, supervisory and maintenance or other purposes for the primary functions of the project will be based on sound economic justifications.

C-15.4. For navigation channels, the estimated effect of required overdepth on the frequency and cost of maintenance dredging will be discussed.

C-16. Access Roads

Describe the proposed permanent access roads and those for use during construction of the project. Describe suitability of temporary access roads for permanent use upon completion of construction. The authority to utilize, improve, reconstruct, and maintain existing public roads for access to the project during construction contained in Section 207(a), P.L. 86-645 as amended by Section 208 of P.L. 87-874, shall be considered when this is more economical than provision of a new access road. If studies indicate that use and improvement of an existing public road for access meet the requirements of the cited legislation, the basic cost comparisons and criteria, including views of local interests exercising jurisdiction over the road, shall be included in the engineering appendix or in a DDR. The cost estimate shall show separately the cost of improving the public road, the cost of constructing the remaining portion of road and the total cost. These data are necessary for a determination pursuant to the above-cited law.

C-17. Corrosion Mitigation

When the water analysis and soil determinations indicate that corrosion mitigation may not be required, the survey data, conclusions and recommendations can be presented as a section of the appendix. If it appears that extensive corrosion mitigation will be required, a DDR shall be submitted to present complete information covering the results of surveys and tests to determine the corrosion characteristics of the water and soil at the site, the conclusions reached, and the proposed solution. The water analysis shall be complete, including resistively, and "pH" at the site.

C-18. Project Security

The designer is directed to use the security engineering manuals, Army TM 5-853-1, -2, -3, and -4, dated May 1994, produced by the Protective Design Mandatory Center of Expertise at the Omaha District as a guide in developing physical security plans. Questions on these manuals or on physical security of civil works projects may be directed to Protective Design Center, Omaha District.

C-19. Cost Estimates

The development of an accurate baseline cost estimate that represents the scope and schedule established in the feasibility report is essential. The baseline cost estimate documentation submitted must be in the MCACES format and include the summary sheets for direct costs, indirect costs, and owner costs to the subfeature level for all features and a total project cost summary that addresses escalation through project completion. It must contain a narrative that discusses cost relationships and assumptions made based on the level of design, quantity issues and unknowns. The narrative shall also identify the risks or uncertainties used in the development of contingencies. One floppy disk, containing the complete estimate and associated database, will be provided for review by CECW-AR.

C-20. Schedule for Design and Construction

In coordination with the Construction Division, provide the estimated time required for construction of the project and its principal components. Provide a schedule to show the sequence of proposed land acquisition, design and construction operations, and the funds required by fiscal year.

C-21. Special Studies

Identify engineering requirements, budget requirements, and schedule for special studies, such as hydraulic model studies, project site specific seismic studies, and concrete thermal studies, required during PED. Provide a discussion of features required to ensure that the project is in compliance with various environmental regulations and/or mitigation commitments.

C-22. Plates, Figures, and Drawings

Plates, figures and illustrations that use color in originals to differentiate project features must also include colored copies in documents forwarded for review. Otherwise, project features shall be identified by the use of varied shading, bars, crosshatch, etc., in order to differentiate specific items in monochromatic copies. When photographs are used to illustrate project features, they shall be clear and provide interpretive value.

C-23. Data Management.

During the feasibility study, an engineering data management system for the project shall be established to insure that all information developed for the project is cataloged and stored for use during the future phases of the project.

C-24. Use of Metric System Measurements.

To be consistent with public law and executive orders, it is important that the use and integration of the metric system be included in Civil Works plan formulation and design process, construction work, and project operations to the maximum extent practicable. In considering the use of metric measurements the non-Federal sponsor's needs and concerns must be taken into account. The Engineering Appendix to the Feasibility Study shall document the discussions and decision concerning the use of metric measurements.

APPENDIX D
CONTENT AND FORMAT
OF DESIGN DOCUMENTATION REPORT

D-1. General

D-1.1. The Design Documentation Report (DDR) is an implementation document that provides the technical basis for the plans and specifications. It serves mainly as a summary of the design to be used by the PDT during development of the P&S. The DDR is used by the independent technical review (ITR) team for reviewing the design and the P&S and is available for future reference. The DDR is primarily an engineering document developed by the lead design engineer in cooperation with the PDT. The engineering members of the PDT, along with the functional chief are responsible for the technical content of the DDR. The original DDR shall be maintained in the official district files. The DDR itself is not a complete record of all design details, which may be necessary to resolve legal issues or to investigate problems during construction or operation. These design details shall also be maintained in the district files. They must be readily retrievable for future reference and appropriately secured to prevent accidental loss or destruction.

D-1.2. Development of the DDR shall start at the beginning of the design phase, when basic criteria decisions are made. Design documentation shall be expanded or modified as the design progresses. In-progress design documentation shall be available for purposes such as coordination among disciplines, reports to management, or in-progress and interim technical reviews.

D-1.3. The DDR shall contain a full record of design decisions, assumptions and methods, subsequent to the Feasibility Report. It shall be sufficiently clear so that an engineer or other individual not familiar with the project could review the DDR and understand how the project evolved into its final configuration, and why each key decision was made. It shall be sufficiently detailed, for each technical specialty, so that the criteria which were used, the critical assumptions which were made, and the analytical methods which were used will be evident for purposes of review and historical documentation. The report shall also contain summaries of important calculation results and selected example calculations for all critical elements of the design. The DDR shall usually be sufficient to support execution of the ITR process without reference to other design records. Since the ITR process is a continuous process through the design phase, the ITR team will need to receive updated versions of the DDR as the design progresses.

D-1.4. The DDR is not finalized until project construction is completed. During the construction phase, design decisions made in connection with contract modifications shall be added to the DDR. The final report shall contain records of the resolution of critical comments during the ITR process, a copy of the Statement of Technical and Legal Review and resolution of critical changes during construction.

D-1.5. For complex projects that may result in several sets of plans and specifications (P&S); it may be appropriate to develop multiple DDR's. If the PDT chooses to have multiple DDR's, the PDT may desire to consider an initial DDR that could address overall project layout and the interfaces between each phase of the project. Use of such multiple reports is at the discretion of the district.

D-2. Syllabus

A summary of project data applicable to the feature being presented shall be included.

D-3. Table of Contents

A table of contents shall be provided. It shall include all major paragraph titles, paragraph numbers, page numbers, and a list of graphical information.

D-4. Project Description

Include a general description of the entire project as set forth in the feasibility report and/or authorizing document. If the project is authorized, cite the authorization. Describe any differences in the feature now being presented with the authorized plan and/or the plan in the feasibility report and why these changes do not require a post-authorization change.

D-5. Pertinent Data

A tabular summary of essential data on the project construction cost, physical features, project purpose, and controlling elevations (e.g., for design flood, real estate acquisition, relocations, etc.) shall be included.

D-6. References

Basic data and criteria used in the design, referring to applicable engineer manuals and regulations, guide specifications, and other sources of criteria, shall be listed. Include any criteria waivers approval.

D-7. Engineering Studies, Investigations and Design

Results of investigations, analyses, and calculations made for the design shall be included. For each technical specialty, include clear definitions of all criteria, analysis methods, and assumptions. The results shall include the description and information necessary to perform independent review to understand the purposes stated in paragraph D-1.3. Such information shall include, as applicable, the following:

D-7.1. Determination of final location and resulting site plan for specific features.

D-7.2. Refinements to project hydrology for specific features.

D-7.3. Determination of pertinent hydraulic design features, flow characteristics and discharge capacities, but not detailed design computations, except in unusual or unprecedented cases when such computations will facilitate review. Sufficient detailed design shall be included for the ITR team and for the preparation of P&S of critical spillways and other water control structures and refinements in levee alignments

D-7.4. Design water surface profiles, discharge coefficients and curves, and other plotted data or tabulations.

D-7.5. Results of hydraulic model tests when the hydraulic design is based on a model study.

D-7.6. For offshore placement of dredged material, the locations of disposal areas and an indication as to whether material is expected to redeposit in the dredged area. For onshore placement, proposed diking to prevent runback shall be indicated, or the rationale for not providing diking shall be given. For design of recreational areas, the effects of possible sediment deposition or shore erosion on waterfront facilities shall be discussed.

D-7.7. Determination of the stability of shoreline and harbor structures, including sand budget analysis characteristics of wave and littoral drift, design still water level, and specific gravity of materials, where applicable. Principles of wave diffraction and refraction analysis shall be employed where pertinent, and diagrams for critical conditions shall be included.

D-7.8. Instrumentation plans including instrumentation during construction shall be discussed and justified, including type, locations, and objectives. Instrumentation facilities essential to long-term evaluation and assessment of structural safety shall be identified. Threshold values for anticipated project performance shall be indicated. Plans, cross sections, and details of the installation of planned instruments shall be presented.

D-7.9. Stability safety factors, applied loads, load factors, and material strengths shall be listed along with comparisons between calculated values and criteria requirements. Typical calculations shall be included for selected critical elements. Summaries of results shall be provided for remaining elements. Analyses shall document the final structural design for the project, except for detailing requirements.

D-7.10. Results of detailed seismic evaluations of structural elements and results of thermal stress evaluations of structural elements. Sufficient data shall be presented to document fully all assumptions and analysis methods. Voluminous results may be presented in a condensed form.

D-7.11. Results of geotechnical investigations, which supplement previous studies but are limited in extent to the area represented by the subject DDR.

D-7.12. Determination of adequacy and use of materials, strengths, stability, slopes, and protection of critical sections of embankments and foundations. Examples of calculations for slope stability, consolidation, settlement, bearing capacity, and seepage analyses shall be included.

D-7.13. Determination of source, adequacy, and use of construction materials, or appropriate references to previously prepared DDR's on the subject. When rubble-mound structures are involved, include the names and locations of satisfactory quarries, estimates of available quantities of suitable stone in the quarry, or tests of other quarry locations.

D-7.14. Determination of the most effective water control plan (including but not limited to dewatering and pressure relief) and order of work which will result in the least property damages, construction delays, or possibility of failures. The level of flood protection and risk during construction shall be addressed.

D-7.15. Design computations made to determine size, strength, rating, adequacy, and interrelationships of electrical and mechanical items, but not design computations to develop details, except in unusual cases where such details are critical. Include a summary of the critical aspects of electrical and mechanical features that have been added since completion of the feasibility report. A description of the operation and maintenance requirements shall also be included. Refined quantities and cost estimates including O&M (or OMRR&R) cost data shall be presented.

D-7.16. Results of investigations and analyses that led to required relocations different from those identified in the Feasibility Report. Include documentation of coordination efforts with the Real Estate element to address changes in required relocations. In those cases where a map study suggests an alignment for relocations that investigation or local knowledge indicates to be obviously unsuitable, the fact that such alignment was considered and rejected shall be documented, including reasons for rejection.

D-7.17. Determination of the water quality characteristics of a proposed impoundment and the ability of the project's outlet works and regulation scheme to meet downstream water objectives.

D-7.18. Design of disposal areas for cleared and excavated material, including access, grading, and erosion and sediment control.

D-7.19. Summary of HTRW considerations related to worker health and safety and disposal requirements.

D-7.20. Discussion of HTRW remedial and other actions required from the sponsor prior to construction and allowable HTRW levels at the start of construction. Also, include a summary of any HTRW investigations, regulatory compliance issues, and remedial activity.

D-7.21. Copies of correspondence with manufacturers concerning items presented in the design. Also, when no additional environmental documentation is required, copies of correspondence documenting additional coordination with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and state natural and cultural resource agencies since completion of the Feasibility Report.

D-7.22. Operation, maintenance, repair, replacement and rehabilitation requirements to be included in the O&M (or OMRR&R) manual furnished to project operators and local interests.

D-7.23. For projects involving channel and/or debris basin clean out, the anticipated frequency and equipment requirements.

D-7.24. Description of the facilities designed to accommodate the physically handicapped.

D-7.25. Results of water analysis and soil testing to determine the need for corrosion mitigation. The water analysis shall include resistivity and pH at the site. If it appears that extensive corrosion mitigation shall be required, complete information on the results of surveys and tests to determine the corrosion characteristics of the water and soil at the site, the conclusions reached, and the solution shall be presented. The solution for the various components shall be presented in detail, listing the materials and/or methods proposed for use.

D-7.26. For government furnished property (GFP), include a Memorandum for Record (MFR) documenting the following three elements:

D-7.26.1. A description of such property,

D-7.26.2. An explanation as to why use of GFP is in the Government's best interest, and

D-7.26.3. Reference to any necessary coordination and concurrence within the District.

D-7.27. For items such as hydraulic turbines, turbine governors, hydraulic turbine driven generators, transformers, and miscellaneous powerhouse equipment for which guide specification have been prepared for procurement under supply contracts, no explanation is required in the MFR.

D-7.28. A summary of all environmental engineering factors and considerations that have been incorporated into the project as established in the authorizing document. This includes a discussion of the environmental impact of proposed project features and measures proposed to mitigate any environmental damage or to enhance the environment including a visual impact analysis. A brief discussion shall include changes, if any, that will need to be reflected in the NEPA document. Explain how the views of natural and cultural resource agencies were incorporated into project design or construction. Include summary of any HTRW investigations and any remedial activity.

D-7.29. A reference to all value engineering (VE) studies that have been prepared for the current design, including a summary of significant VE proposals incorporated.

D-8. Graphical Information

Design drawings, sketches, charts, diagrams, maps, profiles, or other graphical information necessary to clearly illustrate the design shall be included or referenced to the contract plans. The maps shall clearly identify all place names mentioned in the text of the DDR.

D-9. Cost Estimates

D-9.1. Cost estimates shall be based on quantities and unit prices, historical data, or cost models depending on the level of design information available. The method selected must be equivalent and establish reasonable supportable costs for comparison of alternate designs.

D-9.2. The total current working estimate developed, as the baseline estimate in the defined work breakdown structure must be continuously updated, as the design is refined. The baseline cost estimate set the target during the feasibility phase for managing and controlling project costs. Effort must be directed continuously to evaluating costs versus design requirements to maintain a design-to-cost philosophy. As the design is refined, the costs associated with each feature become more specific to satisfy the scope requirements and the uncertainties are reduced. A total current working estimate must be prepared at each major milestone in the project development. The cost estimate documentation shall be in the MCACES format and include the summary sheets for direct costs, indirect costs, and owner costs to the subfeature level for all features and a total project cost summary that addresses escalation through project completion. It must contain a narrative that discusses cost relationships and assumptions made based on the level of design, quantity issues and unknowns. The narrative shall also identify the risks or uncertainties used in the development of contingencies.

D-10. Technical Review Documentation

Both reviews by the PDT and by the ITR team shall be documented in the DDR.
Include documentation of in-progress reviews (IPR's) at key decision points in the design process, resolutions and agreements reached in technical review conferences (TRC's), and annotated comments surfaced during the independent technical review process. Technical review documentation shall be included as an appendix in the DDR. In addition a copy of the Statement of Technical and Legal Review for the design and P&S process shall be included in the DDR. The documentation from the ITR team required by the QCP may be either included or referenced in the DDR.

D-11. Relocation Documentation Report for Navigation

In a relocation documentation report for navigation projects, the locations of existing facilities proposed for remedial work shall be fully described so as to show whether such existing facilities are located in navigable or non-navigable waters. If located on or along navigable waterways, information shall be

included as to the elevation of existing ordinary high water and whether such existing facilities are located above or below the elevation of existing ordinary high water.

D-12. Format of Design Documentation Report

In-progress design documentation and its supporting documents such as drawings, sketches, criteria, manufacturer's data, etc. may exist in hard copy, electronic form or a combination of these. An official copy of the final DDR is necessary for construction support, reference, future projects, litigation, and etc. The complete design analysis and DDR shall be maintained in the official district files for as long as the project exists. It may be produced in the form of a bound hard copy or any permanent electronic media such as CD-ROMs, in accordance with this appendix and the following guidelines:

D-12.1. *Table of Contents* - To facilitate references and review, each DDR shall have a table of contents, which identifies major paragraphs of the text, appendices and graphical information.

D-12.2. *Text* - All text paragraphs shall be numbered or lettered.

D-12.3. *Graphical Information* - Graphical information shall be appropriate for binding and filing.

D-12.4. *Calculations* - Calculations and summaries of analysis results shall be presented in appendices, in a form readable and understandable for the reviewer. Edit calculations, if necessary, to clarify analysis methods for the reviewer and to remove unnecessary pages, such as repetitive trials and errors. Calculations shall always include page numbers and shall be preceded by a detailed table of contents.

D-12.5. *Binding and Cover* - Bindings for DDR's shall be of a type that facilitates removal of pages and substitutes of revised pages.

D-12.6. *Numbering* – DDR's for a complex project shall be numbered in sequence, generally as the design progresses. Each DDR shall contain a front flyleaf identifying all previously issued and currently scheduled DDR's for the particular project, including their actual or expected completion dates.

APPENDIX E
CONTENT AND FORMAT OF ENGINEERING DOCUMENTATION REPORT

E-1. Definition

An Engineering Documentation Report (EDR) is a technical implementation document that supplements a decision document or that is used in lieu of a regular decision document to support a PCA. An EDR is required to support the PCA when there are minor changes in design and costs from the authorizing reports. The EDR may also be used in lieu of a GRR to document other information not included in a decision document when project reformulation is not required and the changes are only technical changes. The content of an EDR will vary based on the purpose for preparing the EDR. An EDR, which presents only technical design changes and revised cost estimate to support a PCA, may be only a few pages in length. Where, an EDR prepared to support a project authorized without a feasibility report would be a more detailed document. When project reformulation is required, a GRR or LRR with Engineering Appendix shall be prepared instead of an EDR. The format of an EDR shall be the same as the format of the Design Documentation Report.

E-2. General

The EDR will be based upon the project identified in the feasibility report and/or authorizing document. Changes in the project configuration shall be properly documented and justified in the EDR. For authorized projects, significant changes shall be presented in an executive summary of the project, including the project plan recommended in the EDR with information such as the project purposes, level of protection, design flows, etc. Duplication of data presented in previous decision documents shall be minimized; however, care shall be taken to cover all areas of insufficiency in the feasibility report and/or engineering appendix thereto. The EDR will include applicable items in the following paragraphs and any additional information required for the specific project concerned.

E-3. Table of Contents

The table of contents shall include all major paragraph titles, paragraph numbers, and page numbers, and shall identify the subject of all appendices. Figures, plates, and tables shall be separately listed.

E-4. Pertinent Data

A tabular summary of essential data on the project cost, benefit-to-cost ratio, physical features, project purpose, and controlling elevations (e.g., for design flood, real estate acquisition, relocations, etc.) shall be provided.

E-5. Status of Project Authorization

State the status of project authorization, i.e., feasibility report completed and public notice issued or project authorized. Explain the need for an EDR. Briefly describe the project recommended in the feasibility report or the authorized project as described in the authorizing document. For authorized projects, cite the specific authorizing law with section number. If not covered in the feasibility report, describe the previous project, if the current project is a modification thereof, and include data conforming to those contained in the Annual Report on percentage of completion, present condition and relation of uncompleted features of the previous project to the current plan.

E-6. Items of Local Cooperation and the Project Cooperation Agreement

The items of local cooperation will be summarized in the report. The proposed actions on the PCA will be discussed in accordance with current policy.

E-7. Previous Investigations

State whether or not the reconnaissance and feasibility phases of project development were managed under the project management policy. If not, state character and extent of previous surveys and studies made in connection with the feasibility document, cite the document number (if applicable), and treat any other pertinent prior investigations similarly. State briefly the character and extent of surveys, studies (including re-evaluation studies) and other planning completed subsequent to initiation of PED, including the results of public meetings held.

E-8. Project Description

Provide a description of the entire project including Federal and non-Federal elements and features in order to convey an understanding of how the project will (and is intended to) function to satisfy project purposes. Also describe adjacent existing Federal and non-Federal projects and facilities that (could) impact the project. Describe briefly each feature or element of the proposed plan of improvement, using headings such as lock, dam outlets, fish passing or propagation facilities, pumping plants, housing facilities, powerplants, shop and maintenance facilities, instrumentation facilities, recreation features, etc., and refer to attached drawings.

E-9. Changes

Changes in the project recommended in the feasibility report for projects not yet authorized shall be documented and fully justified. For authorized projects, post-authorization changes, which exceed the criteria in ER 1105-2-100, shall be processed in accordance with the cited ER.

E-10. Current Engineering Studies, Investigations, and Design

Since projects requiring an EDR involve substantial changes or deficiencies in feasibility reports, engineering studies for the EDR will follow closely those currently required for feasibility reports and described in paragraph 12 of the main text. The EDR shall include applicable items of an engineering appendix to a feasibility report; data shall not be duplicated. In lieu of duplication, reference shall be freely made to the engineering appendix for items, which have not changed subsequent to its preparation.

E-11. Cost Estimate

If the baseline cost estimate was not established in the feasibility phase (e.g., for older authorized projects), it must be developed during the PED phase and reported in the EDR. The submittal requirements to support the EDR are identical to those given for an Engineering Appendix to the Feasibility Report; however, the approval level is the District Commander. Project costs estimates during PED are approved at the district level, unless the cost increase exceeds the project Section 902 limits, which then require project reauthorization and the preparation of a Post-Authorization Change Report by the planning organization.

E-12. Economic Analysis

An update of the economic analysis for the project shall be included. The project benefits and annual costs presented in the feasibility report and/or project document shall be updated as appropriate and a new benefit-to-cost ratio provided. Reasons for any revisions shall be explained. Guidance is provided in ER 1105-2-100.

E-13. Cost Allocation and Cost Sharing

The cost allocation and cost sharing presented in the feasibility report shall be updated using any new costs and benefits. All changes shall be fully described and supported.

E-14. Environmental Documentation and Coordination

The EDR shall include any additional NEPA documentation prepared as a result of the changes to the project during design, or document that no additional NEPA documentation is necessary. The views and comments of other interested Federal, State and local agencies will be obtained as they relate to their specific areas of responsibilities. The document will also include the views and comments of the non-Federal sponsor.

E-15. Review and Approval

The EDR is subject to the standard ITR process. Once, the review comments are resolved, the approval level of the EDR is the District Commander.

APPENDIX F
INDEPENDENT TECHNICAL REVIEW (ITR)

F-1. All engineering and design products shall have an independent technical review (ITR). The ITR team shall be established when work as started on a product and shall conduct such reviews as necessary to insure that the product is consistent with established criteria, guidance, procedures, and policy. The ITR process shall be a continuous process with reviews coordinated with the PDT to minimumize lost design effort.

F-2. The ITR team shall document its actions and recommendations; furnishing the PDT reports at critical points during project formulation, design, and construction. Five review options are available to districts for conducting independent technical reviews. The reviews may be conducted within the district, by another district(s), by Centers of Expertise, by USACE teams, or by contract.

F-3. A statement of technical and legal review should be completed for all final products and final documents. In the case of decision documents forwarded to HQUSACE for review a statement of technical and legal review should accompany both draft and final documents. A sample statement of technical and legal review is included as enclosure 1 to this appendix. The statement shown is a sample. Districts may modify the sample to include PDT members and IRT team members or to include other functional chiefs or the District Commander. These modifications shall be justified and included in the QCP. Also, when the ITR is preformed by contract, the appropriate members of the contractor's staff shall sign the statement.

F-4. In developing an ITR and quality control program, the Districts are encouraged to prepare a standard guideline for independent technical review. This document could be used as a stand alone guide for the ITR teams on small projects and as a guide for developing the quality control plan for large projects. A sample guideline is included as enclosure 2 to this appendix.

ENCLOSURE 1 TO APPENDIX F
STATEMENT OF TECHNICAL AND LEGAL REVIEW
SAMPLE

COMPLETION OF INDEPENDENT TECHNICAL REVIEW

The District has completed the (type of study) of (project name and location). Notice is hereby given that an independent technical review, that is appropriate to the level of risk and complexity inherent in the project, has been conducted as defined in the Quality Control Plan. During the independent technical review, 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 of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy. The independent technical review was accomplished by (an independent district team/personnel from XX District/by A-E contractor).

(Signature) (Date)
Technical Review Team Leader

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW:

Significant concerns and the explanation of the resolution are as follows:

(Describe the major technical concerns, possible impact, and resolution)

As noted above, all concerns resulting from independent technical review of the project have been considered. The report and all associated documents required by the National Environmental Policy Act have been fully reviewed.

(Signature) (Date)
Project Manager

(Signature) (Date)
Chief, Planning Division

(Signature) (Date)
Chief, Engineering Division

(Signature) (Date)
Chief, Operations Division

(Signature) (Date)
Chief, Real Estate Division

CERTIFICATION OF LEGAL REVIEW:

The report for _____, including all associated documents required by the National Environmental Policy Act, has been fully reviewed by the Office of Counsel, District and is approved as legally sufficient.

_____ (Signature) _____ _____ (Date)_____
District Counsel

ENCLOSURE 2 TO APPENDIX F
GUIDELINES FOR INDEPENDENT TECHNICAL REVIEW

F2-1. OBJECTIVES.

F2-1.1. There are six primary objectives of engineering technical review.

F2-1.1.1. To ensure that the engineering concepts are valid,
F2-1.1.2. To ensure that the recommended plan is feasible and will be safe and functional,
F2-1.1.3. To ensure that a reasonable cost estimate has been developed,
F2-1.1.4. To ensure that the engineering analysis is correct,
F2-1.1.5. To ensure that it complies with engineering policy requirements, and
F2-1.1.6. To ensure that it complies with accepted engineering practice within USACE.

F2-1.2. Reviewers must identify any significant deficiency. Comments should be limited to those that are required to ensure adequacy of the product; it is not the reviewer's responsibility to enforce personal preferences.

F2-1.3. A secondary review objective is to ensure that the recommended plan is an economical solution.

F2-1.4. The following simple checklist should be used as the basis for performing engineering technical reviews:

SAMPLE BASIC CHECKLIST FOR ENGINEERING TECHNICAL REVIEW

Is the proposed solution safe, functional, constructible, economical, and reasonable?

Does the design follow USACE engineering criteria? (If not, have proper waivers been obtained?)

Are appropriate analysis methods being used?

Are the basic design assumptions valid?

Are the calculations initialed by designers and checkers, and are results essentially correct?

For the current phase of the project, is the engineering content sufficiently complete, and does it provide an adequate basis for the baseline cost estimate?

Is the documentation adequate?

F2-1.5. Technical reviewers should not comment on inconsequential items, such as the following:

INAPPROPRIATE TECHNICAL REVIEW COMMENTS

Spelling, grammar, format or language in the report. (This type of comment may be made informally, in parallel with the official technical review process.)

Minor numerical errors, which do not affect adequacy of the results.

Alternate design solutions or analysis methods, where the designers have already used appropriate methods to develop an adequate solution.

Any other issues which will not add value by making the project safe, functional, or more economical.

F2-2. REVIEW PROCEDURES. The Chief of Engineering should provide written objectives and procedures for use by independent technical review teams. The chief is also responsible for selecting qualified review team members, appointing a team leader, and in cooperation with the project manager providing the time and funding resources necessary for an adequate review. The team leader should discuss with the team their responsibilities and objectives. When the review is completed, the team leader should verify that each comment is appropriate. When comments seem inappropriate, the team leader should discuss them with the reviewer, and should have inappropriate comments withdrawn by the reviewer. The team leader should also eliminate any mutually conflicting comments, and consolidate similar or related comments. The final review comments should be submitted to the design team for resolution.

F2-3. COMMENT RESOLUTION. Use of the guidelines identified in paragraph F2-1, and the procedures in paragraph F2-2, should result in a reasonable volume of review comments. Comments do not necessarily have to be complied with, but each comment must be resolved, not ignored. When the designer disagrees with a comment, the best means of resolution is a discussion between designer and reviewer. When this does not result in an appropriate resolution, the issue should be elevated through the designer's chain of command. The review team does not have authority to enforce comments, authority for comment resolution lies in the design chain of command. The Chief of Engineering in the responsible design district is the final authority for resolution of engineering technical review comments. The design team leader and the review team leader should jointly ensure that each comment has been resolved. The final comments, and the resolution of these comments, should be included in the district's project documentation. Significant issues raised by the reviewers, and the resolution of these issues, should be included with the submittal of the decision document.

F2-4. CERTIFICATION. A certification by Project Manager, the Chief of Engineering and other functional chiefs that the issues raised by the technical review team have been resolved is required. This certification must be included with submittal of decision documents and should be included with the design documentation for subsequent phases of design.

F2-5. ARCHITECT-ENGINEERS. When engineering work is performed under contract, ITR is still essential components of the process. Frequently, the AE contract includes provisions for providing QC, including ITR. In these cases, the contract should define the scope for proper execution of these requirements.

APPENDIX G
OUTLINE OF REPORT ON ENGINEERING CONSIDERATIONS AND INSTRUCTIONS TO FIELD PERSONNEL

G-1. General

It is essential that all of the construction personnel associated with the construction of any project be familiar with the design criterion, material requirements, operational performance, and all special details of the project. To accomplish this and to ensure that field personnel are aware of the design assumptions regarding field conditions the designers will prepare a short report entitled "Engineering Considerations and Instructions for Field Personnel." This report shall also provide guidance for critical portions of the contract documents. The report shall be augmented by briefings, instructional sessions, and guidance for laboratory testing. Field personnel can provide important input to the design process and shall be consulted as the design progresses. Field personnel shall review the report before it is published in final form.

G-2. Content

The report format shall include, but not be limited to, the following:

G-2.1. *Introduction.*

G-2.1.1. Purpose.

G-2.1.2. Scope.

G-2.2. *Excavation.*

G-2.2.1. General.

G-2.2.2. Common.

G-2.2.3. Rock.

G-2.2.4. Dewatering.

G-2.2.5. Stockpiles.

G-2.3. *Foundation cleanup and preparation.*

G-2.4. *Care and diversion of water.*

G-2.5. *Drilling and grouting.*

G-2.5.1. General.

G-2.5.2. Floodplain.

G-2.5.3. Abutments.

G-2.5.4. Exploratory drilling.

G-2.6. *Dam construction (embankment or concrete).*

G-2.6.1. General.

G-2.6.2. Materials.

G-2.6.3. Processing.

G-2.6.4. Batch plants.

G-2.6.5. Placement.

G-2.6.6. Compaction.

G-2.6.7. Backfill and structures.

G-2.6.8. Drainage materials and drains.

G-2.7. *Slope protection.*

G-2.8. *Instrumentation.*

G-2.9. *QC/QA testing.*

G-2.10. *Special requirements for construction.*

G-2.11. *Architectural requirements.*

G-2.12. *Operational facilities.*

G-2.13. *Special environmental considerations or procedures.*

APPENDIX H
MANAGEMENT CONTROL EVALUATION CHECKLIST

H-1. FUNCTION. The function covered by this checklist is Civil Works Engineering and Design.

H-2. PURPOSE. The purpose of this checklist is to assist the District Chiefs of Engineering in evaluating the key management controls listed below. It is *not* intended to cover *all* controls.

H-3. INSTRUCTIONS. Answers must be based on the actual *testing* of key management controls (e.g., document analysis, direct observation, sampling, simulation, etc.). Answers, which indicate deficiencies, must be explained and corrective action indicated in supporting documentation. These management controls *must* be evaluated at least once every five years and may be evaluated as often as very project. Certification that this evaluation has been conducted must be accomplished on DA Form 11-2-R (Management Control Evaluation Certification Statement).

H-4. TEST QUESTIONS.

H-4.1. Do project managers (PM's) develop detailed management plans including appropriate engineering functions for each phase of a project?

H-4.2. Does the engineering staff conduct periodic conferences with the Programming, Planning, Construction, Operations, and other Engineering elements of the organization to discuss overall organizational workload?

H-4.3. Are budget estimates included in the management plan to fund the engineering elements for all phases of the project?

H-4.4. Are estimates based on a realistic schedule for accomplishing the engineering work by the engineering element?

H-4.5. Do estimates show direct labor, other direct costs, and all indirect costs in accordance with the operating budget guidance of EP 37-1-3?

H-4.6. Does the engineering staff, in coordination with the other technical staffs and with the local interests, develop a sufficient scope of work on new projects to allow for preparation of budget estimates in accordance with the programming cycles?

H-4.7. Are analyses and investigations conducted in accordance with published engineering criteria and guidance and/or recognized engineering practice?

H-4.8. Has an HTRW Preliminary Assessment been included in the Reconnaissance Phase and all follow-on activities included in subsequent phases?

H-4.9. Are engineers encouraged to consider alternative designs when analysis and investigation indicate special conditions and/or problems exist?

H-4.10. Are technical coordination meetings scheduled to review complex problems?

H-4.11. Is the engineering level of detail sufficient for an engineering assessment of potential alternatives to determine if they will function safely, reliably, efficiently, and economically and if they are practical to construct, operate, and maintain?

H-4.12. Are the engineering efforts for the feasibility phase of the project fully defined in the Management Plan for this phase? Also, does the Management Plan include

H-4.12.1. Accurate citation of all policy documents?

H-4.12.2. Regulations/guidance documents that are unfamiliar to all reviewers? If outside document references are included, is there an abstract/discussion provided respecting the document requirements/contents?

H-4.12.3. Does the work efforts presented refer to the appropriate policy documents being considered for compliance?

H-4.12.4. Does the Quality Control Plan (QCP) accompany the project Management Plan? Does the Management Plan provide, in specific terms, a discussion of the proposed accomplishment of the independent technical review (ITR) certification of the final feasibility report?

H-4.12.5. Does the QCP include consideration to the maximum extent practicable our longstanding commitment to integrate the metric system into our Civil Works plan formulation and design processes?

H-4.12.6. Is the FCSA and Management Plan a companion document to the reconnaissance report?

H-4.13. Are costs estimates and schedules prepared including engineering and design costs and schedules?

H-4.14. Is a conference conducted at the conclusion of the reconnaissance phase to establish aspects of the Management Plan and FCSA and engineering documentation required during the next two phases of the projects?

H-4.15. Does the engineering assessment made of alternatives include a constructibility analysis and establish that the alternative fully meets safety, reliability, and functional requirements?

H-4.16. Does the engineering concept support the PM's development of the complete project schedule as presented in the Management Plan?

H-4.17. Does the engineering concept, for engineering and design of the project, address the engineering objectives outlined in ER 1110-2-1150?

H-4.18. Is a complete engineering appendix included in the feasibility report?

H-4.19. Are the proper technical functions (Hydrology and Hydraulics, Surveying and Mapping, Real Estate, Geotechnical, Structural, and Construction) addressed in the engineering appendix?

H-4.20. Has the National Geospatial Data Clearinghouse been checked for existing data? And has geospatial data been documented using the Federal Geospatial Metadata Standards and has the metadata been posted on the USACE Geospatial Clearinghouse?

H-4.21. Does the Management Plan provide budget and schedules for the preparation of the project O&M manual?

H-4.22. Does the baseline cost estimate include the total (Federal and non-Federal) costs of implementing the project?

H-4.23. Are all elements in the project, including real estate and work to be performed by local interest, included in the cost estimate in accordance with ER 1105-2-100?

H-4.24. Is engineering input used in the development of the schedule for design and construction in accordance with ER 1105-2-100?

H-4.25. Has engineering provided the PM the data on the project description, real estate requirements, cost estimate, and other critical performance items for inclusion in the draft PCA?

H-4.26. Is there continuing coordination between Federal engineering staff and engineers representing the local sponsor?

H-4.27. Has the Corps-Wide Centers of Expertise Program, as outlined in ER 1110-1-8158, been used in the planning and design of this project as appropriate?

H-4.28. Do completed feasibility reports and Management Plans contain sufficient information and detail to allow start of PED phase?

H-4.29. Has the district engineer's recommendation for the selected plan been signed?

H-4.30. Can the preparation of plans and specifications proceed during the DDR review process?

H-4.31. Are DDR’s completed in accordance with the outline and format shown in Appendix D of ER 1110-2-1150?

H-4.32. Are VE studies scheduled and conducted with local interest participation, when appropriate?

H-4.33. Are engineering changes, with the potential of causing a Post Authorization Change, promptly reported to the PM?

H-4.34. Are DDR’s given an independent technical review and approved promptly upon completion?

H-4.35. Are copies of all correspondence concerning a DDR bound with the DDR and maintained with the district’s record copy?

H-4.36. Is proper distribution of approved DDR’s made to Headquarters, the MSC, and to Research Library at Waterways Experiment Station?

H-4.37. Has engineering provided the PM updated data on the project description, cost estimate, real estate requirements and other critical performance items for inclusion in the final PCA?

H-4.38. Are P&S schedules and costs estimates included in the Management Plan and baseline cost estimate?

H-4.39. Has the engineering staff prepared P&S in accordance with DDR's and applicable engineering guidance? Are the P&S in metric units where required? Were the Plans prepared using CADD and to Tri-Service standards?

H-4.40. Does the district's engineering staff periodically review the modifications to current construction contracts to improve the preparation of future P&S?

H-4.41. Are bid estimates prepared and safeguarded in accordance with applicable procurement regulations?

H-4.42. Are contract bids correlated and compared with the baseline cost estimate for the project?

H-4.43. Are contract solicitations issued in Electronic Bid Solicitation (EBS) format?

H-4.44. Are approvals for P&S obtained in a timely matter in accordance with the Management Plan?

H-4.45. Are contractor's ENG Forms 4288 a recognized requirement in the specifications?

H-4.46. Are shop drawing submittals tracked with reviews and approvals processed in the timely manner?

H-4.47. Are site visits regularly scheduled, conducted, and well documented?

H-4.48. Are claims and modifications reviewed by design engineers prior to execution?

H-4.49. Is feedback and technical advice concerning claims and modifications provided to the cost engineers and the PM?

H-4.50. Are the O&M manuals for projects completed and provided to the local sponsor no later than when the project is placed into operations?

H-4.51. Does engineering maintain a complete set of as-built drawings in CADD format with duplicates furnished to the operating manager?

H-4.52. Are periodic inspections scheduled and conducted in accordance with established guidance?

H-4.53. Are inspection results analyzed and specific O&M recommendations furnished to the operations manager?

H-4.54. Do the operating plans and manuals conform to the current use patterns for each function project?

H-4.55. Are water control plans consistent with current state water allocations and environmental standards?

H-4.56. Are operating and water control manuals reviewed on a periodic cycle and updated as necessary?

H-4.57. Are project operations conducted in accordance with the approved operating and water control manuals?

H-4.58. Does engineering develop an annual budget submission for technical functions on O&M projects in accordance with the annual budget EC and applicable PCA's and are approved funds provided to engineering?

H-4.59. Are deficiencies reported and tracked in accordance with ER 1110-2-101?

H-4.60. Does the engineering staff conduct periodic reviews, with operating personnel, to update Federally operated project deficiency lists and backlog maintenance listings?

H-4.61. Are advance P&S prepared for correcting project deficiencies to permit usage of year-end funds when available?

H-4.62. Does the engineering staff review the scheduled replacement and major maintenance program for each Federally operated project on a periodic basis?

H-4.63. Is the current technology reviewed when operating equipment is replaced and is equipment replaced with newer items consistent with current energy and environmental standards?

H-5. SUPERSESSION. This checklist replaces the checklist for Civil Works Engineering and Design previously published in Appendix F, ER 1110-2-1150, dated 31 March 1994.

H-6. COMMENTS. Help to make this a better tool for evaluating management controls. Submit comments to HQUSACE ATTN: CECW-EP, 20 Massachusetts Avenue, NW, Washington, DC 20314-1000.