

Estimating Procedures

**LAST UPDATED
12/29/2009**

TABLE OF CONTENTS

10.0	ESTIMATING	1
10.1	PURPOSE	1
10.2	INTRODUCTION	1
10.2.1	DEPARTMENT POLICY	1
10.2.2	CENTRAL REPOSITORY OF ESTIMATES	1
10.2.3	PURPOSE OF PRE-AWARD ESTIMATES	1
10.2.4	PURPOSE OF POST-AWARD ESTIMATES	2
10.2.5	GENERAL DEPARTMENTAL STAFF RESPONSIBILITIES	2
10.3	PROCEDURE C-3 CONSTRUCTION COST ESTIMATES	3
10.3.1	STAGES OF PROJECT DEVELOPMENT AND CORRESPONDING TYPES OF CONSTRUCTION ESTIMATES	3
10.3.2	NET COST PROCEDURE	11
10.3.3	ROLES AND RESPONSIBILITIES	11
10.4	ANALYSIS OF BID PROCEDURE	17
10.4.1	PURPOSE	17
10.4.2	REQUIREMENTS	17
10.5	PROCEDURE C-24 VALUE ENGINEERING	21
10.5.1	PURPOSE	21
10.5.2	APPLICABILITY	21
10.5.3	VALUE ENGINEERING TEAM	21
10.5.4	VALUE ENGINEERING METHODOLOGY	21
10.5.5	PRE-STUDY PHASE	21
10.5.6	INFORMATION PHASE	22
10.5.7	FUNCTION ANALYSIS PHASE	22
10.5.8	CREATIVE PHASE	22
10.5.9	EVALUATION PHASE	22
10.5.10	DEVELOPMENT PHASE	22
10.5.11	PRESENTATION PHASE	23
10.6	POST STUDY	23
10.7	MISCELLANEOUS	23

APPENDICES

APPENDIX A—PREAPPROVED CLASSIFIED/UNIT PRICE ITEMS	A-1
APPENDIX B—ACRONYMS	B-1
APPENDIX C—REFERENCE MATERIALS	C-1

LIST OF FIGURES

FIGURE 10-A	CONCEPTUAL DEVELOPMENT ESTIMATE (STAGE I)
FIGURE 10-B	PRELIMINARY DESIGN ESTIMATE (STAGE II)
FIGURE 10-C	FINAL DESIGN ESTIMATE (STAGE III)
FIGURE 10-D	ANALYSIS OF BID
FIGURE 10-E	POST-AWARD ESTIMATE (STAGE IV)
FIGURE 10-F	BID VS. EE COMPARISON
FIGURE 10-G	BID VARIANCE WHITE PAPER – HIGH BID
FIGURE 10-H	BID VARIANCE WHITE PAPER – LOW BID

10.0 ESTIMATING

10.1 PURPOSE

This procedure is designed to provide guidance to in-house staff and to consultants regarding the background, procedures, data sources, and required forms for the preparation of construction cost estimates.

10.2 INTRODUCTION

10.2.1 DEPARTMENT POLICY

It is the general policy of the Engineering Department (ED) to have the engineers, architects, and/or design consultants prepare cost estimates for the work they have designed for all project stages. This includes all estimates prior to construction contract award, which involves the tasks of estimation of material and labor quantities, checking of quantity take-offs, determination of pricing, and computation of cost estimates. Design changes directed after contract award require quantity take-offs only with pricing applied by the Construction Management Division (CMD).

Near the completion of each design stage a summary cost estimate is prepared and a total estimated price is calculated. This total estimated price is called the "Engineer's Estimate" and represents the ED estimated cost of the project at that particular point in time. All such estimates must be approved by the Chief Estimator except Stage IV estimates below \$100,000.

All Port Authority of New York & New Jersey estimates, whether prepared by in-house staff or by outside consultants, are to be treated as confidential information and the distribution of the Engineer's Estimate or disclosure of any information contained therein must be limited to those personnel who have a legitimate need to know. In addition, all estimators should use the forms attached to this procedure, which can also be found on the ED website, *Engineering OnLine* (EOL). The Engineering Management Services (EMS) Estimating Unit is responsible for maintaining the standard estimating forms and their placement on EOL. These forms should also be given to outside consultants for their use in preparing Port Authority of New York & New Jersey estimates.

10.2.2 CENTRAL REPOSITORY OF ESTIMATES

The EMS Estimating Unit is responsible for maintaining a central repository of all Engineer's Estimates. The entire Engineer's Estimate with details is sent for scanning by the EMS estimator for inclusion in the Project Information Center. The Engineer's Estimate summary sheet is also entered into the estimate database for search and retrieval.

10.2.3 PURPOSE OF PRE-AWARD ESTIMATES

Pre-award construction cost estimates are prepared by designers or consultants and are finalized near the end of each design stage as a project progresses from design concept through completion of pre-bid contract documents.

Pre-award estimates should reflect the fair and reasonable cost that a general contractor may bid to execute the construction requirements, based upon the information shown on the available plans and specifications, assumptions for work required but not yet detailed, and the prevailing or anticipated market conditions. Such pre-award estimates are utilized to:

- Determine initial project feasibility and develop budgets for proposed construction projects.
- Serve as support in the project authorization process.
- Confirm that the established budget for an active project remains an attainable goal.

- ❑ Reflect and document the impact of incorporating changes or alternatives in the design/scope.
- ❑ Serve as a yardstick to evaluate the reasonableness and responsiveness of the low bid, but not to guess what the lowest bid will be or to put a value on the advantage that an incumbent or otherwise advantageously positioned single contractor may enjoy.

10.2.4 PURPOSE OF POST-AWARD ESTIMATES

Post-award estimates are prepared in order to:

- ❑ Provide the Resident Engineer (RE) and the Project Manager (PM) with an accurate, detailed listing of the resources and materials, and the expected cost of a post-award contract change.
- ❑ Establish the Engineer's Estimate of the cost of a field change or claim.
- ❑ Serve as a yardstick in order to help evaluate and negotiate the contractor's change proposal.

10.2.5 GENERAL DEPARTMENTAL STAFF RESPONSIBILITIES

10.2.5.1 IN-HOUSE STAFF RESPONSIBILITIES

Lead Engineer/Architect (LE/A) coordinates the preparation of the various Design Division (DD) discipline estimates and is responsible to ensure that estimates prepared by DD Task Leaders (TLs) and/or consultants are summarized at each stage of design development and reviewed by the EMS estimator.

PMs assist the EMS estimator by contributing information to the development of general conditions, contingency, net cost work, and extra work to be added to the estimate summary sheet. The PM will have the opportunity to sign the estimate as concurring. The Present & Planned Workload (P&PW) report will have a field for the Project Management Office to use for an estimate that may differ from the official Engineer's Estimate. The Chief Estimator or designee has the overall responsibility to approve the cost estimates at each stage of design, including the final pre-bid Engineer's Estimate.

The RE office will typically prepare the Engineer's Estimate for any post-award contract changes.

EMS estimators support the discipline LE/A, TLs, PMs, and REs with estimating services and cost estimating information. The DD staff and estimators may also be asked to prepare Order of Magnitude estimates for Line Department construction projects. EMS estimators conduct a final review of estimates prepared at each stage of design, whether prepared by the in-house staff or consultants, and establish the "recommended" total Engineer's Estimate. This review covers reasonableness of pricing and completeness, adherence to estimating guidelines, estimating of general conditions and other indirect costs, and summarizing the estimate. EMS estimators are also responsible for the preparation of the Analysis of Bid worksheet, which is used to construct the Analysis of Bid page included in the contract book.

More specific examination of the detailed roles and responsibilities of departmental staff in the preparation, review, and approval of each of the different types of estimates are presented in [Tables 10-B, 10-C, 10-D, and 10-E](#).

10.2.5.2 USE OF OUTSIDE CONSULTANTS TO PREPARE ESTIMATES

Outside consultants are typically used to prepare estimates in the following two instances:

- A. Whenever an ED division retains an outside architectural and engineering (A-E) consultant to design a project, the contract typically includes the requirement to prepare cost estimates.
- B. For large priority projects or other complex projects where special estimating expertise or a second opinion is required, the PM may request the services of the EMS "call-in" consultant to prepare an independent estimate.

In the latter instance, the responsible PM or RE must ensure that the estimating consultant has at its disposal all the necessary plans, specifications, design basis/criteria, schedule, staging, and other information, necessary to prepare an "independent" estimate.

Outside A-E consultants are required to perform all quantity take-offs and pricing and prepare all estimate worksheets, general condition estimates, and estimate summaries in accordance with the standards, format, and detail enumerated within this procedure, subject to the discretion of the responsible PM or RE.

10.3 PROCEDURE C-3 CONSTRUCTION COST ESTIMATES

10.3.1 STAGES OF PROJECT DEVELOPMENT AND CORRESPONDING TYPES OF CONSTRUCTION ESTIMATES

[Table 10-A](#) summarizes the project development stages and the corresponding cost estimates, which are described in greater detail later in this procedure.

**TABLE 10-A
TYPES OF CONSTRUCTION COST ESTIMATES**

Estimate Name	General Purpose	% Design Complete	Estimate Basis	Contingency (approx.)	Field Investigation
Order of Magnitude	Budget or "ball park" figure for planning purposes	No design	Historical or parametric data	25% - 40%	Minimum except when interfacing with existing facilities and utilities
Conceptual Development (Stage I)	Alternative comparisons and Board authorization for project development	10 - 20% Rough conceptual designs to identify alternatives	Square foot cost and/or parameters Take-offs of majority elements	15% - 25%	Some field visits for site conditions and minimum quantity survey
Preliminary Design (Stage II)*	Board authorization for project implementation	Up to 50% Development of major elements	Per unit of design elements	10% - 20%	Additional field data feedback
Final Design (Stage III)	Final pre-bid estimate (including general conditions, market, and bid analysis)	100% Detailed design	Detailed quantity take-offs	None	All field conditions identified and considered
Post-Award (Stage IV)	Design changes, field changes, and claims	Detailed design	Detailed quantity take-offs if applicable	None	All field conditions identified and considered

* Some projects eliminate Stage II.

10.3.1.1 ORDER-OF-MAGNITUDE ESTIMATE

The Port Authority of New York & New Jersey Line Departments are responsible for identifying and determining scope, objectives, and schedules of projects to be included into the Port Authority of New York & New Jersey capital and operating plans. Prior to Stage I commencement of a project, the LE/A is responsible for providing Order of Magnitude estimates of the cost of planned projects to help the Line Departments determine each project's feasibility and to establish the initial project budget. The LE/A has the option of using traditional estimate preparation methods (e.g., DD disciplines each utilize historical data to build an Order of Magnitude estimate that is reviewed by EMS estimators) or they can use the in-house expert services of the EMS Estimating Unit or the services of the EMS estimating consultant.

If the LE/A chooses to use EMS Estimating Unit staff to prepare an Order of Magnitude estimate, EMS staff will consult with DD discipline staff and use combinations of historical cost data and parametric cost estimating procedures combined with the application of site adjustment and cost growth factors.

In general, EMS will adjust its methodology to suit the amount of time and information that is available to produce the most cost-efficient estimate possible.

Order of Magnitude cost estimates typically contain contingency allowances ranging from 25% to 40% above the total calculated cost of construction based on the complexity of the project.

10.3.1.2 CONCEPTUAL DEVELOPMENT ESTIMATE (STAGE I)

A Stage I construction cost estimate is used to compare alternatives and develop a concept sufficiently for authorization to go further.

During Stage I, sketches and more refined scope parameters may be used to establish quantities. Until such refinements are available, these estimates will be calculated in much the same fashion as Order of Magnitude estimates. The LE/A again has the option to have the EMS estimator prepare the Stage I estimate, using combinations of historical cost data and parametric cost estimating procedures and a specialty estimating software package. Should this option be exercised, the LE/A must keep in mind that the estimate will still be broken down by major construction components.

For all the required work that has not been depicted in the conceptual plans and specifications, reasonable cost allowances may be included for such items in anticipation of further design development. However, the basis for such allowances should be documented, and unidentified lump sum allowances should be avoided. The confidence level of Stage I estimates is higher than that of the Order of Magnitude estimates, thus the contingency allowance is reduced to 15% to 25% above the total calculated cost depending upon the complexity of the project.

See [Figure 10-A](#) for the Conceptual Development Estimate (Stage I) cost estimate form.

10.3.1.3 PRELIMINARY DESIGN ESTIMATE (STAGE II)

Stage II generally represents the midpoint of design. The geometry will have been firmed-up and most of the project's systems will have been selected. For architectural projects the site situation, building materials, typical construction sections, roof drainage, interior finishes, floor plan, equipment locations, and supporting mechanical, electrical and fire protection systems are defined. For engineering projects the load calculations, choices of basic equipment (sizes and types), and design layouts are defined. Much of the critical construction phasing and sequencing is known.

Preliminary drawings and specifications have been prepared and the designers' assumptions listed for less defined areas, so as to provide enough detail to establish many of the exact quantities of required construction materials. The need for design contingencies will have diminished and the contingency allowance can therefore be reduced to 10% to 20% depending upon the complexity of the project.

See [Figure 10-B](#) for the Preliminary Design Estimate (Stage II) cost estimate form.

10.3.1.4 FINAL DESIGN ESTIMATE (STAGE III)

The preliminary Stage III cost estimate is prepared after the contract drawings have been completed. The estimate will reflect the cost of all elements of work, which will have been clearly shown, and all special conditions pertaining to the site that have been clearly defined in the specifications.

There should be no need to include any cost allowance for unknown items, design refinements, or contingencies. However, any items of work discovered to be inadequately defined by the final plans and specifications should be flagged during the Preliminary Stage III estimate, so that they may be revised or clarified.

The Stage III estimate should include a detailed breakdown of all direct costs and all indirect costs (which include field overhead [also known as general conditions], home office overhead, and profit), as more fully detailed in subsequent respective sections.

Stage III estimates should normally break down each direct cost work item in terms of labor and material. Although the Port Authority of New York & New Jersey policy is to encourage lump sum contract awards, the use of lump sum items without details of labor and material in the Stage III cost estimate is discouraged when it is possible to describe and quantify work items. The use of vendor quotations for specialty items is an exception to this general guideline.

A Stage III estimate is signed off by the Chief Estimator, LE/A, and Estimator or designee at the time of the signing of the contract drawings. Any updates of the estimate must also be signed by the Chief Estimator, including any final update. At that time, all the addenda will have been issued and their effect on a contract's cost can be evaluated. A final assessment of the bidding climate can be made at that time.

See [Figure 10-C](#) for the Final Design Estimate (Stage III) cost estimate form.

10.3.1.5 USE OF UNIT PRICE OR CLASSIFIED ITEMS

It is the policy of the ED to use classified items (see [Appendix A](#)) prudently and in appropriate circumstances. The aggregate amount of classified items in a contract should be greater than 5% of the total Engineer's Estimate. Projects with classified items less than 5% should attempt to have these items rolled into the base lump sum amount by defining the work sufficiently to allow the contractor to develop quantities. The DD Deputy Director must approve the use of classified items other than those contained on the attached list or for the use of classified items when the total classified amount does not exceed 5% of the total Engineer's Estimate.

10.3.1.5.1 General Conditions Cost Estimate (Part of Stage III Estimate)

The general conditions cost estimate is prepared as part of the Stage III cost estimate and is included within the estimate to more accurately represent the total cost of the project. The EMS estimator and LE/A will typically prepare the general conditions cost estimate and/or provide assistance to the PM in compiling the general conditions summary sheet. The following guidelines apply to the general conditions cost estimate:

- ❑ For small projects with an estimated value under \$2 million, Order of Magnitude, and Stage I and II estimates a percentile rate ranging from 8% to 20% of the direct cost can be used in lieu of the more detailed general conditions summary or general conditions detailed breakdown.
- ❑ For medium sized projects (\$2M to \$10M) an estimate using only the general conditions summary sheet will be sufficient.
- ❑ For large projects, greater than \$10 million, the general conditions summary sheet and the entire general conditions detailed breakdown worksheets should be utilized.

A number of factors affect the percentile rate of the general conditions (as a percentage of direct costs). The size of the project is the major factor and on larger projects the indirect costs will typically be a smaller percentage of the direct costs, while on smaller projects the indirect costs will be a larger percentage of direct costs. Other factors are the length of the job, its complexity, and the contractor's risk exposure. As those factors increase, there is typically a proportional increase in the indirect cost percentile rate.

10.3.1.5.2 Analysis of Bid Worksheet (Part of Stage III Estimate process)

The Analysis of Bid worksheet ([Figure 10-D](#)) is prepared upon completion of the Stage III cost estimate, prior to final preparation of the contract book. It provides a summary of the major construction components of the contract. It is prepared by the EMS estimator in accordance with the [Analysis of Bid Procedure](#). It is then given to the LE/A who submits it to the contracts specification writer to be incorporated into the contract book before the bid documents are printed.



ANALYSIS OF BID

PROJECT _____

BID DATE _____

THIS IS NOT PART OF THE CONTRACT

CONTRACTOR _____

SHEET _____

CONTRACT NO. _____

Unit No.	Descriptions ⁽¹⁾	Quantity	Unit ⁽²⁾	Unit Price	Amount
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

1. Separate and list all items or operations of work included in your estimate in accordance with Specifications.
When listing subcontracts, the prime contractor will have each subcontractor complete an analysis of bid form.
2. Unit of measure, i.e., SF, CY, Bbls, Pcs, Ea., etc.
3. Include all charges, such as moving on site, removal, rental, etc.
4. In case of conflict between information hereon (whether supplied by the Authority or the bidder) and the terms or prices contained or inserted in the Contract Booklet or Contract Drawings, said Booklet and Drawings shall control.
5. The Analysis of Bid is not part of the contract. No information hereon (whether supplied by the Authority or the bidder) and no information deduced from information hereon, including quantities of materials or work, shall be deemed to vary, alter or modify any provision of the Contract, including provisions therein as to compensation and performance. The unit prices contained hereon serve the sole purpose of informing Port Authority as to components of the bidder's price quoted in the Contract. The items of materials or work contained hereon shall not be deemed to be an exhaustive list of the items of materials or work required by the Contract Drawings and Specifications in their present form.

**Figure 10-D
Analysis of Bid**



ANALYSIS OF BID

PROJECT _____

CONTRACTOR _____

THIS IS NOT PART OF THE CONTRACT

BID DATE _____
SHEET _____
CONTRACT NO. _____

Unit No.	Descriptions ⁽¹⁾	Quantity	Unit ⁽²⁾	Unit Price	Amount
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
	Total Lump Sum				

**Figure 10-D, Cont'd.
Analysis of Bid**

The bidders are asked to show on that form the breakdowns of their lump sum bid item pricing for the specific contract work. The Analysis of Bid is a non-binding tabulation of prices for the items listed and is not considered to be part of the contract. After the receipt of bids, the Analysis of Bid form submitted by the bidder is used to help examine possible areas of divergence between the Engineer's Estimate and the other bidders.

10.3.1.6 POST-AWARD ESTIMATE (STAGE IV)

The Stage IV construction cost estimates are prepared for Post Award Contract Changes (PACCs) and supplemental work in order to establish the Engineer's Estimate for modifications to a contract. Such modifications are typically negotiated with the contractor.

Stage IV estimates for PACCs that are the result of Line Department-directed design changes or for field changes that require a design change will have a quantity take-off prepared by the DD staff. CMD will price and complete the estimate. The EMS estimator will review all estimates greater than \$100,000.

Stage IV estimates for those "field initiated" PACCs, which are the result of field conditions and other field-related supplemental work or for contractor claims, are typically prepared by CMD field personnel. Those estimates greater than \$100,000 must also be reviewed and signed off by the EMS estimator.

Stage IV estimates must be broken down into separate elements for materials and labor and for each item of work for comparison against the contractor's estimate in order to facilitate a negotiated lump sum price for the modification. If a lump sum agreement cannot be reached, the work is performed on a time and materials basis.

The indirect cost mark-ups for subcontractor overhead and profit and for General Contractor (GC) overhead and profit must be added whenever a change produces an addition to the contract cost.

See [Figure 10-E](#) for the Post-Award Estimate (Stage IV) cost estimate form.

10.3.2 NET COST PROCEDURE

Contracts may contain net cost provisions when it is reasonably certain that specific items of work will be required, but there is no way to sufficiently determine the character or extent of the work until it is actually performed (e.g., rock removal, replacement of unsuitable fill, etc.).

An Order of Magnitude estimate must be prepared for each net cost item. An Order of Magnitude estimate is a "ball park" amount that is used for budgeting purposes and does not require any design. The Order of Magnitude net cost estimate shall be part of the formal Engineer's Estimate and must be included in the Policy MJ briefing folder. The list of Net Cost items must be reviewed with the RE and must be in the contract documents.

The value of the net cost work in relation to the Engineer's Estimate determines whether the net cost work is bid by the contractor (see chart below) or included as "clause work" in the contract documents, in which case it is not bid by the contractor.

Engineer's Estimate	Net Cost Must Be Bid When Net Cost Estimate Is:
\$0 to \$1M	Greater than 50% of the Engineer's Estimate
\$1M to \$5M	\$500K or 25% of the Engineer's Estimate, whichever is greater
\$5M to \$10M	\$1.25M or 15% of the Engineer's Estimate, whichever is greater
\$10M to \$20M	\$1.5M or 10% of the Engineer's Estimate, whichever is greater
\$20M+	\$2M+

10.3.3 ROLES AND RESPONSIBILITIES

[Tables 10-B](#), [10-C](#), [10-D](#), and [10-E](#) depict details of the roles and responsibilities of key staff regarding estimate preparation, review, and approval for each of the five estimate stages.

TABLE 10-B
ORDER OF MAGNITUDE ESTIMATES (CONCEPT OR PRE-DESIGN)
AND
STAGE-I ESTIMATES (10% TO 20% OF DESIGN)

Staff	Role	Description of Responsibility
PM	Support	<ol style="list-style-type: none"> 1. Coordinate identification of requirements and major project elements with DD. 2. Coordinate development of conceptual or schematic Work Breakdown System (WBS). 3. Consult with the LE/A and EMS Estimator on issues and conditions that may affect the estimate. 4. Transmit estimate to Line Department and include in P&PW report.
Chief Estimator	Oversee	<ol style="list-style-type: none"> 1. Oversee project scope/cost development and approve estimate.
DD (each Discipline)	Primary	<ol style="list-style-type: none"> 1. LE/A develops conceptual scope documents. 2. Prepare conceptual design criteria. 3. Develop conceptual or schematic WBS via input from PM. 4. Prepare/maintain estimating QA/QC checklist(s). 5. Organize discipline estimate by WBS element. 6. Prepare assumptions as basis of estimate. 7. Develop parametric or other means to roughly estimate quantities. 8. LE/A establishes proposed summary costs (Order of Magnitude) and summary unit costs (Stage I). 9. Compute separate discipline estimates. 10. Summarize costs to WBS elements. 11. LE/A evaluates individual discipline estimates for conformance to project scope.
EMS (Estimators)	Support	<ol style="list-style-type: none"> 1. Maintain historical and subscription cost data and prior estimate data. 2. Review all discipline and summary estimates or prepare all Order of Magnitude estimates and summaries as service to the Line Departments. 3. Scan all approved estimates for upload to EOL and Livelink. 4. Enter estimate summary information into the estimate database. 5. Check individual DD estimates for missing or overlapping of items.
CMD (RE)	Support	<ol style="list-style-type: none"> 1. Feasibility, fatal flaw check, if requested. 2. Review completed estimate, if requested.

**TABLE 10-C
STAGE II ESTIMATES
(PRELIMINARY DESIGN DEVELOPMENT - 20% TO 50% OF DESIGN)**

Staff	Role	Description of Responsibility
PM	Support	<ol style="list-style-type: none"> 1. Coordinate updating user requirements and project elements with DD. 2. Coordinate development of preliminary WBS. 3. Consult with the LE/A and EMS Estimator on issues and conditions that may affect the estimate. 4. Transmit estimate to Line Department and include in P&PW report.
Chief Estimator	Oversee	<ol style="list-style-type: none"> 1. Oversee project scope/cost development and approve estimate.
DD (each Discipline)	Primary	<ol style="list-style-type: none"> 1. LE/A develops preliminary scope documents. 2. Prepare preliminary design criteria. 3. Develop preliminary WBS by revising Stage I WBS via input from PM. 4. Utilize estimating QA/QC checklist(s). 5. Organize discipline estimate by WBS element. 6. Update assumptions as basis of estimate. 7. Develop preliminary quantities within discipline. 8. Assemble information regarding specialty vendors. 9. Establish proposed combined unit prices. 10. Apply element and Construction Specification Institute (CSI) cost codes to estimate as described in the Estimating Guidelines. 11. Compute separate discipline estimates. 12. Summarize costs to WBS elements.
EMS (Estimators)	Support	<ol style="list-style-type: none"> 1. Maintain historical and subscription cost data and prior estimate data. 2. Review all discipline and summary estimates. 3. Assist LE/A with summary estimate. 4. Participate in "independent" estimate preparation as needed. 5. Scan all approved estimates for upload to EOL and Livelink. 6. Enter estimate summary information into the estimate database.
CMD (RE)	Support	<ol style="list-style-type: none"> 1. Feasibility, fatal flaw check, if requested. 2. Review completed estimate, if requested. 3. Participate in "independent" estimate preparation as needed.

**TABLE 10-D
STAGE III ESTIMATES
(FINAL DESIGN - 100% DESIGN)**

Staff	Role	Description of Responsibility
PM	Support	<ol style="list-style-type: none"> 1. Coordinate final user requirements and project elements with DD. 2. Coordinate development of final WBS (revise Stage II WBS). 3. Consult with the LE/A and EMS Estimator on issues and conditions that may affect the estimate. 4. Organize pre-bid meeting. 5. Transmit estimate to Line Department and include in P&PW.
Chief Estimator	Oversee	<ol style="list-style-type: none"> 1. Oversee project scope/cost development and approve final estimate.
DD (each Discipline)	Primary	<ol style="list-style-type: none"> 1. LE/A develops final scope documents. 2. Prepare final design criteria. 3. Develop final WBS via input from PM. 4. Utilize estimating QA/QC checklist(s). 5. Organize discipline estimate by WBS element. 6. Update assumptions as basis of estimate. 7. Develop final quantities within discipline. 8. Assemble information regarding specialty vendors. 9. Establish proposed labor/material pricing. 10. Apply element and CSI cost codes to estimate as described in the Estimating Guidelines. 11. Compute separate discipline estimates. 12. Summarize costs to WBS elements. 13. LE/A attends pre-bid meeting, if requested by PM. 14. Adjust estimate, as appropriate.
EMS (Estimators)	Support	<ol style="list-style-type: none"> 1. Maintain historical and subscription cost data and prior estimate data. 2. Review all discipline and summary estimates. 3. Assist LE/A with summary estimate. 4. Participate in "independent" estimate preparation as needed. 5. Prepare Analysis of Bid form. 6. Attend pre-bid meeting. 7. Scan approved estimates for upload to EOL and Livelink. 8. Enter estimate summary information into the estimate database.
CMD (RE)	Support	<ol style="list-style-type: none"> 1. Provide input regarding constructability and staging. 2. Review all completed estimates. 3. Participate in "independent" estimate preparation as needed. 4. Attend pre-bid meeting if requested by PM.

**TABLE 10-E
STAGE IV ESTIMATES
(POST-AWARD CONTRACT MODIFICATIONS)**

Staff	Role	Description of Responsibility
PM	Support	<ol style="list-style-type: none"> 1. Coordinate requirements with DD regarding Line Department and Design changes (L&D). 2. Review estimate summary (for major L&D changes only) and transmit to Line Department.
Chief Estimator	Oversee	<ol style="list-style-type: none"> 1. Approve estimate (for D changes). 2. Approve design (for L changes).
DD (each Discipline)	Primary	<ol style="list-style-type: none"> 1. LE/A develops scope documents (for L&D changes). 2. Develop take-off quantities within discipline and provide take-off details to CMD.
EMS (Estimators)	Support	<ol style="list-style-type: none"> 1. Maintain historical and subscription cost data and prior estimate data. 2. Review all design-related estimates and all estimates greater than \$100,000. 3. Scan selected approved estimates for upload to EOL and Livelink. 4. Enter estimate summary information into the estimate database.
CMD (RE)	Primary	<ol style="list-style-type: none"> 1. Provide post award payment breakdown to EMS. 2. Review scope of change. 3. Prepared Engineer's Estimate (for L&D changes) and review DD take-offs. 4. Analyze schedule impacts as required. 5. Prepare independent take-offs, pricing, and compute estimate (for field changes). 6. Apply pricing to DD take-offs for all L&D changes. 7. Review estimates greater than \$100,000 with EMS. 8. Negotiate with contractor. 9. Prepare information for contract modification/supplement.
Contractor	Primary	<ol style="list-style-type: none"> 1. Review owner-directed change (L&D) or field change. 2. Prepare estimate of cost and schedule impact (proposal). 3. Review and negotiate with CMD.

10.4 ANALYSIS OF BID PROCEDURE

10.4.1 PURPOSE

The EMS Estimator shall prepare the Analysis of Bid form for inclusion in the Contract Book by the Contract Engineer. Upon receipt of bids, the PM and EMS Estimator shall analyze and compare the low bid to the Engineer's Estimate and other bidders. This will aid in determining whether a low bid meeting or Technical Qualification Hearing (TQH) will be required. The comparison will determine whether the lowest qualified bid is fair and reasonable and whether the contract should be awarded.

10.4.2 REQUIREMENTS

- A. The EMS Estimator shall evaluate and develop a composite list of major scope items and review it with the LE/A. The EMS Cost Estimator shall prepare the Analysis of Bid form with assistance from the RE as required.
- B. The EMS Estimator shall transmit the completed Analysis of Bid form to the Contract Engineer for review and inclusion in the Contract Book.
- C. Upon receipt of bids, the Cost Estimator shall prepare a spreadsheet of the Engineer's Estimate (EE) and bid array for review by the PM and the LE/A. Comparison can be used to determine if a low bid meeting or TQH is required or if Recommendation to Award can proceed.
- D. In general, if the low bid is more than 10% higher or lower than the EE, a low bid meeting should be held to ensure that the low bidder understands and has included all work required by the contract and/or to justify the difference in bid price to the EE.
- E. In cases where the low bid is significantly lower than the EE and/or the other bids received, then a TQH should be held in lieu of the low bid meeting.
- F. Prior to the low bid meeting or TQH, the EMS Estimator should prepare a side-by-side comparison of major cost items of the EE and low bidder's Analysis of Bid ([Figure 10-F](#)). Significant differences should be highlighted.

Note: For unit price items; unbalanced unit prices or very low unit prices for certain items could possibly indicate an underestimating of the quantity in the schedule of classified items. The quantities of these items should be checked prior to recommending award. If necessary, the specifications or drawings may need to be modified and the project rebid in order to get better results.

- G. When this low bid is more than 10% higher than the EE, or the EE is more than 25% higher than the average of all bids, a Bid Variance White Paper should be prepared indicating the reason for the difference and justification for recommending award or rejecting bids ([Figure 10-G](#) and [Figure 10-H](#)).
- H. If high bid price cannot be justified, consideration should be given to rejecting bids.

Sample



BID vs. EE COMPARISON

RFK-884-103 Rental Car Site Roadway Improvements - Phase IV Canopy
 Frank Montefus co, PM; Bid Date: 2/4/04; 4 Bidders
 ANALYSIS OF BID

Unit	Descriptions	Engineer's Estimate			1 VRH			2 Conti			3 Arena		
		Qty	Unit \$	Total \$	Qty	Unit \$	Total \$	Qty	Unit \$	Total \$	Qty	Unit \$	Total \$
1	Reproducibles of As-Built Shop Drawings				1	10,000	10,000	1	1,500	1,500	1	9,000	9,000
2	Site Work												
3	LF Architectural Steel Fence - Incl. Excavation, Post, Footing	2,723	106	289,727	2,800	179	500,000	2,989	140	418,460	2,723	238	647,000
4	LF Cast Iron Trench Drain	408	266	108,528	420	714	300,000	441	350	154,550	408	184	75,000
5	LS Remaining Site Work	1	227,525	227,525	1	414,000	414,000	1	512,899	512,899	1	249,000	249,000
6	Canopy Work												
7	SF West Lobby Extension Canopy	825	124	102,369	825	182	150,000	750	225	168,500	825		980,000
8	SF East Lobby Extension Canopy	730	115	83,613	730	205	150,000	817	225	183,823	730		Included
9	LF Linear Canopy - Including Side Drops	156	935	145,797	156	1,103	172,000	150	1,375	206,250	156		Included
10	SF Drop-off/Pick-Up Main Canopy - Including Side Drops	1,646	356	585,921	1,646	152	250,000	1,857	155	287,827	1,646		Included
11	LS Electrical	1	220,220	220,220	1	220,000	220,000	1	265,060	265,060	1	296,000	296,000
12	LS Permanent Traffic	1	36,300	36,300	1	50,000	50,000	1	70,000	70,000	1	19,000	19,000
Total Lump Sum				1,800,000			2,216,000			2,268,869			2,275,000

Total Canopy Only (Item 7 - 10) 917,700 722,000 846,400 980,000

Figure 10-F
 Bid vs. EE Comparison

Sample

(High Bids)
Contract JFK-834.103
JFK – Rental Car Site
Federal Circle Station AirTrain Canopies
Bid Variance White paper

Engineer's Estimate:	\$1,700,000
Low Bid:	\$2,216,000
Bid Variance:	\$ 516,000

The Engineer's Estimate indicated on the attached bid tab was mistakenly shown as \$1.7 million – it should have been shown as \$1.8 million per signed Estimate.

Upon review of our estimate, it was determined that the consultant's estimated cost for the Architectural Steel Fence was underestimated based upon comparison with our prior experience with this type of fence. Discussions with a fence fabricator also confirmed that the consultant's unit price for the fence was too low. The estimate for the fence should have been about \$200,000 higher.

The Engineer's Estimate should, therefore, have been approximately \$2 million. This results in the low bid being about 11% above the Engineer's Estimate.

The top three bidders were within 3% of each other.

In light of the above, I plan on recommending award of the contract pending line department concurrence.

Figure 10-G
Bid Variance White Paper – High Bid

Sample

(Low Bids)
Contract BJ-375
Upper Buss Level
Bearing Plate Replacement
Bid Variance White Paper

Engineer's Estimate:	\$183,000
Low Bid:	\$ 95,700
Bid Variance:	\$ 65,300

Although the subject contract was bid via a Select List, a low bid meeting was held with the low bidder (NAB) to insure that they understood all of the contract requirements.

A major portion (\$60,000) of the difference between NAB's bid and the Engineer's Estimate is related to the jacking of existing beams needed to perform the required repairs. NAB indicated that they have reviewed their estimate and are confident that they can do the work at their bid price. In particular, NAB feels that their plan to reutilize the temporary steel beams for the jacking operation will reduce their costs. They also feel that since they have done this type of work in the past, (at the Tappan Zee Bridge), they can do it very efficiently with their own forces.

Based upon a discussion of the details of the jacking operation, it appears that NAB is aware of all of the contract requirements.

A smaller portion of the difference, about \$15,000, is due to the fact that NAB thought that the removal of existing fireproofing (non-asbestos) was net cost in all areas rather than just at one location. Since some of the existing fireproofing is already missing or loose, NAB feels that this may not be a significant problem.

In light of NAB's good performance in the past, their previous experience on similar type of work and their confidence in their estimate, I will be recommending award to NAB.

Figure 10-H
Bid Variance White Paper – Low Bid

10.5 PROCEDURE C-24 VALUE ENGINEERING

10.5.1 PURPOSE

Value Engineering (VE) is a methodology that applies teamwork and a systematic analysis of function to remove unnecessary costs from a project or process, while maintaining the required characteristics regarding performance, schedule, safety, reliability, maintainability, and customer/user acceptance. It is based on generally accepted VE methodology promoted by the Society of American Value Engineers (SAVE). VE is the same as, and sometimes referred to as, value management, value improvement, or value planning.

10.5.2 APPLICABILITY

Although Value Methodology (VM) is applicable to hardware, building, or other construction projects and to "soft" areas, such as manufacturing and construction processes, healthcare and environment services, programming, management systems, and organization structure, the main purpose for this procedure is the applicability of VM for projects.

The exact trigger point for a VE study is not based so much on the project cost as on the requirement to ensure that the best and most cost-effective design approach has been taken on the project. It may also be undertaken at the request of a client or funding agency. Generally, the larger a project, the more beneficial a VE study will be.

For the best effect, VE studies should take place prior to the Stage III point of a project. This will allow for any necessary changes in design with as little disruption to the project as possible.

10.5.3 VALUE ENGINEERING TEAM

A key to the successful application of a VE study is the skill and experience of those applying the methodology. While the methodology can be and often is used by individuals, for significant projects it has been proven that a well-organized team obtains the best value for effort performed. The team leader performs a key role and is a significant factor in the degree of success. The team leader must have thorough training in both VM and team facilitation. The requirements include strong leadership, communication skills, and experience working with users/clients. In addition, the team leader should be a Certified Value Specialist (CVS).

The size and composition of the team is project dependent. The members should represent a diverse background and experience that incorporates all the knowledge required to fully cover the issues and objectives of the project. Team size is ideally five to seven members. Typically these include cost, estimating, procurement/materials, and those technical disciplines unique to the project, such as architecture, civil, construction, mechanical, and environmental. It is most advantageous for the team leader, or a team member, to implement the approved value proposals at study completion. Decisions based primarily upon one technical discipline will often have significant effects on other disciplines within the project. In addition to being technically competent, team member selection should include individuals who represent the range of disciplines and end users that the study results will impact. They must be individuals who generate positive attitudes and are willing to investigate new ideas and then rationally evaluate them.

10.5.4 VALUE ENGINEERING METHODOLOGY

The VM uses a systematic job plan. The job plan outlines specific steps to effectively analyze a product or service in order to develop the maximum number of alternatives to achieve the product's or service's required functions. Adherence to the job plan will better assure maximum benefits while offering greater flexibility. The job plan should include the following phases.

10.5.5 PRE-STUDY PHASE

This phase occurs prior to the actual VE exercise. During this phase team composition is decided and the goals and objectives are established.

10.5.6 INFORMATION PHASE

The objective of the information phase is to complete the value study data package started in the pre-study work. If not done during the pre-study activities, the project sponsor and/or designer brief the value study team, providing an opportunity for the team to ask questions based on their data research. If a "site" visitation was not possible during pre-study, it should be completed during this phase.

The study team agrees to the most appropriate targets for improvement, such as value, cost, performance, and schedule factors. These are reviewed with appropriate management, such as the Project Manager (PM), value study sponsor, and designer, to obtain concurrence.

Finally, the scope statement is reviewed for any adjustments due to additional information gathered during the information phase.

10.5.7 FUNCTION ANALYSIS PHASE

Function definition and analysis is the heart of VM. It is the primary activity that separates VM from all other "improvement practices." The objective of this phase is to develop the most beneficial areas for continuing study. The team performs the following steps:

- Identify the functions of the project under study using active verbs and measurable nouns.
- Classify the functions as basic or secondary.
- Build a function model or Function Analysis System Technique (FAST) diagram.
- Assign cost and/or other measurement criteria to functions.
- Compare cost to worth of functions to establish the best opportunities for improvement.
- Assess functions for performance schedule considerations.
- Select functions for continued analysis.
- Refine study scope.

10.5.8 CREATIVE PHASE

The object of the creative or speculation phase is to develop a large quantity of ideas for performing each function selected for study. No judgment or discussion occurs during this activity. The quality of each idea will be developed in the next phase from the quantity generated in this phase.

There are numerous well-accepted idea generation techniques that may be used. The guiding principle in all of them is that judgment/evaluation is suspended to allow for the free flow of ideas.

10.5.9 EVALUATION PHASE

The objective of the evaluation phase is to synthesize ideas and concepts generated in the creative phase and to select feasible ideas for development into specific value improvement.

Using the evaluation criteria established during the pre-study effort, ideas are sorted and rated as to how well they meet those criteria.

10.5.10 DEVELOPMENT PHASE

The object of the development phase is to select and prepare the best alternative(s) for improving value. The data prepared for each alternative should provide as much technical, cost, and schedule information as practical so that the designer and project sponsor(s) may make an initial assessment concerning their feasibility for implementation.

The team then begins with the highest ranking alternatives, developing a benefit analysis and implementation requirements including estimated initial costs, life cycle costs, and implementation costs while taking into account risk and uncertainty.

10.5.11 PRESENTATION PHASE

In the presentation phase, the value team presents the results of the value study back to the designers, project sponsor(s), and other management. Through the presentation and its interactive discussions the team obtains either approval or direction for additional information needed.

The follow-up written report documents the alternatives proposed with supporting data and confirms the implementation plan. Specific organization of the report is unique to each study and organization requirements.

10.6 POST STUDY

The objective during the post study period is to assure the implementation of the approved value study change recommendations. Assignments are made either to individuals within the study team or by management to other individuals, to complete the tasks associated with the approved implementation plan.

While the VM team leader may track the progress of the implementation, in all cases the design professional is responsible for the implementation. Each alternative must be independently designed and confirmed, including contractual changes, if required, before its implementation into the project. Further, it is recommended that appropriate post audits are done to verify to management the full benefits resulting from the VM study.

10.7 MISCELLANEOUS

See [Appendix A](#) for a list of preapproved items that are eligible to be bid as classified or unit price.

See [Appendix B](#) for a list of acronyms.

See [Appendix C](#) for list of reference material.

APPENDIX A

PREAPPROVED CLASSIFIED/UNIT PRICE ITEMS

Items
Asphalt milling
Asphalt paving
Clearing and grubbing
Cleats and bollards
Concrete patching and crack repair
Curb repair
DGABC
Dredging
Excavation including borrow, hauling and surcharge
Expansion joint repairs
Fender systems
Mobilization
Pavement patching and crack repair
Pavement removal (other than Milling)
Pile load tests and set ups
Piles and pile caps
Removal of fender systems
Removal of piles
Repair of piles and pile caps
Resetting manholes and catch basins
Rip-rap
Rock removal
Roofing
Shotcrete repairs
Slab concrete repairs
Sod

APPENDIX B

ACRONYMS

Acronym	Description
A-E	Architecture and Engineering
CMD	Construction Management Division
CSI	Construction Specification Institute
CVS	Certified Value Specialist
DD	Design Division
ED	Engineering Department
EE	Engineer's Estimate
EMS	Engineering Management Services
EOL	Engineering OnLine
FAST	Function Analysis System Technique
GC	General Contractor
LE/A	Lead Engineer/Architect
MJ	Memorandum of Justification
P&PW	Present and Planned Workload
PACC	Post Award Contract Change
PM	Project Manager
RE	Resident Engineer
SAVE	Society of American Value Engineers
TL	Task Leader
TQH	Technical Qualification Hearing
VE	Value Engineering
VM	Value Methodology
WBS	Work Breakdown System

APPENDIX C

REFERENCE MATERIALS

- *Standard Practice for Performing Value Analysis (VA) of Buildings and Building Systems*, American Society for Testing and Materials, Publication E-1699-95.
- **[SAVE International](#)**
 - [Annual Conference Proceedings](#):
Includes all presentations given at each annual conference. Also available is a VM bibliography, a compilation of all presentations since 1980, and articles from Value World. Each presentation shows title, author, abstract, and source. Papers can be individually ordered from SAVE International.
 - [Certification & Recertification Manual](#)
 - [Seminar/Workshop Manual](#)
 - [Certification Examination Study Guide](#)