

CHAPTER 4

TYPES OF COST ESTIMATES

1. INTRODUCTION

All projects, both construction and environmental restoration, require cost estimates to plan and budget the project efficiently. Numerous estimates are often prepared sequentially for a given project as the project matures, and the level of information and detail available to the estimator increases.

This chapter will describe the estimates required on government-managed projects for both general construction and environmental management. The various estimates required for each type of project will be described, including what comprises these estimates and the time frame in the project's life at which they are required. Guidelines for these designs and estimates will be in accordance with the DOE Order 5700.2, COST ESTIMATING, ANALYSIS AND STANDARDIZATION, and DOE Order 4700.1, PROJECT MANAGEMENT SYSTEM. Table 4-1 summarizes these estimates and indicates the Degree of Accuracy associated with each.

2. CONSTRUCTION ESTIMATES

For construction project development and control, there are four basic types of cost estimates that are developed and used by DOE and its contractors. These estimates are planning/feasibility study estimates, budget or conceptual design estimates, Title I design estimates, and Title II design estimates. Each type of estimate has a separate purpose, basis, and design scheme. These traits are described in this section. The level of accuracy and confidence in the estimate are based on the type and detail of the estimate.

The American Association of Cost Engineers defines accuracy as "the degree of conformity of a measured or calculated value to some recognized standard or specified value." Accuracy depends on the amount of quality information available as well as the judgment and experience of the estimator. Consequently, as the amount of information and specific details increase, so does the degree of accuracy.

A. Planning/Feasibility Study Estimate

1. Purpose

Planning/feasibility study estimates are normally prepared by the operating contractor for a proposed project prior to completing conceptual design. Planning estimates are used for scoping studies and for preliminary budget

estimates of TPCs and shall be reflected on short form project data sheets for identified projects. The short form project data sheet includes an estimate of funds required and a schedule for the performance of conceptual design on each project. These short form project data sheets are submitted to the appropriate DOE Headquarters program office for review and advisement on which projects will be supported in the budget requests. Planning/feasibility study estimates should support Key Decision 0.

2. **Basis**

The basis for the planning estimate must describe the purpose of the project, general design criteria, significant features and components, proposed methods of accomplishment, proposed construction schedule, and any known research and development requirements. Any assumptions made by the estimator in this phase shall be documented for review and concurrence. Planning estimates are based on past cost experience with similar type facilities, where available, and order of magnitude estimates in the absence of previous cost experience. Engineering costs in this type of estimate generally are based on a percentage of estimated construction costs, and consideration will be given to the complexity of the project in establishing the percentage to be used. Similarly, an allowance for contingency will be included in the total project estimate using a percentage of total engineering and construction costs established on the basis of complexity and uncertainties of the component parts of the project.

3. **Design Scheme**

- a. Requirements: Sufficient criteria must be provided to enable the estimator to prepare a planning estimate. This criteria can range from a description of the functional/operational requirements of the project to a brief description of the completed project's intended objective. The description may be supplemented with a sketch, a tour of the proposed project site, or references to similar projects that are already existing.
- b. Guidelines: A planning estimate is an order of magnitude estimate; it can be estimated on a per square foot, linear foot, cubic yard, kilowatt, etc., basis. The estimator shall get all available information about the project from the requestor. On many projects, the available data will be minimal and only an allowance can be made for various segments of the estimate. It is imperative that the estimator fully describe the basis of the estimate, how the estimate was prepared, and any items specifically excluded from the estimate.

- c. Degree of Accuracy: Because this estimate is an order of magnitude estimate, the degree of accuracy is generally plus or minus 40 percent. This range could be wider if the design criteria are not well defined.

B. Budget or Conceptual Design Estimates

1. Purpose

A budget/conceptual design estimate is required to request congressional authorization for funding. This request is required for each line item construction project and each contingency-type project. The fundamental purposes of a budget or conceptual design estimate are:

- to ensure project feasibility and attainable performance levels;
- to develop a reliable project cost estimate consistent with realistic schedules;
- to use it to establish baseline project definitions, schedules, and costs; and
- to support Key Decision 1.

The completed conceptual design estimate normally serves as the basis for preparation of a construction project data sheet. This form is submitted to DOE Headquarters for review and, if approved, the project is included in the budget submitted to the Office of Management and Budget (OMB). If the project is approved at this level, it is included in the President's budget submittal to the Congress. When the project is approved by the Congress and funds are appropriated, OMB apportions the funds to DOE Headquarters which, in turn, issues a financial plan to the DOE Field Office providing funds for the project. Work on the project is initiated at this time.

2. Basis

The basis for a budget or conceptual design estimate shall include as many of the detailed requirements in the CDR as possible. This CDR shall include all general criteria and design parameters, applicable codes and standards, quality assurance requirements, space allocations for required functions, types of construction, significant features and components, building and facility utility services, energy conservation goals, site work, process equipment requirements, project cost estimates, schedules, methods of performance, environmental protection requirements, waste minimization requirements, decontamination and decommissioning requirements, health and safety requirements, related research and development or test programs,

comprehensive project planning, and any other special requirements for the project.

3. Design Scheme

- a. Requirements: The conceptual design sketches and specifications, as well as the functional/operational requirements, shall be available to the estimator prior to developing the budget/conceptual design estimate. Where possible, this information shall be supplemented with a tour of the proposed site. Site drawings can be used as a reference for details of construction and for quantity take-off. These reference drawings are very helpful when estimating demolition costs.
- b. Guidelines: The request for funding is based on the budget/conceptual design estimate. The estimate shall incorporate all details available as well as a detailed breakdown of any allowances used. The estimator must fully document the basis of the estimate, including sources of quotations, assumptions, and any items specifically omitted.
- c. Degree of Accuracy: The degree of accuracy is plus or minus 30 percent for budget/conceptual design estimates.

C. Title I Design Estimate

1. Purpose

The Title I design estimate is an intermediate estimate used to verify that the Title I design details still remain within the project funding. The Title I design details are written in the Title I design phase; this is the initial work accomplished under an approved project. Estimates of this type are completed in conjunction with the Title I preliminary design phase. These Title I design estimates should support Key Decision 2.

2. Basis

The basis for the Title I estimates shall include all items mentioned in the CDR estimate basis, plus all the refinements developed during the course of producing the Title I engineering package. This includes all drawings, outline specifications, data sheets, bills of material, schedule refinements, definitions of scope, methods of performance, and changes in codes, standards, and specifications.

3. Design Scheme

- a. Requirements: Title I estimates are based on the Title I drawings and specifications. In addition to the Title I drawings and specifications, the estimator shall have access to the budget/conceptual design estimate and the project's final functional/operational requirements. A tour of the site and reference drawings of the construction site shall be used in preparing the estimate. Criteria to be followed in the performance of Title I design are based upon the conceptual design for the project. In Title I, the design criteria are defined in greater detail, and, if necessary, the conceptual design drawings are expanded with more detailed information including additional drawings. Also, further refined descriptive information and more detailed specifications are developed, as required, to serve as a firm basis to proceed with Title II definitive design.
- b. Guidelines: The Title I estimate is an estimate of construction cost. At this point in a project, the engineering design, inspection, and project administration costs have been allocated and only need to be verified. A Title I estimate will have more detail available than a conceptual estimate and this additional detail shall be shown.
- c. Degree of Accuracy: Due to the increased accuracy of the detailed drawings and information developed during the course of Title I design, the Title I estimate and the schedules developed from the estimate are more accurate than those previously developed. The degree of accuracy range is plus or minus 20 percent.

D. Title II Design Estimates

1. Purpose

The purpose of the Title II estimate is to estimate construction costs as accurately as possible, prior to the commencement of competitive bidding and construction activities. As Title II design specifications and drawings are developed, the Title II estimate is completed. The completed Title II estimate is in support of Key Decision 3.

2. Basis

The basis for the Title II cost estimate must include all the approved engineering data, methods of performance, final project definition and parameters, project schedule, and final exact detailed requirements. This will include a complete list of all engineering data used (i.e., drawing data sheets, specifications, bills of material, job instructions, proposed schedules, etc.) Since the Title II definitive design results in working drawings and specifications for construction work, including procurement and shop

fabrication, the Title II estimates are prepared in accordance with the approved Title II drawings and specifications.

3. Design Scheme

- a. Requirements: The Title II estimate is based on the Title II drawings and specifications. This estimate shall approximate the construction bids that will be received for this project and may be used as the independent government estimate. The estimator shall have the Title II drawings and specifications for the Title II estimate, the functional/operational requirements, and the tentative construction schedule before generating the Title II estimate. A project site tour shall be made if the estimator is not completely familiar with the construction area.
- b. Guidelines: The Title II Estimate is a refinement of the Title I estimate. Allowances shall only be used on minor items whose total is an insignificant portion of the total cost. Engineering design, inspection, and project administration costs only need verification at this point.
- c. Degree of Accuracy: The degree of accuracy is plus 15 percent to minus 5 percent.

3. ENVIRONMENTAL RESTORATION ESTIMATES

Unlike construction capital projects that have well established points at which cost estimates are generated, there is little agreement in the environmental community on the types and time frame of environmental restoration estimates. In this document, the environmental restoration project will be discussed using the terminology and phase divisions found in CERCLA, Superfund Amendments and Reauthorization Act of 1986 (SARA), and RCRA programs.

Environmental restoration projects can be divided into two distinct phases, the assessment phase and the cleanup phase. Estimates for both phases have different purposes, bases, code of accounts, and degrees of accuracy.

A. Assessment Phase

In the assessment phase of an environmental restoration project, information is gathered on the types and amount of contamination involved at a project site. All sampling is completed and a list of environmental restoration options is developed. The assessment phase concludes with a final decision on the remediation alternative to be implemented on site. In the assessment phase there are three types of

estimates: the planning estimate, the preliminary estimate, and the detailed estimate.

1. Planning Estimate

- a. Purpose: The planning estimate assists in the preliminary planning and budgeting of the project. This estimate is normally requested for use in Environmental Restoration and Waste Management 5-Year Plans.
- b. Basis: The basis for the planning estimate is very limited because there is a large amount of unknown and/or highly uncertain information. Only the location of the work, likely contamination, and prior use of the land may be known. Due to the limited information available, analogies, simple cost estimating relationships, and more sophisticated parametric tools are utilized for the estimate.
- c. Degree of Accuracy: The degree of accuracy for the planning estimate is minus 50 percent to plus 100 percent.

2. Preliminary Estimate

- a. Purpose: A more detailed estimate can be completed after some basic information is available from a preliminary assessment or site inspection. preliminary estimates are used as a budgetary tool and are included in the Environmental Restoration and Waste Management's 5-Year Plan.
- b. Basis: This estimate is developed after the preliminary assessment is completed. The estimate is more detailed. Unit cost is applied at this point to some project categories in the assessment phase, such as laboratory analysis and monitor well drilling.
- c. Degree of Accuracy: The degree of accuracy for the preliminary estimate is minus 30 percent to plus 70 percent.

3. Detailed Estimate

- a. Purpose: Detailed estimates are used to decide between the alternatives for remediating a site. There are numerous detailed estimates, one for each remediation alternative. The detailed estimates are the final estimates of the assessment phase.
- b. Basis: The basis of the detailed estimate includes all information gathered during the assessment phase.

- c. Degree of Accuracy: The degree of accuracy for the detailed estimate is plus or minus 25 percent.

B. Cleanup Phase

After the remediation alternative is selected, estimates are required during the cleanup phase of the project. There are four basic cleanup estimates: planning estimates, feasibility estimates, preliminary estimates, and detailed estimates.

1. Planning Estimate

- a. Purpose: The planning estimate is required for budgetary purposes or for inclusion in planning documents. This estimate is included in the Environmental Restoration and Waste Management 5-Year Plan, and is the basis for the funds represented in the activity data sheets (ADSs).
- b. Basis: Minimal design information is available; therefore, use of historical cost data is helpful. All information gathered during the assessment phase is used in the computation of this estimate.
- c. Degree of Accuracy: The degree of accuracy for the planning estimate is minus 50 percent to plus 100 percent.

2. Feasibility Estimate

- a. Purpose: Feasibility estimates are used to evaluate the numerous technical solutions developed to remediate a site. These estimates perform two functions: one, they present a total estimated cost on each alternative on the basis of the best information available, and two, they provide a logical, traceable framework for comparing alternatives with each other.
- b. Basis: Use lowest level of detail possible and takeoffs from available drawings. When sufficient detail is not available, historical data may be used.
- c. Degree of Accuracy: The degree of accuracy for the feasibility estimate is minus 30 percent to plus 80 percent.

3. Preliminary Estimate

- a. Purpose: After a remediation alternative is selected, a more detailed cost estimate is developed. This estimate shall be in sufficient detail so it can be used as one of the project control tools.

- b. Basis: This estimate shall show all costs incurred to date. All future estimated costs, such as equipment costs, vendor pricing, or materials pricing, shall be as accurate as possible.
- c. Degree of Accuracy: The degree of accuracy for preliminary estimates is minus 30 percent to plus 60 percent.

4. Detailed Estimates

- a. Purpose: This estimate is used to verify the contractor's figures in both lump sum and negotiated fee projects.
- b. Basis: The basis of the final detailed estimate for an environmental restoration project includes the final approved drawings, specifications, calculations, schedule, and anticipated method of accomplishment of the project goals. This estimate shall be performed as an independent contractor would perform the estimate for bidding purposes. All cost figures shall be escalated to the midpoint of each activity. All major equipment required for the project shall be outlined and priced, and escalation rates shall be established to arrive at a total dollar figure.
- c. Degree of Accuracy: The degree of accuracy for detailed estimates is minus 10 percent to plus 25 percent.

4. OTHER ESTIMATES

Once actual work commences on either construction or EM projects, revised estimates may be required when changes in the work are discovered or unknowns are identified. A revised estimate may also be generated when schedule changes affect escalation calculation.

A. Government Estimate

1. Government estimates, sometimes called engineer's estimates, are used to determine the reasonableness of competitive bids received in connection with construction contracts and serve as a control in evaluating cost estimates prepared by a prime construction contractor. In construction, the Title II design estimate is prepared by the designer. After the Title II estimate is reviewed and approved by the government, it is the basis for the government estimate. The detailed cleanup estimate is used in EM projects.
2. The services of an M&O contractor, construction contractor (with respect to subcontracts), or construction manager may be used as appropriate to prepare, review, or revise the government estimate prior to government approval. Government review and approval of the government estimate is not required

when the estimate is within the limits established by the government's approval of the cost-type contractors procurement system. The specifics of a government estimate vary with the size and type of contracts as delineated below.

a. Architect-Engineer and Construction Contracts

Government estimates shall be prepared for all construction and architect-engineer contracts, except for contracts less than \$25,000. Such estimates may be revised when inaccuracies or inconsistencies are revealed during negotiations.

b. Fixed-Price Construction Contracts

1. Government estimates for fixed-price construction contracts and modifications thereto shall be based on approved Title II working drawings and specifications. These estimates shall be prepared in accordance with the practices of the construction industry and in the same careful manner as if the government were bidding in competition with private contractors.
2. Government estimates shall be summarized to conform with bid items but shall include the following items as backup listed separately:
 - separate estimates for alternates set forth in the bidding documents;
 - a breakdown indicating quantities and unit costs for labor, materials, and equipment entering into the work;
 - estimates for mobilization, demobilization, etc.; and
 - allowance for contractor's overhead and profit, including the cost of such items as sales tax, insurance, and bonds.
3. Government estimates shall be prepared independently in advance of any bid or solicited proposal submitted by a prospective contractor or subcontractor.
4. Prior to opening of bids, access to or disclosure of information concerning government estimates shall be limited to personnel requiring such information in performance of their duties.

5. Government estimates for formally advertised or competitive proposal fixed-price construction contracts shall not be changed after the opening of bids or proposals except where careful reexamination indicates a definite typing or arithmetic error. In the event an estimate is changed under such circumstances, detailed reasons for the revision shall be documented.

B. Estimates for Minor Projects

The preparation of government estimates in connection with work estimated to cost less than \$10,000 is optional with the field organization manager. Where the field organization manager elects to use a contractor's estimate, bid, or proposal instead of a government estimate under this limitation, the contractor's estimate shall be carefully evaluated to verify that it is fair and reasonable. The basis used to make adjustments or refinements shall be listed and made a part of the project file. Estimates shall be performed in the same manner as Title II estimates.

C. Current Working Estimates

Current working estimates are required for cost control on construction projects and are conducted periodically throughout the life of the project from the completion of conceptual design until final completion of construction. It is necessary that working estimates be kept under constant review to ensure that they reflect the latest cost and design data available, the estimated cost to complete, the allowance for contingency, detailed contingency analysis, and the uncertainties remaining under the project.

D. Independent Cost Estimate

An independent cost estimate (ICE) is a documented cost estimate that has the express purpose of serving as an analytical tool to validate, cross check, or analyze estimates developed by proponents of a project.

An ICE is performed by the Office of Infrastructure Acquisition (FM-50), Office of the Associate Deputy Secretary for Field Management, in support of key decisions by the Under Secretary. Other check estimates may be initiated by an Assistant Secretary, program manager, project manager, or some other program advocate as an "independent" assessment of the project estimate, but they shall be labeled as a program office check estimate.

The basis for an ICE shall be the identical parameters used to formulate the estimate it will be compared with.

The basis for these cost estimates must carefully define the purpose and scope of the estimate, along with a complete list of all the considerations used to develop the estimate for costs experienced to date and data used to complete the projections.

E. Bilateral (Two-Party) Estimate

This estimate is prepared concurrently by two parties who have mutual responsibility or interest in the total cost. For example, when a site changes operations from production to decontamination and decommissioning (D&D), a budget estimate for the shutdown and D&D must be completed. When this transfer of operations involves two programs or agencies, both interested parties will work together to develop the estimate. An FM-50 ICE could also be performed on this type of estimate.

F. Performance versus Forecast

Performance versus forecast estimates are usually produced for long-term projects (i.e., a project life of 5 or more years). These estimates can be completed for the whole project or a portion of a project. The performance versus forecast estimate looks at the project costs in two divisions: what the costs are to date, and what the forecast costs are to complete the project. The costs to date can be compared against what was expected (performance). The estimated forecast costs may need to be adjusted based on the performance of the project. For example, if actual excavation costs are higher than the original estimate, the soil may have been rockier than originally expected. This slows productivity. This new productivity factor should be used in the forecast amount. The actual and forecast values will give you the total project costs.

TABLE 4-1		
DEGREES OF ACCURACY		
TYPE	PURPOSES	ACCURACY RANGE
Conventional Construction		
Planning/Feasibility or Order of Magnitude Estimate (Proposal)	<ol style="list-style-type: none"> 1. Scoping Studies. 2. Preliminary budget estimates of Total Project Cost. 3. Support Key Decision 0. 	± 40%
Budget/Conceptual Design Estimate (Equipment Factored)	<ol style="list-style-type: none"> 1. Ensure project feasibility. 2. Develop reliable project cost estimate. 3. Establish baseline project definitions, schedules, and costs. 4. Support Key Decision 1. <p style="text-align: center;">(Design 10% to 15% Complete)</p>	± 30%
Title I Estimate	<ol style="list-style-type: none"> 1. Verify that Title I design details still remain within the project funding. 2. Support Key Decision 2. <p style="text-align: center;">(Design 25% to 35% complete)</p>	± 20%
Title II or Definitive Estimate (Detailed)	<ol style="list-style-type: none"> 1. Estimate construction costs as accurately as possible, prior to the commencement of competitive bidding and construction activities. 2. Support Key Decision 3. <p style="text-align: center;">(Design 60% to 100% Complete)</p>	- 5% to + 15%
Construction Estimate	<ol style="list-style-type: none"> 1. Estimate is based on bid information. <p style="text-align: center;">(Design 100% complete)</p>	- 5% to + 10%

TABLE 4-1		
DEGREES OF ACCURACY		
TYPE	PURPOSES	ACCURACY RANGE
Environmental Restoration - Assessment Phase		
Planning Estimate	Assist in the preliminary planning and budgeting of a project. (usually requested for use in EM 5-Year Plans)	- 50% to + 100%
Preliminary Estimate	Used as a budgetary tool and is included in the EM 5-Year Plan.	- 30% to + 70%
Detailed Estimate	Used to decide between the alternatives for remediating a site.	- 25% to + 55%
Environmental Restoration - Cleanup Phase		
Planning Estimate	<ol style="list-style-type: none"> 1. Assist in preliminary planning and budgeting of the cleanup. 2. Required for budgetary purposes for inclusion in planning documents. 3. Included in the EM 5-Year Plan. 4. Basis for funds represented in the ADSs. 	- 50% to + 100%
Feasibility Estimate	Used to evaluate the numerous technical solutions developed to remediate a site.	- 30% to + 80%
Preliminary Estimates	A more detailed cost estimate that is developed after a remediation alternative is selected.	- 30% to + 60%
Detailed Estimate	Used to verify the contractor's figures in both lump sum and negotiated fee projects.	- 10% to + 25%