

**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.

ER 1110-2-1150  
31 Aug 99

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.