DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

ER 1110-2-1302

CECW-EC

Regulation
No. 1110-2-1302

15 September 2008

Engineering and Design
CIVIL WORKS COST ENGINEERING

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1. Purpose. This engineer regulation (ER) provides policy, guidance, and procedures for cost engineering responsibilities for all civil works (CW) projects assigned to the U.S. Army Corps of Engineers (USACE).

2. Applicability. This regulation is applicable to all Headquarters USACE (HQUSACE) elements, major subordinate commands (MSC), districts, laboratories, and field operating activities as well as to all appropriations and decision documents for all CW projects that invest Federal dollars on infrastructure development or rehabilitation.

3. Distribution Statement. Approved for public release; distribution is unlimited.

4. References. References are in appendix A.

5. Policy.

a. All cost engineering products required to support CW projects shall be prepared in accordance with this regulation and all referenced regulations. Detailed preparation requirements and the format of all estimates shall follow the guidance in Engineer Technical Letter (ETL) 1110-2-573.

b. By Public Law 95-269, all construction cost estimates shall be prepared as though the Government were a prudent and well-equipped contractor. Therefore, all costs, which a prudent and experienced contractor would expect to incur, shall be included in the cost estimate.

c. Cost engineering products obtained by architect-engineer (A-E) contracting shall conform to all cost engineering regulations, applicable ETL, and referenced regulations (appendix A). For cost estimates and decision documents for Congressional authorization, HQUSACE mandates that the National Planning Centers of Expertise (PCX) coordinate with the Cost Engineering Center of Expertise (CX) at the Walla Walla District (appendix B).

* This regulation supersedes ER 1110-2-1302, dated 31 March 2004.

d. Government cost engineers shall review all cost estimates, whether prepared by the cost engineering office or by contract, as prescribed by the specific review procedures in this regulation and those referenced. Each estimate shall be reviewed to confirm that each estimate meets the design scope and that the assumptions and logic used are valid in estimating the cost of all CW features.

6. Project Delivery Team.

a. USACE is committed to effective management of the scope, quality, cost, and schedule of each project by using project delivery teams (PDT). ER 5-1-11 presents the requirements for establishing a PDT for all projects. Each PDT is led by a project manager (PM) and composed of everyone necessary for successful development and execution of all phases of the project. The PDT may consist of individuals from more than one USACE district and may include specialists, consultants/contractors, stakeholders, or representatives from other Federal and state agencies. Team members are chosen for their skills and abilities to successfully execute a quality project. The project cost estimate shall be recognized as a major management tool for establishing, monitoring, and managing costs from the study phase through project completion.

b. CW projects are planned and approved following ER 1105-2-100 and are designed following ER 1110-2-1150.

c. The efforts of all PDT members shall be coordinated to ensure that sufficient project information is provided for all cost estimates.

7. Responsibilities.

a. Project Manager. Each project is assigned to one PDT, with a single PM for management and leadership during the life cycle of the project. Senior leaders select the PM based on the individual's abilities to best lead the specific project without regard to assigned organizational element. Generally, the PM will reside in the geographic area of responsibility, but can be elsewhere as needed to meet project requirements. The PM is responsible for the following:

(1) Provide PDT leadership and facilitation with responsibility for assuring that the project stays focused on the public interest and on the customer's needs and expectations.

(2) Ensure necessary disciplines and perspectives are represented within the PDT.

(3) Manage scope, schedule, quality, and budget while leading a PDT to successful project execution.

(4) Serve as primary interface with the customer and the USACE primary internal advocate for the specific project.

(5) Manage all project resources, information and commitments, and integrate and focus the efforts of the PDT.

(6) Consult to ensure customer's quality objectives are clearly articulated and that the customer understands the essential professional standards, laws, and codes, as well as public trust issues that must be incorporated into the project.

(7) Develop scope as pertaining to cost engineering products associated with project execution including construction cost estimates, construction schedules, and the development of cost and schedule risk analysis.

(8) PMs and their PDTs are to use project risk principles and methods from the Project Management Institute's Project Management Body of Knowledge in developing a project risk assessment plan that includes a risk assessment and analysis and a risk response plan to support the cost risk analysis (see appendix B).

(9) Certify project cost estimates and cost changes and provide Project Review Board technical support on project costs as required.

(10) Review, approve, sign, and date all total project cost summary (TPCS) documents.

(11) Ensure all schedules and commitments for the project are fulfilled.

b. Division Cost Engineer.

(1) Act as MSC point of contact in communicating with HQUSACE cost engineering offices.

(2) Receive, interpret, disseminate, and implement cost engineering guidance, direction, and correspondence from higher authority in a timely manner.

(3) Conduct field reviews of district commands' execution of cost quality management and recommend necessary corrective actions when warranted.

(4) Support PM in the certification for project cost estimates and cost changes and provide Project Review Board technical support on project costs as required.

(5) Review proposed awards of negotiated contracts and modifications requiring award approval above the authority delegated to district commanders.

(6) Review bid results, protests, and mistakes in bids. Evaluate and make recommendations on district actions for bid protests and mistakes in bid. Provide analysis and recommendations and take necessary actions as required.

(7) Participate in HQUSACE Cost Engineering Steering Committee and lead in subcommittee efforts.

(8) Provide technical assistance to districts and MSC elements on cost engineering issues. Consolidate and disseminate MSC-wide historical cost data.

(9) Provide technical support to HQUSACE on development, upgrade, maintenance, and implementation of Microcomputer Aided Cost Estimating System (MCACES).

c. Chief, Cost Engineering. The chief of each cost engineering office is responsible for providing cost engineers to support the PDT. The chief shall ensure that all appropriate estimating activities, including site visits prior to construction and during construction, have been adequately funded and scheduled in the Project Management Plan (PMP) for the estimate development. When cost engineering products are to be obtained by A-E contracting, the chief shall ensure that the A-E contract statement of work requires the A-E to comply with USACE estimating policies of this regulation and ETL 1110-2-573.

d. Project Delivery Team Cost Engineer.

(1) The cost engineer is the PDT member responsible for the development of all cost engineering products.

(2) The cost engineer member of the PDT is responsible to support the PM in the development of scope as pertaining to cost engineering products associated with project execution including construction cost estimates, construction schedules, and the development of the total project cost (TPC) and schedule risk analysis. The cost engineer member of the PDT will provide the labor estimate for cost engineering product development and shall develop the total cost summary sheet with input from PDT members. The cost engineer shall work with all PDT members and local interests to develop scopes of work sufficient to prepare sound budget estimates. These budget estimates are a critical part of the PMP (ER 1110-2-1150 paragraph 9 states, “it is necessary for engineers on the PDT to work with the PM, planning, real estate, and construction team members, along with local interests, to develop a scope of work sufficient to prepare sound budget estimates.”).

e. Project Delivery Team.

(1) Members of the PDT shall provide the cost engineer estimates for the Civil Works Work Breakdown Structure (CWWBS) feature codes 01 (Lands and Damages), 30 (Planning, Engineering and Design), and 31 (Construction Management). All costs for these activities will be developed by the appropriate office and forwarded to the PM to ensure all schedules and commitments for the project are fulfilled.

(2) Each PDT member is responsible for defining confidence/risk levels associated with their office products. HQUSACE requires PDTs prepare a formal cost risk analysis for all decision documents requiring Congressional authorization for projects exceeding $40 million (TPC) (see appendix B). The PDT shall assist the cost engineer in identifying cost-related project items including but not limited to:

(a) Project risks.

(b) Project contingencies.

(c) Project schedule.

(d) Construction schedules.

(e) Contract phasing.

(f) Bid schedule.

(g) Contract completion dates.

8. Document Submittals. The approved Baseline Cost Estimate (BCE) and baseline schedule within the engineering appendix of the feasibility report will be forwarded to HQUSACE or division depending on the approval authority. The submission will include, as a minimum, the estimate summary sheets for direct costs, indirect costs, and owner costs to the subfeature level, and a TPCS. The estimate prepared (utilizing the latest approved MCACES software) must contain a narrative that discusses cost relationships and assumptions made, based on the level of design, quantity issues and unknowns, and identified risks or uncertainties used in the development of contingencies. The submission must also include native electronic files (not portable document format [PDF]) containing the complete estimate.

9. Cost Quality Management. Cost engineering offices shall follow the established USACE guidance for quality management systems per ER 1110-1-12. Only qualified cost engineers, preferably certified estimators, shall be used for quality control reviews.

a. Accuracy and completeness of project cost estimates must be emphasized throughout the project development process, including the reconnaissance and feasibility phases. Even in these early phases, cost estimates should represent as complete and accurate a picture as is practicable. This is necessary for Federal and non-Federal sponsor planning and budgeting processes.

b. The division cost engineer is responsible for quality assurance of division cost engineering products. Part of the quality assurance process is to review a sampling of estimating products to ensure they comply with guiding policy. The division cost engineer, as a minimum, shall sponsor an annual meeting with each constituent district's cost engineering chiefs and senior estimators to ensure the quality of the division estimating procedures complies with current USACE policy.

c. The district cost engineering chief (resource provider) is responsible to provide quality cost resources for the preparation of accurate and complete cost engineering products, including estimates, schedules, and risk analyses. To support the quality management/quality assurance process, the resource provider shall establish a process to routinely transmit electronic copies of the following estimating documents to the division cost engineer:

(1) TPCS and supporting cost estimate for any projects requiring division or HQUSACE approval.

(2) Bid result summary for all awarded construction contracts.

(3) Immediate notification of any bid award complications and copies of original and revised Independent Government Estimates (IGEs).

(4) Other documents required by the division cost engineer.

10. Technical Reviews. In accordance with ER 1110-2-1150, technical reviews are required and/or recommended during various phases of project development through the life of the project. Technical reviews consist of three levels of review: District Quality Control Review (DCQ), Agency Technical Review (ATR), and Independent External Peer Review (IEPR).

a. A District Quality Control Review is an internal peer review by a technical element within a district as a quality control measure on decision documents.

b. An ATR is an independent technical review (formerly known as an ITR), which is a critical examination by a qualified person or technical team outside the submitting district that is not involved in the day-to-day technical work that supports a decision document. HQUSACE mandates (see appendix B) that the PCX coordinate with the CX at the Walla Walla District for an ATR of cost estimates, construction

schedules, and contingencies included in all decision documents requiring Congressional authorization. An ATR is intended to confirm that such work is done in accordance with clearly established professional principles practices, codes, and criteria. Feasibility studies and reports within this definition shall have a peer review plan included in its PMP that shall indicate if the report will likely undergo an external (i.e., outside of USACE) peer review or an ATR only. In general, these mandatory peer reviews will focus on the technical appendixes, e.g., engineering appendix to the feasibility report containing cost estimates and the BCE.

(1) An ATR during the reconnaissance phase shall concentrate on evaluation of the overall project plans, on the initial cost estimates, and on the PMP. Reviewers shall also evaluate the schedule, budget, and work plan proposed in the PMP for the feasibility phase (refer to ER 1110-2-1150).

(2) An ATR for the feasibility phase, as a minimum, must verify that the level of engineering is sufficient to substantiate both the screening level comparative cost estimates and the BCE with contingencies to support selection of the recommended plan and to establish the baseline schedule and cost estimate with contingencies.

(3) Senior estimators, preferably USACE regional technical experts, shall be used for ATRs. A-Es shall use senior experienced cost engineers or estimators, who are certified by a professional estimating organization, to conduct their product ATRs. The ATR process requires a formalized comment and resolution process.

c. An IEPR is an independent review of the technical efficacy of a decision document by a review organization external to USACE. The term “external” implies non-USACE or non-governmental review. IEPR is conducted on projects that meet mandatory or discretionary triggers outlined in EC 1105-2-410. Similar to the ATR process, a formalized comment resolution process must take place and may fall under scrutiny through the Freedom of Information Act. Often times, the IEPR occurs at the same time as an ATR. IEPR coordination is critical regarding timeliness and funding, because the IEPR commonly requires a contractual process to fund the IEPR.

11. Definitions.

a. Project.

(1) Each project is a temporary endeavor undertaken to create a unique product, service, or result. Internal services are discrete projects when they are unique and non-recurring (ER 5-1-11).

(2) USACE is committed to effective management of the scope, quality, cost, and schedule for each project. The project cost estimating products are major management tools used for establishing and monitoring costs from the planning, construction, and

operation and maintenance (O&M) life cycle project phases. The PDT develops and manages projects, which is lead by the PM. The PDT members include all necessary staff to develop the project.

(3) By Public Law 95-269, the Secretary of the Army acting through the Chief of USACE is responsible to contract for improvements to the rivers and harbors. CW projects are originated when a state or city (local sponsor) requests help from USACE for an improvement to a national river or harbor. CW projects are planned and approved following ER 1105-2-100 and are designed following ER 1110-2-1150.

(4) Cost engineering involvement in CW project development is continuous. The level of estimating intensity varies with progression through the different phases of project development and implementation. The five CW project phases are:

(a) Reconnaissance phase.

(b) Feasibility phase.

(c) Preconstruction engineering and design (PED) phase.

(d) Construction phase.

(e) Operation, Maintenance, Repair, Replacement, and Rehabilitation phase.

(5) In some cases, such as Continuing Authorities Program (CAP) projects, some of the phases are combined.

b. Microcomputer Aided Cost Engineering System.

(1) MCACES is the acronym for cost estimating software program tools used by cost engineering to develop and prepare all CW cost estimates. Using the tools of this system, estimates are prepared uniformly allowing cost engineering throughout USACE to function as one virtual cost engineering team.

(2) Engineer Pamphlet 1110-1-8 presents construction equipment hourly rates. These hourly rates are one of the supporting databases in MCACES and shall be used in the preparation of all cost estimates.

c. Effective Price Level. The effective price level (EPL) is the date of the point in time of the pricing used in the cost estimate. The EPL for critical decision document estimates shall not be more than one year older than the date of the critical document. Some examples of critical decision documents include feasibility reports sent for Congressional authorization and Project Cooperation Agreements signed with the project sponsor. For these documents, the TPC must be updated to ensure the cost

estimate is at current price levels and that the estimate is based on the current project scope.

d. Constant Dollar Analysis. Constant dollar analysis is the process using price indices to adjust a cost from one moment in time to another moment in time. Typically used to adjust an estimate from its EPL (date on which it was prepared) to a future date to account for inflation.

e. Risk Analysis.

(1) Cost risk analyses identify the amount of contingency that must be added to a project cost estimate to reduce the uncertainty to an acceptable level to ensure that reasonable costs can be developed for the identified project features. During the early project development, the PDT shall assist the cost engineer in defining confidence/risk levels associated with the project features.

(2) As project development progresses, 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 (ER 1110-2-1150).

(3) All estimates must include a narrative identifying the risks or uncertainties used in the development of contingencies.

f. Total Project Cost. The TPC for each CW project includes all Federal and authorized non-Federal costs represented by the CWWBS features and respective estimates and schedules, including the lands and damages, relocations, project construction costs, construction schedules, construction contingencies, planning and engineering costs, design contingencies, construction management costs, and management contingencies. The TPC will change over time and, therefore, represents the TPC based on a particular scope of work at a specific date (point in time).

g. Total Project Cost Summary.

(1) The TPCS is the required cost estimate document to be submitted with all projects sent for either division or HQUSACE approval. Both the PM and chief of the cost engineering office shall review, approve, sign, and date all TPCS documents. Real estate estimates included in the TPCS shall be reviewed, approved, and the TPCS signed by the chief or designee of the real estate office.

(2) All TPCSs shall present the TPC at the EPL of the estimate, the TPC escalated to a programming year in constant dollars, and the TPC inflated through construction. ETL 1110-2-573 presents a complete discussion on preparing the TPCS.

h. Baseline Cost Estimate. The TPCS accompanying the feasibility report is used for project authorization and is the basis for allowable cost increases without reauthorization (ER 1110-2-1150). The TPC at the time the project is authorized by Congress becomes the BCE. The BCE represents the scope and schedule established in the feasibility report. The cost estimate based on constant dollars is used for authorization purposes (ER 1105-2-100).

i. Baseline Project Schedule. The primary engineering objective during the feasibility phase is to provide engineering data and analyses sufficient to develop the complete project schedule and cost estimate. Engineering data and analyses in the feasibility phase shall be sufficient to develop the complete project schedule and BCE with reasonable contingency factors for each cost item or group of cost items (ER 1110-2-1150).

j. Independent Government Estimate.

(1) The IGE is the formal, approved cost estimate prepared to support a contract award. An IGE of construction costs shall be prepared and furnished to the contracting officer at the earliest practicable time for each proposed contract and for each contract modification anticipated to cost $100,000 or more. The contracting officer may require an estimate when the cost of required work is anticipated to be less than $100,000. The estimate shall be prepared in as much detail as though the Government were competing for award (Federal Acquisition Regulation 36.203). Access to information concerning the IGE shall be limited to Government personnel whose official duties require knowledge of the estimate.

(2) Policy, general information, and handling of the IGE are contained in ER 1110-1-1300.

k. Total Cost Management.

(1) Total Cost Management is the effective application of professional and technical expertise to plan and control resources, costs, and risk. Simply stated, Total Cost Management is a systematic approach to managing cost throughout the life cycle of any project, product, or service.

(2) During the feasibility phase, the BCE sets the target for managing and controlling project costs. As the design is refined, the uncertainties are reduced, and the costs associated with each feature become more specific to satisfy the scope requirements. To identify these changing costs, a TPCS must be prepared at each CW phase in the project development.

(3) Project development can span multiple years. To ensure the project is still within the authorized cost, periodic TPC estimates are prepared to compare with

the BCE. All TPCS documents, subsequent to a Congressionally approved BCE (Section 902 of the Water Resources Development Act of 1986, Public Law 99-662), shall document the current computed TPC at the appropriate price level, the TPC escalated to the current programming year, and the TPC inflated through construction based on a current project schedule. For Congressionally authorized projects, the TPC must be updated annually. The construction estimate must be updated and repriced at least every two years reflecting current design and project schedule. For major or unique projects, the update shall include repricing using current labor and material rates.

(4) A TPC estimate, along with a TPCS, is required for Design Document Reports, Engineering Documentation Reports, General Reevaluation Reports, and Limited Reevaluation Reports.

12. Civil Works Work Breakdown Structure. All cost estimates shall be organized according to the CWWBS format. This ensures uniform cost estimate format throughout USACE and divides the cost into appropriate cost accounting codes. As a minimum, each estimate shall utilize the top two levels of the CWWBS. When estimating a CW building, the estimate shall follow the military work breakdown structure format.

13. Cost Engineering Tools. The USACE approved estimating software programs, MCACES and the Corps of Engineers Dredge Estimating Program (CEDEP), are the required software programs for the preparation of CW cost estimates throughout USACE. The programs and their use, along with all the other estimating software programs, are detailed in the ETL 1110-2-573.

14. Cost Estimates.

a. To support the CW missions addressed in ER 1105-2-100, cost estimates are required for all CW construction projects and are recommended for all projects.

b. Cost estimates for the reconnaissance phase may be developed using quotes, calculations, unit price, or historical data as backup. The Planning, Engineering, and Design feature and the Construction Management feature are obtained through the PDT and may be a percentage based upon historical cost data. The costs for the Lands and Damages feature are obtained through the PDT from the real estate office.

c. During the feasibility phase, comparative cost estimates of the viable alternatives used in formulating the National Economic Development (NED) and/or the locally preferred plan must be prepared in the CWWBS format to at least the subfeature level. A screening process may be used in the feasibility phase to review all the initial alternatives. Different levels of cost estimating detail may be appropriate at each level of screening. Typically, this screening process will narrow the number of alternatives to a final list, i.e., two to five viable alternatives for a more detailed

assessment. Historical bid cost data, experience, and/or unit prices adjusted to expected project conditions are acceptable methods of developing project costs for these alternatives. The cost estimate for each viable alternative will include appropriate comments describing the method of construction, assumptions used in developing the estimate, and the technical/design data available.

d. The TPC based on the feasibility recommended plan will be prepared using the MCACES tools and the established CWWBS to at least the subfeature level of detail. When the non-Federal sponsor requests a plan different from the NED plan, cost estimates for both the NED plan and the "locally preferred" plan will be prepared using MCACES as described for inclusion in the feasibility report. In general, the unit costs for the construction features will then be computed by estimating the equipment, labor, material, and production rates suitable for the project being developed. This estimate, developed with a specific price level date, must then be escalated for inflation through project completion. This TPC, which supports the project scope and schedule developed in the feasibility report, is defined as the "Baseline Cost Estimate," and its value becomes fixed when the public notice is issued by the MSC.

e. Project cost estimates during PED are primarily revisions to the BCE due to refinements or changes in the design and/or progress schedule developed in the feasibility study. As the project is developed and the design is refined, the BCE must be used as a guide in managing the PED phase. TPC estimate must be prepared and included as a part of any required report submitted for reevaluation or post authorization changes. A new risk analysis shall be conducted upon major changes in design and for each update in the TPC. A cost risk analysis report shall be included as part of any Post Authorization Change Report to support the revised authorized cost. The cost estimate documentation required for any of these project submissions requiring HQUSACE or higher approval will be the same as estimates for the feasibility phase.

f. During the construction phase, IGEs are required for each construction contract that exceeds the dollar limit defined by the appropriate Federal Acquisition Regulation. Each IGE is based upon a defined set of plans and specifications and represents the cost of performing the work in the time allocated by determining the necessary labor, equipment, and materials. The bid schedule shall be structured for the specific contract in coordination with the cost engineer. Each bid item on the bid schedule must be identified by the appropriate CWWBS that will allow tracking of the TPC.

15. Classification of Cost Estimates.

a. Cost estimates are prepared during all five CW project development phases. The basis of an estimate can range from no design (very high cost risk for uncertainties) to complete plans and specifications (very low cost risk for uncertainties).

b. The minimum classification requirements for CW cost estimates can be described using the system in Table 1, ASTM E 2516-06, Standard Classification for Cost Estimate Classification System. This classification system uses five classes, numbered 1 through 5 (Class 5 corresponding to little to no design, and Class 1 corresponding to a fully designed project). All CW cost estimates shall be prepared, as a minimum, in accordance with the classes as prescribed in table 2 (also refer to ER 1110-2-1150 and ETL 1110-2-573).

Table 1. ASTM E 2516-06, Standard Classification for Cost Estimate Classification System*

| | *Primary Characteristic* | *Secondary Characteristic* | | | |
|---|---|---|---|---|---|
| **ESTIMATE CLASS** | **LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition | **END USAGE** Typical purpose of estimate | **METHODOLOGY** Typical estimating method | **EXPECTED ACCURACY RANGE INDEX** Typical +/- range relative to best index of 1 [a] | **PREPARATION EFFORT INDEX** Typical degree of effort relative to least cost index of 1 [b] |
| **Class 5** | 0% to 2% | Screening or Feasibility | Stochastic or Judgment | 4 to 20 | 1 |
| **Class 4** | 1% to 15% | Concept Study or Feasibility | Primarily Stochastic | 3 to 12 | 2 to 4 |
| **Class 3** | 10% to 40% | Budget, Authorization, or Control | Mixed, but Primarily Stochastic | 2 to 6 | 3 to 10 |
| **Class 2** | 30% to 70% | Control or Bid/ Tender | Primarily Deterministic | 1 to 3 | 5 to 20 |
| **Class 1** | 50% to 100% | Check Estimate or Bid/Tender | Deterministic | 1 | 10 to 100 |

[a] If the expected accuracy range index value of “1” represents +10/-5 percent, then an index value of “10” represents +100/-50 percent.

[b] If the preparation effort index value of “1” represents 0.005 percent of project costs, then an index value of “100” represents 0.5 percent.

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Table 2. Civil Works Estimating Requirements

| Civil Works Project Phase | Product | Sub-Product | Minimum Estimate Classification Required [1/] |
|---|---|---|---|
| **Reconnaissance and Feasibility Phases** | | | |
| | Rough Order of Magnitude | | **5** |
| | Pre-Authorization | | |
| | | Reconnaissance/905b Report | **4** |
| | | Alternative Studies | **4** |
| | | Feasibility NED Plan | **3** |
| | | Feasibility Sponsor Preferred Plan | **3** |
| | | Project Corporative Agreement | **3** |
| | Post-Authorization | | |
| | | General Reevaluation Report | **3** |
| | | Limited Reevaluation report | **3** |
| | PED | | |
| | | Design Document Report | **3** |
| | | Engineering Decision Report | **3** |
| | CAP | | |
| | | Preliminary Restoration Plan | **4** |
| | | CAP Fact Sheet Estimate | **4** |
| | | Detailed Project Report | **4** |
| | | Final Restoration Plan | **4** |
| **Planning, Engineering, and Design Phases** | | | |
| | | 60% P&S[2/] | **2** |
| | | 90% P&S | **2** |
| | | 100% P&S | **1** |
| | | Independent Government Estimate | **1** |
| **Construction Phase** | | | |
| | | IGE for Modification >$100,000 | **1** |
| **O&M Phase** [3/] | | | |

[1/] Based on the ASTM E 2516-06 classification system.
[2/] Plans and specifications.
[3/] Projects within the O&M Phase generally follow the first four phases of CW project development. The above estimate classification requirements shall also apply in this phase.

Risk Mitigation by Estimate Class. Further discussion regarding risk can be found in ETL 1110-2-573.

(1) *Class 5* - Considerable risk and uncertainty is inherent in a Class 5 estimate. Each PDT shall identify areas of risk and uncertainty in the project and describe them clearly to determine the amount of contingency that must be added to a cost estimate to reduce the uncertainty to an acceptable level.

(2) *Class 4* - Although Class 4 estimates may be more accurate than Class 5 estimates, they are based on a very limited project definition. The PDT shall identify areas of risk and uncertainty in the project and describe them to determine the amount of contingency that must be added to a cost estimate to reduce the uncertainty to an acceptable level.

(3) *Class 3* - Class 3 estimates must be supported by a discussion of the scope of the estimate and the uncertainties associated with each major cost item in the estimate. Special attention will be given to large cost items and items that are sensitive to change. Appropriate contingencies may be applied for each element to account for information that is lacking to more accurately establish its cost. To accomplish this process, it is vital to identify those areas that significantly contribute to cost uncertainty. Based on the Pareto Principle, 80 percent of the cost of a project is contained in 20 percent of the estimated work elements. The object is to focus on the uncertainties associated with these so called 20 percent “critical” elements to reduce the cost risk. Results of the risk analysis shall be the basis for determining contingencies.

(4) *Class 2* - A Class 2 estimate may include a PDT project evaluation to determine if additional investigations or studies are necessary to reduce the uncertainties and refine the cost estimate. It shall be accomplished as a joint analysis between the cost engineer and the designers or appropriate PDT members that have specific knowledge and expertise on all possible project risks. It should be noted that the use of cost risk analysis will not reduce the uncertainties associated with the project cost estimate or solve the problems of cost variance due to insufficient investigations or design data. Results of the risk analysis shall be the basis for determining contingencies.

(5) *Class 1* - Class 1 does not imply that all unknowns and risk are eliminated. Estimates prepared to this level should include risk analysis to the degree described in Class 2 above. Results of the risk analysis will be the basis for determining contingencies.

c. Estimates Submitted for Congressional Authorization. All cost estimates submitted for Congressional authorization, i.e., BCEs, must be Class 3, 2, or 1.

16. Estimating for Design-Build Contracting.

a. The selection of design-build or any other contracting method to acquire facilities is the responsibility of the contracting agency. USACE, as a Department of Defense construction agent, is responsible for selecting such methods. One of the requirements for proceeding with design-build contracting is that the project be fully defined, functionally and technically, by performance specifications (ER 1180-1-9).

b. For all design-build projects, district commanders will ensure that adequate funding and time are provided for all PDT members to fully develop both specifications and a cost estimate.

c. PDT members must participate in assessing the functional and technical requirements of the project to determine as much as possible the physical components that comprise the project. Determining the physical components may require extreme judgment and many assumptions. The engineering assessment of project components shall be based upon knowledge of standard analyses, operating experience, and sound engineering judgment. Senior engineering staff must be involved to provide experienced judgment in determining the physical components. Appropriate outside specialists shall be consulted whenever the in-house engineering staff is not sufficiently trained or lacks experience in the type of work and components being considered. All members of the PDT must have input in the decision process for establishing the assumed physical properties to be used in preparing the cost estimate. These properties include size, dimensions, weights, amounts, and material, i.e., stainless, galvanized, black iron, etc.

d. A cost risk analysis shall be prepared for contracts where quantities and/or scope is not well defined (ER 1110-1-1300). Therefore, a detailed risk analysis is required for all design-build cost estimates. The uncertainties and cost risk are too great unless a complete risk analysis is conducted on the project physical properties and price. When applicable, the risk analysis must be the basis for assigning contingency.

17. Profit.

a. General.

(1) Profit is defined as a return on investment and provides the contractor with an incentive to perform the work as efficiently as possible.

(2) For early design stage estimates, profit can be estimated as a percentage based on experience. However, for all other estimates, profit shall be developed using the profit weighted guidelines evaluating the contractor’s degree of risk, the relative difficulty of work, the monetary size of the job, the period of performance, the

contractor's investment, assistance by the Government, and the amount of subcontracting. Calculation methodologies are detailed in the ETL 1110-2-573.

b. Application of Profit.

(1) Title 33 United States Code Section 624 provides that projects for river and harbor improvement shall be performed by private contract if the contract price is less than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or less than 25 percent in excess of a fair and reasonable estimated cost of a well-equipped contractor doing the work. The legislative history indicates the IGE shall not include profit.

(2) The IGE is the formal, approved construction cost estimate prepared to support contract award. Profit, contingencies, and Government costs associated with the contract award and execution are not included in the IGE.

(3) IGEs prepared for contract modifications will include profit based on the factors as determined by use of the weighted guidelines.

18. Dredging Estimates.

a. Dredging estimates using floating plants shall utilize the CEDEP to prepare the estimate. Most projects have a mixture of non-dredging construction and dredging. For these mixed construction projects, CEDEP shall be used to develop the dredging cost and this cost shall be included in the MCACES estimate to provide a total construction cost.

b. Dredging estimates using land-based equipment installed on a floating plant (e.g., crawler dragline on floating platform used for dredging) may use MCACES instead of CEDEP, with the floating plant rates developed using chapter 4 of Engineer Pamphlet 1110-1-8.

19. Regional Dredge Teams. The use of regional dredge teams is recommended for the development of dredge cost estimates. Members of regional dredge teams can be contacted for guidance on production rates, effective times, cost data, or other pertinent information. The regional dredge teams can be a valuable resource for estimate

development, value engineering studies, and ATRs on projects requiring dredge estimating. For current listing of regional dredge teams, see HQUSACE Cost Engineering Community of Practice website (http://www.hq.usace.army.mil/cemp/e/ec/ec_new.htm).

20. Risk and Uncertainty.

a. Risk Analysis. Cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties on the estimated TPC. It shall be accomplished as a joint analysis between the cost engineer and the designers or appropriate PDT members that have specific knowledge and expertise on all possible project risks

(1) PDTs are required to prepare a formal cost risk analysis for all decision documents requiring Congressional authorization for projects exceeding $40 million (TPC) (see appendix B). Where cost risk analysis is required, it is anticipated that the cost risk analysis will be performed once the recommended plan is identified prior to the alternative formulation briefing milestone.

During the feasibility phase, a cost risk analysis shall be performed once the recommended plan is identified. The results of the cost risk analysis will be included in the feasibility report and discussed at the alternative formulation briefing (see appendix B).

(2) During the PED phase, a new cost risk analysis shall be conducted upon major changes in design and for each update in the TPC estimate. A cost risk analysis report shall be included as part of any post authorization change report to support the revised authorized cost (see appendix B).

(3) To accomplish this process, it is vital to identify those areas that significantly contribute to cost uncertainty. Based on the Pareto Principle, 80 percent of the cost of a project is contained in 20 percent of the estimated work elements. The object is to focus on the uncertainties associated with these so-called 20 percent “critical” elements. Variables such as quantity, productivity, and unit cost, which are related to the critical elements affecting the cost, shall be evaluated to determine their range of values (lowest and highest) and probability for the outcome. HQUSACE mandates the use of the nationally recognized software Crystal Ball, an Excel-based Monte-Carlo risk simulation software, to conduct cost risk analysis.

(4) Cost risk analysis provides a graphic display of the risks associated with the cost estimate and the probability of having a cost overrun. Cost risk analysis identifies the amount of contingency that must be added to a cost estimate to reduce the uncertainties to an acceptable level. It should be noted that the use of cost risk analysis will not reduce the uncertainties associated with the project cost estimate or solve the problems of cost variance due to insufficient investigations or design data. This process

more readily identifies areas in the study or design where additional effort could reduce the uncertainties and provide a more reliable cost estimate.

(5) When considerable uncertainties are identified, cost risk analysis can establish the areas of high cost uncertainty and the probability that the estimated project cost will or will not be exceeded. This gives the management team an effective additional tool to assist in the decision making process associated with project planning and design. It does require additional funds, time, and effort to develop the cost estimate. The added benefits obtained shall be identified and compared with the extra cost. The management team shall review the possible use of cost risk analysis techniques for projects with considerable uncertainties.

b. Contingencies.

(1) Contingencies are included in the estimate to cover unknowns, uncertainties, and/or unanticipated conditions that are not possible to evaluate from the data on hand at the time the cost estimate is prepared but must be represented by a sufficient cost to cover the identified risks within the defined project scope. Contingencies are not a means of adding costs to the project for possible schedule slippage or future cost growth or to cover items that are not specifically being considered in the current scope.

(2) HQUSACE requires using a formal cost risk analysis to determine contingency amounts for decision documents requiring Congressional authorization for projects exceeding $40 million (TPC) (see appendix B).

21. Project Escalation and Inflation.

a. Civil Works Construction Cost Index System. Engineer Manual 1110-2-1304 will be used to update (i.e., escalate) unit prices and various project cost features to current price levels. Factors published in Civil Works Construction Cost Index System for use in predicting future costs (i.e., inflating) are based on factors developed by the Office of Management and Budget. The Office of Management and Budget factors are published by HQUSACE, Civil Works Programs Division, in the Engineer Circular for the Annual Program and Budget Request for Civil Works Activities.

b. Update of Cost Estimates. Special consideration is required for projects with cost estimates more than two years old without an update in pricing. In these situations, it is the responsibility of the cost engineer to perform an appropriate analysis to ensure that the project estimate is based on the current design and schedule. The construction cost estimates for major or unique projects will be repriced using current labor and material rates. For other projects, it is acceptable to use the cost indices to update the

estimate for projects that have been inactive for two years. This decision should be based on the judgment and experience of the cost engineer.

FOR THE COMMANDER:

2 Appendixes
(See Table of Contents)

STEPHEN L. HILL
Colonel, Corps of Engineers
Chief of Staff

# APPENDIX A

## References

**Public Law No. 95-269 (91 Stat. 218-1-219)**
Pertains to preparation of construction cost estimates as though the Government were a prudent and well-equipped contractor.

**Public Law No. 99-662 (H.R.6)**
The Water Resources Development Act of 1986.

**Title 33 United States Code Section 624**
Section 624 provides that projects for river and harbor improvement shall be performed by private contract if the contract price is less than 25 percent in excess of the estimated comparable cost of doing the work by Government plant or less than 25 percent in excess of a fair and reasonable estimated cost of a well-equipped contractor doing the work.

**33 Code of Federal Regulations Parts 209 and 335-338**
Operations and Maintenance Regulations for Activities Involving the Discharge of Dredged or Fill Material in Waters of the United States and Ocean Waters.

**Davis – Bacon Act**

**Federal Acquisition Regulation (FAR), Subpart 36.203**
Construction and Architect-Engineer Contracts.

**FAR, Subpart 15.404-4**
Profit.

**FAR, Subpart 36**
Construction and Architect-Engineer Contracts.

**Engineer FAR, Subpart 1.602**
Contracting Officers.

**Engineer FAR, Subpart 36**
Construction and Architect-Engineer Contracts.

**Engineer Regulation (ER) 5-1-11**
U.S. Army Corps of Engineers Business Process.

**ER 11-2-240**
Civil Works Activities – Construction and Design.

**ER 1105-2-100**
Planning Guidance Notebook.

**ER 1110-1-12**
Engineering and Design Quality Management.

**ER 1110-1-1300**
Cost Engineering Policy and General Requirements.

**ER 1110-2-1150**
Engineering and Design for Civil Works Projects.

**ER 1180-1-9**
Design-Build Contracting.

**Engineer Manual 1110-2-1304**
Civil Works Construction Cost Index System.

**Engineer Pamphlet 1110-1-8**
Construction Equipment Ownership and Operating Expense Schedule.

**Engineer Technical Letter 1110-2-573**
Construction Cost Estimating Guide for Civil Works Projects.

**Office Memorandum 25-1-51**
Guidance for Preparation and Processing of USACE Command Publications within Headquarters, U.S. Army Corps of Engineers.

**Headquarters, U.S. Army Corps of Engineers, Cost Engineering Community of Practice** http://www.hq.usace.army.mil/cemp/e/ec/ec_new.htm.

**ASTM E 2516-06**
Standard Classification for Cost Estimate Classification System, Reprinted, with permission, from the Annual Book of ASTM Standards, copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM, www.astm.org.

Project Management Institute, Inc. A Guide to the Project Management Body of Knowledge. PMBOK® guide, 3rd ed, 2004.

REPLY TO
ATTENTION OF:

CECW-CP

S: 19 September 2007

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Initiatives to Improve Accuracy of Total Project Costs in Civil Works Feasibility Studies Requiring Congressional Authorization

1. References:

a. E-mail message, dated 9 March 2007, subject: Planning Centers of Expertise – Cost Estimating, (Mr. Harry Kitch to MSC Planning Chiefs).

b. Memorandum, CECW-CE, dated 3 July 2007, subject: Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs.

c. Engineering and Construction Bulletin No. 2007-17, CECW-EC dated 10 September 2007, subject; Application of Cost Risk Analysis Methods to Develop Contingencies for Civil Works Total Project Costs.

d. Engineering Regulation 5-1-11, USACE Business Process, dated 1 November 2006.

2. Headquarters, U.S. Army Corps of Engineers (HQUSACE) through the Planning Community of Practice (CoP); the Engineering CoP; and the Program and Project Management CoP are working three initiatives that will provide more reliable project recommendations at the feasibility phase of the project by developing project cost and construction schedule contingencies using a standard cost risk analysis program. Cost risk analysis is the process of identifying and measuring the cost and schedule impact of project uncertainties and risks on the estimated total project cost. The goal is to ensure funds are adequately authorized, programmed and appropriated for all phases of the life cycle of the project. Our ability to provide quality project estimates is an essential element of our support to our customers and partners for the successful accomplishment of the project.

3. The first initiative mandates that the National Planning Centers of Expertise (PCX) coordinate with the Cost Engineering Directory of Expertise (DX) at the Walla Walla District for Independent Technical Review (ITR) of cost estimates, construction schedules and contingencies

included in all decision documents requiring Congressional authorization. The Cost Engineering DX will assign the reviewer(s) to the review teams and will utilize the U.S. Army Corps of Engineers personnel and/or the private sector to assure highly qualified persons are available to conduct these reviews. This approach will provide consistency in business practices and in the use of cost engineering tools. The Cost Engineering DX also developed a technical review checklist for the Cost Estimator on the Project Delivery Team (PDT) and the ITR team to ensure that the critical project planning, design and engineering data were available prior to preparation of the baseline cost estimate.

4. The second initiative takes effect on 1 October 2007 and requires that the PDT assists in developing a formal cost risk analysis for all decision documents requiring Congressional authorization for projects exceeding $40 million (total project cost estimate), unless the final feasibility report package was forwarded to HQUSACE prior to that date. For those projects requiring this formal cost risk analysis, the methods described in the referenced bulletin and subsequent guidance shall be applied before the project's next scheduled HQUSACE policy review milestone (Alternative Formulation Briefing, Draft and Final Reports). This method is incorporated in the referenced engineering bulletin and will be used for the development of contingencies for the Civil Works Total Project Cost Estimate.

5. The third initiative is to have Project Managers and their Project Delivery Teams use project risk management principles and methods from the Project Management Institute's Project Management Body of Knowledge in developing a project risk management plan that includes a risk assessment and analysis and a risk response plan to support the cost risk analysis. Development of this plan is supported by our Project Management Business Processes (PMBP) under Project Management Plan (PMP) requirements (see PMBP Risk Management Plan - REF 8007G). Together the project risk management plan along with the cost risk analysis will produce a defensible assessment of the Civil Works Total Project Cost Estimate. This gives the management team an effective tool to assist in managing the planning study and will assist decision makers in making project recommendations.

6. The HQUSACE is making a concerted effort to assure accurate cost estimates, construction schedule and contingency development of projects at the early stages to help formulate alternatives that will lead to more reliable recommendations. Where cost risk analysis is required, it is anticipated that the cost risk analysis will be performed once the recommended plan is identified prior to the Alternative Formulation Briefing milestone. Compliance with this and the other requirements presented above shall be addressed in the ITR documentation and the ITR certification shall include the signature of the ITR Cost Estimator.

CECW-CP
SUBJECT: Initiatives to Improve Accuracy of Total Project Costs in Civil Works Feasibility Studies Requiring Congressional Authorization

7. Points of contact at the Cost Engineering DX are Messrs. Kim Callan, Chief, CENWW-EC-X, 509-527-7511 or James Neubauer, CENWW-EC-X, 509-527-7332.
HQUSACE points of contact are Messrs. Harry Kitch, CECW-CP at 202-761-4721 or Raymond Lynn, CECW-CE at 202-761-5887 or Ms. Mary Gauker, CECW-CB at 202-761-1811.

FOR THE COMMANDER:

THOMAS W. WATERS, P.E.
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Directorate of Civil Works

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US Army Corps of Engineers

# ENGINEERING AND CONSTRUCTION BULLETIN

**No. 2007-17** **Issuing Office: CECW-EC** **Issued: 10 Sep 2007**

**Subject:** Application of Cost Risk Analysis Methods to develop Contingencies for Civil Works Total Project Costs

**Applicability**: Civil Works Studies, Projects and Programs

1. Background: Project cost estimates shall be prepared with an appropriate amount of contingencies, depending on the level of investigation data and design detail available, and support each stage or milestone of project development. The level of engineering shall be in accordance with ER 1110-2-1150, Engineering and Design for Civil Works Projects, developed specifically to support the planning phases in ER 1105-2-100, Planning Guidance Notebook. An appropriate level of field investigations and engineering analyses are essential to a competent cost estimate. Contingencies represent allowances to cover unknowns, uncertainties, and/or unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared, but must be represented by a sufficient cost to cover the identified risk. Contingencies are not a means of adding costs to the project for possible schedule slippage or to cover items which are thought to be a project requirement but are not specifically being considered in the current scope.

Cost risk analysis methods will be used for the development of contingency for the Civil Works Total Project Cost estimate. It is the process of identifying and measuring the cost and schedule impact of project uncertainties on the estimated total project cost. When considerable uncertainties are identified, cost risk analysis can establish the areas of high cost uncertainty and the probability that the estimated project cost will or will not be exceeded. This gives the management team an effective additional tool to assist in the decision making process associated with project planning and design.

2. Purpose: This bulletin has been coordinated with HQUSACE, Directorate of Civil Works, and Program and Project Management Community of Practices, and Policy and Planning Compliance Division. It establishes additional guidance for the development of contingency for Civil Works Total Project Cost estimates as directed by MG Riley's memorandum, Subject: Application of Cost Risk Analysis Methods to develop Contingencies for Civil Works Total Project Costs, dated 3 July 2007.

3. Guidance: A formal cost risk analysis shall be prepared for all decision documents requiring congressional authorization for projects exceeding forty million dollars. This applies to USACE commands having design and/or construction responsibilities for Civil Works. To facilitate this process, the following guidance is applicable:

a. The cost engineer is assigned the responsibility for conducting the cost risk analysis for development of project contingencies presented in the total project cost estimate.

b. The Project Delivery Team (PDT) shall assist the cost engineer in establishment of project contingencies by identifying risks and their potential impacts to cost and schedule.

c. Crystal Ball software shall be used to conduct Cost Risk Analysis. Until a Corps-wide license agreement is negotiated with Decisioneering, the Crystal Ball software is available for purchase through GSA contract #GS-35F-0544P, effective through 24 May 2009.

d. Initial web-based training for cost risk analysis will be provided at no cost and scheduled in Oct 2007. The training is targeted for cost engineers and will be recorded and made available for other PDT members at a later date.

e. Application.

1. During the Feasibility phase, a cost risk analysis shall be performed once the recommended plan is identified. The results of the cost risk analysis will be included in the Feasibility Report and discussed at the Alternative Formulation Briefing.

2. During the PED phase, a new cost risk analysis shall be conducted upon major changes in design and for each update in the Total Project Cost Estimate. A cost risk analysis report shall be included as part of any Post Authorization Change Report to support the revised authorized cost.

3. As required by ER 1110-2-1302, the project cost estimate shall be updated every 2 years. A new cost risk analysis shall be conducted at this time.

4. Points of contact for this bulletin is Raymond Lynn, CECW-CE, 202-761-5887 or Mark Fascher, CECW-CE, 202-761-7750.

//S//
James C. Dalton, P.E.
Chief, Engineering and Construction
Directorate of Civil Works

# GLOSSARY

## Terms and Abbreviations

| | |
|---|---|
| A-E | Architect-Engineer |
| ATR | Agency technical review (formally independent technical review) |
| BCE | Baseline Cost Estimate |
| CAP | Continuing Authorities Program |
| CEDEP | Corps of Engineers Dredge Estimating Program |
| Constant Dollar | Constant dollar analyses are utilized to determine an equivalent cost in the future or in the past by price indexing using CWCCIS data. |
| CoP | Community of Practice |
| CW | Civil Works |
| CWWBS | Civil Works Work Breakdown Structure |
| CWCCIS | Civil Works Construction Cost Index System |
| CX | Cost Engineering Center of Expertise at the Walla Walla District |
| EPL | Effective Price Level (date at which the estimate pricing is based upon) |
| ER | Engineer Regulation |
| Escalate | Escalate; predicts future cost usually using CWCCIS inflation rates |
| ETL | Engineer Technical Letter |
| FAR | Federal Acquisition Regulation |
| HQUSACE | Headquarters, U.S. Army Corps of Engineers |
| IEPR | Independent external peer review |
| IGE | Independent Government Estimate, an independent construction cost estimate prepared as if the Government were in competition for the contract award |
| Inflate | Inflate – update to current costs |
| ITR | Independent Technical Review (now agency technical review) |
| MCACES | Microcomputer Aided Cost Estimating System |
| MSC | Major Subordinate Command |
| NED | National Economic Development |
| O&M | Operation and Maintenance |
| P&S | Plans and Specifications |
| PCX | National Planning Centers of Expertise |
| PDT | Project Delivery Team |
| PDF | Portable document format |
| PED | Preconstruction engineering and design |
| PM | Project Manager |
| PMP | Project Management Plan |
| TPC | Total Project Cost |
| TPCS | Total Project Cost Summary |
| USACE | U.S. Army Corps of Engineers |