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SUBJECT: Civil Works Design Milestone Checklists

CATEGORY: Guidance

1. References:

- a. Engineering Construction Bulletin (ECB) 2022-7, Interim Approach for Risk-Informed Designs for Dam and Levee Projects, 20 October 2022
- b. Engineer Regulation (ER) 11-1-321, Army Programs Value Engineering, 28 February 2005
- c. ER 415-1-11, Engineering and Construction Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) Reviews, 1 January 2013
- d. ER 1110-1-1901, Project Geotechnical and Materials Completion Report, 28 February 2017
- e. ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
- f. ER 1110-2-1302, Civil Works Cost Engineering, 30 June 2016
- g. ER 1165-2-217, Civil Works Review Policy, 1 May 2021

2. **Purpose.** The purpose of this Engineering and Construction Bulletin (ECB) is to provide Project Delivery Teams (PDTs) with a list of submittal requirements by design milestone to identify design issues early enough to allow for mitigation or resolution. This ECB serves as a roadmap and a best practice and is not a comprehensive list of requirements. The items in this checklist have been associated with quality issues that impact project schedule and increase project costs. This ECB is intended to be complementary to ER 1165-2-217 and provide a clear set of expectations for both designers and reviewers. The forthcoming update to Engineering Regulation (ER) 1110-2-1150 will provide additional details and milestone requirements.

3. **Applicability.** This ECB applies to all Civil Works projects in the feasibility study and design phase, including both design/build and design/bid/build, except for dam safety modification study (DSMS) and preconstruction engineering and design (PED) of dam safety modifications, which have their own design milestone checklists. However, the contents of this ECB can and should be scaled based on risk (i.e., life safety, design and construction quality, environmental issues, etc.) and sound engineering judgement.

4. **Background.** Given the unprecedented workload facing the agency, projects must be resourced across district boundaries. With this increase in regional and national workload it is

inefficient for each PDT, District, and Major Subordinate Command (MSC) to have different defined minimum standards for design milestones. Such practice has been shown to result in inconsistent design milestone standards for Agency Technical Reviews (ATR) and Safety Assurance Reviews (SARs), resulting in increased comments and delays to design schedules and costs for comment resolution. PDTs are often deferring design work that was traditionally completed during the feasibility study phase of a project, so designs may not be as advanced as anticipated. Standardizing minimum design milestone contents will give PDTs the ability to track progress toward design milestones consistently and to communicate more clearly what elements of a design milestone may not be sufficiently advanced as the milestone package is being developed. Ensuring early project milestones (30% and 60%) are produced with high quality, appropriate attention to detail, and sufficient information and data will reduce the likelihood of schedule compression at the end of the design process, in turn reducing the likelihood of errors and omissions that would be discovered during construction or operations and maintenance (O&M).

Submittals ready for review are typically 30%/60%/90% and considered 35%/65%/95% after reviews are performed and comments delivered to the design team.

5. Implementation. Each Technical Lead (TL), in coordination with the Project Manager (PM) and PDT, should adapt this list of submittal requirements to their specific project needs (add or subtract items) and work with the PM to include this list of milestone requirements in the Project Management Plan (PMP). Depending on the project size, risk, and complexity, a project may add items not listed or subtract items that do not apply to the project and even add milestones (i.e. 15% concept) if appropriate. An evaluation of the completeness of the following items at each design submittal should be discussed at District governance meetings. If a project faces a delay, additional reviews should be considered when the project is activated again.

6. Milestone Checklists.

a. Preliminary Design – typically 30% Submittal

Purpose: The 30% submittal intent is to ensure the design has defined significant scope items and incorporated major features and any changes since initial planning or since authorization. Most of the preliminary design analysis should be complete so the risk of rework is relatively low. All field data (i.e., subsurface investigations, surveys, etc.) needed to complete the design should be collected prior to this submittal. The Review Plan (RP) should be complete, endorsed by appropriate Review Management Organization (RMO), and approved by Major Subordinate Command (MSC) prior to this submittal. This submittal should follow the review process as outlined in the approved RP, including District Quality Control/Assurance (DQC/DQA) and all other required reviews.

Checklist:

Management, Planning and Control:

- Approved Review Plan.
- Risk Register updated in coordination with the PDT from Feasibility phase, to include updated engineering and construction/constructability risks.

- Cost Analysis – Reviewed Feasibility Study (FS) or planning cost estimate, confirmed assumptions, identified significant cost risks, and Cost and Schedule Risk Assessment (CSRA) (if required by ER 1110-2-1302).
- Assessment of permits (404, environmental, cultural, historic, etc.) and associated data that will be required.
- Strategy to comply with Value Engineering (VE) requirements, in accordance with ER 11-1-321, including resourcing and schedule.
- Identification and coordination with relevant Mandatory Centers of Expertise (MCX) and incorporation into the PDT.
- Establish a project directory and repository, such as ProjectWise.

Design Documentation Reports (DDR) documenting Basis of Design (See ER 1110-2-1150 for a complete list of requirement elements):

- All disciplines identify relevant Engineering Regulations, Manuals, and other guidance to be used. Identify any potential waivers from mandatory criteria.
- All disciplines identify models being used and confirm models are validated or approved by appropriate authority.
- Initial Hydraulic and Hydrology (H&H) analysis complete and shared with the PDT, such that geotechnical and structural analysis can be performed. Hydraulic loading conditions are critical for geotechnical and structural consistency.
- Initial geotechnical investigations complete and shared with the PDT, such that geotechnical and structural analysis can be performed. Characterize regional geology, geo-hazards, and site conditions. Identify borrow sites, material sources, materials properties, and existing instrumentation. Establish typical or concept cross-sections and material properties for analyses. Perform stability and seepage analysis on critical and typical sections. Identify any data gaps and plan for additional investigations, if needed.
- Preliminary structural analysis complete, including established codes and design criteria, identified all load cases, weights, geometries, and calculated critical load cases.
- Preliminary mechanical/electrical analysis complete, including established codes/Unified Facility Criteria (UFC) and design criteria, determine power systems/requirements, determine space needs, mechanical/machinery systems, instrumentation and control systems, telecommunications, etc.
- Architectural requirements identified and shared with the PDT, including established design criteria and identified all functional requirements.
- Preliminary models of key representative features that have been reviewed and checked, i.e., cofferdam, embankment stability, monolith stability, gate/valve, etc.
- Hazardous material survey, sampling, and reports complete and if positive, tied to design documents, such that concept drawings, design memorandum, and future technical specifications include measures for abatement and worker/occupant safety.
- Survey (field and hydraulic) complete and tied to benchmarks, such that concept drawing and real estate needs can be identified, to include access routes and staging areas. Any differences in datums should be resolved.
- Real estate footprint established and initial Right of Way (ROW) drawings are developed.

- Identify and establish locations of existing utilities to include preliminary plan for relocations.
- Requirements for environmental and/or cultural resource mitigation identified and shared with the PDT.
- Documentation and justification of any changes since initial planning or since authorization.
- Alternatives analysis (as needed)
- Design charrette summary (if performed)

Plans (in compliance with the latest Engineer Research and Development Center (ERDC) A/E/C Computer-Aided Design (CAD) and Building Information Model (BIM) Standard, as applicable):

- Concept drawings developed to approximately 30% complete. A full drawing index should be drafted including all planned sheets. General plans and sections of project features developed in sufficient detail to illustrate the basis of design for each feature to include site plans, subsurface profiles, etc.
- Draft project site plan and footprint showing the layout of the project site including property lines, project boundaries, existing features, proposed features, proposed and existing utilities, site drainage features, access roads, cultural sites, all easements, etc.

Specifications:

- Outline list of specifications.

Solicitation and Award:

- Draft Bid Schedule
- Draft Construction Schedule
- Updated Current Working Estimate (CWE) (Class 3 or better) as defined by ER 1110-2-1302
- Initial Acquisition Strategy

Quality:

- Appropriate discipline-specific and DQC/DQA documentation in accordance with ER 1165-2-217 (i.e., QC certification of completed items, Architect Engineer (AE) – Quality Control Plan (QCP), etc.).

b. Intermediate Design – typically 60% Submittal

Purpose: The 60% design submittal intent is to ensure that the design has successfully progressed since the Preliminary Design and is following pertinent policy and guidelines. For this review, design analyses should be predominately complete. Only engineering details should remain to be finalized. Discussion of major constructability risks should begin at this milestone to help prevent delays to project development associated with discovery of major constructability issues during final reviews. For information to be developed in future submittals, placeholders must be included within the DDR. The DDR should be updated to provide the reviewers a clear

understanding of the design processes, assumptions, and critical decisions made prior to this submittal. All prior review comments have been addressed/closed and incorporated into the 60% submittal.

Checklist:

Management, Planning and Control:

- Approved Review Plan, evaluated at least annually to confirm content is up to date. Update as needed.
- Updated Risk Register, to include updated engineering and construction/constructability risks.
- Cost Analysis – Updated CWE (Class 2 or better), CSRA update, as required
- VE study, if not already completed and required
- Risk Assessment, if required by ECB 2022-7
- Any permits required for construction should be submitted at this milestone. If permits cannot be submitted at this milestone, coordination and preparation for submission should be substantially complete.

DDR documenting Basis of Design (See ER 1110-2-1150 for a complete list of requirement elements):

- All items from 30% design advanced/updated/finalized.
- Haul routes and staging areas identified
- All relocations identified. Coordination with owners of those features has begun by PDT/sponsor.
- Basis of Design for each feature and discipline is substantially complete, checked, and DQC documented, to include inputs and outputs computational models. Geotechnical (including proposed instrumentation needs for construction and post-construction, complete additional investigations, if needed, etc.), H&H, structural, mechanical, electrical, civil, and architectural (if applicable) calculations and analyses complete.

Plans:

- Drawings developed to approximately 60% complete including those addressing construction phasing. The drawing index should be complete including all planned sheets.
- A draft of all plans listed on the Plan Index Sheet should be prepared in sufficient detail to understand the construction procedures, phasing, any special requirements, restrictions, site access, staging areas.
- Site plans and grading plans complete, initial and final grades established.
- Project site plan and final footprint showing the layout of the project site including property limits, easements, existing features, proposed features, proposed and existing utilities, communication towers (as appropriate) site drainage features, and access roads and Real Estate footprint.
- ROW drawings are finalized and submitted to Real Estate for acquisition (if appropriate).

Specifications:

- All specifications sections should be identified and at least marked up in draft form.

- Division 1 section drafted (submittal register, etc.).

Solicitation and Award:

- Bid schedule indicating bid items, units of measure, and estimated quantities.
- Updated construction schedule.
- Final Acquisition Strategy. If sole source is proposed, justification documents prepared.
- Outline of Engineering Considerations and Instructions for Field Personnel (ECIFP) with all major subject areas identified in accordance with ER 1110-2-1150.

Quality:

- Appropriate discipline specific and DQC/DQA documentation in accordance with ER 1165-2-217 (i.e., QC certification of completed items, AE QCP, etc.).
- An assessment of whether ATR/SAR/BCOES (if performed) and sponsor comments generated on 30% have been addressed.

c. Final Design – typically 90% Submittal

Purpose: Design, plans, DDR, and specifications are complete and final. PDT has completed all technical work and is confident that the package is ready to advertise. The only changes necessary following this iteration are as a result of final reviews. Major uncertainties have been eliminated or mitigated and are well documented in the updated risk register and ECIFP by this milestone. All prior review comments have been addressed/closed and incorporated into the 90% submittal.

Checklist

Management, Planning and Control:

- Approved Review Plan, evaluated at least annually, updated as needed.
- Updated Risk Register, to include updated engineering and construction/constructability risks.
- Cost Analysis – Updated CWE (Class 1), CSRA update, as required.
- VE study documentation, if applicable, complete and certified.
- Real estate certification for construction to include all temporary and permanent easements.

DDR documenting Basis of Design (See ER 1110-2-1150 for a complete list of requirement elements):

- All items from 60% design finalized.
- DDR narrative and calculations are complete and updated based on comments from 60% review.

Plans:

- Drawings complete including those addressing construction phasing.
- Specifications:

- Final edited specifications to include Division 1 specification items (submittal register, etc.).

Solicitation and Award:

- Updated bid schedule indicating bid/option items, units of measure, and estimated quantities based on the current design.
- Updated construction schedule.
- Updated Acquisition Strategy if it has changed.
- Contract clauses, instructions to bidders, and selection criteria established.
- Draft ECIFP.

Quality:

- Appropriate DQC/DQA documentation in accordance with ER 1165-2-217 (i.e., QC certification of completed items, AE QCP, etc.). DQC should be fully certified prior to sending for external reviews.
- An assessment of whether ATR/SAR/ BCOES and sponsor comments generated on 60% have been addressed.

d. **Design Complete** – typically 100% Submittal (P2 Milestone Code: CW330)

Purpose: Design, plans, and specifications are final with all comments addressed and ready to advertise. PDT has completed all technical work and is confident the package is suitable for soliciting bids, obtaining the required construction permits, and constructing the project. All prior review comments have been addressed/closed and incorporated into the 100% submittal.

Checklist

Management, Planning and Control:

- Updated Risk Register to include updated engineering and construction/constructability risks.
- Operations and Maintenance (O&M) manual outline.
- Construction management plan/engineering during construction (EDC) strategy (QA testing, staffing, scope of services, site visits, funding, as-built reviews, etc.).
- Resourcing strategy and schedule for updating the DDR post-construction or developing the Project Geotechnical and Materials Completion Report (ER 1110-1-1901), as appropriate.

DDR documenting Basis of Design:

- Final DDR is complete for design, pending documentation of any changes during construction.
- All items from 30%/60%/90% complete.

Plans:

- Final complete drawings for bidding and construction, including all appropriate signatures.

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Subject Civil Works Design Milestone Checklists

Specifications:

- Final complete specifications for bidding and construction.

Solicitation and Award:

- Final bid schedule indicating bid/option items, units of measure, and quantities.
- Updated total project schedule supported by a detailed construction schedule.
- ECIFP complete.

Quality:

- All DQC/DQA comments addressed, closed, and certified.
- An assessment of whether ATR/SAR/BCOES and sponsor comments generated on 90% have been addressed. Certifications will follow this milestone, as this submittal is typically used for backcheck. ER 415-1-11 requires BCOES certification prior to bid opening.

7. **Date of Applicability.** PDTs shall implement this ECB, to the maximum extent possible, within 30 days or at the next milestone deliverable.

8. **Point of Contact.** HQUSACE point of contact for this ECB is Vanessa Bateman, CECW-EC, (202) 761-7423.

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