LA-SUB--95-166

Project Time & Cost

PROJECT MANAGEMENT SUPPORT AND SERVICES FOR THE ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

FINAL REPORT
SUBCONTRACT 9-XG-8822F-1

APRIL 10, 1995

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ABSTRACT

The Los Alamos National Laboratory (LANL) Environmental Restoration Technical Support Office (ERTSO) contracted Project Time & Cost, Inc. (PT&C) on 16 November 1992 to provide support services to the U.S. Department of Energy (DOE). ERTSO had traditionally supported the DOE Albuquerque Office in the Environmental Restoration and Waste Management Programs and had also supported the Office of Waste Management (EM-30) at DOE Headquarters in Germantown, Maryland. PT&C was requested to provide project management and support services for the DOE as well as liaison and coordination of responses and efforts between various agencies. The primary objective of this work was to continue LANL's technical support role to EM-30 and assist in the development of the COE Cost and Schedule Estimating (CASE) Guide for EM-30.

PT&C's objectives, as specified in Section B of the contract, were well met during the duration of the project through the review and comment of various draft documents, trips to DOE sites providing program management support and participating in the training for the EM-30 Cost and Schedule Estimating Guide, drafting memos and scheduling future projects, attending numerous meetings with LANL, DOE and other subcontractors, and providing written observations and recommendations.

The results obtained were determined to be satisfactory by both the LANL ERTSO and DOE EM-30 organizations. The objective to further the support from LANL and their associated subcontractor (PT&C) was met. The contract concluded with no outstanding issues.

FINAL REPORT

The Los Alamos National Laboratory (LANL) Environmental Restoration Technical Support Office (ERTSO) contracted Project Time & Cost, Inc. (PT&C) on 16 November 1992 to provide support services to the U.S. Department of Energy (DOE). ERTSO had traditionally supported the DOE Albuquerque Office in the Environmental Restoration and Waste Management Programs and had also supported the Office of Waste Management (EM-30) at DOE Headquarters in Germantown, Maryland. The primary PT&C researcher on this task, Marc A. Zocher, was requested to provide "a wide range of short duration project management support and services for the DOE" as well as "liaison and coordination of responses and efforts between various agencies." A significant amount of support was expected to occur at the DOE Germantown, Maryland location.

PT&C's objectives under this contract, as specified in Section B of the contract, and further described in Appendix B, Statement of Work, consisted of:

1.0 Rapid Response Capability - to provide rapid response project management capability.
2.0 Implementation Review Coordination - to provide implementation review coordination as requested.
3.0 Meeting Attendance - to attend meetings a requested in order to aid in problem identification and solution.
4.0 Project Management Services - to provide program/project management services as requested.
5.0 Reports - to provide reports including findings and recommendations.

Beginning in November 1992, the first task performed under this contract consisted of review and comment on the Draft EM-30 Cost Estimating Guide prepared for the Office of Waste Management. This task was completed on November 19, 1992. The second task included a trip to Richland, Washington to determine needed program management support on the Tank Waste Remediation System (TWRS). This trip involved meetings with Westinghouse Hanford (WHC), LANL, and PT&C personnel. A memorandum was submitted to Gene Higgins (DOE-RL) November 11, 1992 detailing PT&C's observations and recommendations for rebaselining TWRS. Subsequently, a trip was made to Oak Ridge National Laboratory (ORNL) in Oak Ridge, TN to complete this work.

In December 1992, the trip to ORNL by PT&C and LANL personnel involved a review of an independent check estimate (ICE) prepared for the Oak Ridge TSCA Incinerator Operations. A follow-up meeting was scheduled for January 1993. PT&C also assisted the DOE EM-333 personnel in Germantown, MD in drafting memos and scheduling future projects. A meeting was attended by PT&C, LANL and other subcontractors to discuss the EM-30 Cost Guide. PT&C and LANL also attended the first pilot training of the EM-30 Cost Estimating Guide in Kansas City. Additional tasks

included sorting and filing information and data shipped from DOE Headquarters to the PT&C project office in Albuquerque, NM.

The tasks in January 1993 centered around two major activities. The first task involved participation in the training for the EM-30 Cost and Schedule Estimating Guide and associated site visits at DOE in Idaho, Washington and California. The second task involved program management support at DOE-RL on the Tank Waste Remediation System (TWRS) Program at Richland.

Tasks in February 1993 included the participation of PT&C personnel in the EM-30 Cost Guide Training in Albuquerque. PT&C personnel also travelled to EM-30 Headquarter offices in Germantown to begin scheduling the EM-30 Program Cost Reviews (PCRs), continuing the following week at LANL. A preliminary scope document was prepared for the PCRs and meetings were held in Los Alamos to discuss roles and responsibilities. A draft review schedule was prepared based on meetings with eighteen EM-32 Program Managers. PT&C personnel also participated in the EM-30 Industry Support Experts (ISE II) forum in Washington, DC to discuss industry and DOE partnerships.

During March 1993, activity occurred on the review of the EM-30 Cost Guides. At Richland, DOE-RL requested review of the current Purex Plant scope, schedule, and estimates for the shutdown of Purex.

LANL has been able to continue supporting EM-30 as a follow on to this contract. LANL ERTSO representatives provided project management support and policy analysis assistance. This support exceeded the original objective of temporary DOE help as the activity continues from LANL at present.

While no formal publications were made under this subcontract, PT&C personnel provided monthly status reports and frequent memoranda and letters to LANL and DOE-RL personnel reporting project status, observations and recommendations, and presenting prepared schedules, manuals, and scope of work proposals. Copies of the monthly status reports and representative letters/memoranda are attached to this report as Appendix A. Additional materials are available upon request.

The primary objective of this work was to continue LANL's technical support role to EM-30 and assist in the development of the DOE Cost and Schedule Estimating (CASE) Guide for EM-30. The results obtained were determined to be satisfactory by both the LANL ERTSO and DOE EM-30 organizations. The objective to further the support from LANL and their associated subcontractor (PT&C) was met. The contract concluded with no outstanding issues.

APPENDIX A

Project Time & Cost

U.S. Department of Energy
Los Alamos National Laboratory

Project Management Support and Services
for the Environmental Restoration
and Waste Management Program

Contract No. 9-XG3-8822F-1

Monthly Status Report
for November, 1992

January 4, 1993

1990

Project Time & Cost

Status Report for Period Ending November 30, 1992

The subcontract between Los Alamos National Laboratory (LANL) and Project Time & Cost, Inc. (PT&C) was signed in Los Alamos on November 16, 1992.

The total manhours expended during November are:

Principal	0 Hours
Manager	32 Hours
Clerical	0 Hours
Total	32 Hours

This compares with a planned expenditure of 2 hours principal, 40 hours manager, and 20 hours clerical for the time period of November 16 through November 30, 1992.

The first task under this contract consisted of review and comment of the draft EM-30 Cost Estimating Guide prepared for the Office of Waste Management. This task was completed on November 19, 1992.

The second task involved a trip to Richland, WA with LANL to determine needed program management support on the Tank Waste Remediation System (TWRS). This trip began on November 17, 1992 and ended on November 19, 1992. This trip involved meetings with Westinghouse Hanford (WHC), LANL, and PT&C personnel.

The third task involved the start of a trip on November 30, 1992 to Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. The details of this task are covered in the December monthly report.

Locations Visited:	Dates:
Los Alamos National Laboratory	11/16
Hanford Site, Richland, WA	11/17 - 11/19
Oak Ridge National Laboratory	11/30

Project Time & Cost

U.S. Department of Energy
Los Alamos National Laboratory

Project Management Support and Services
for the Environmental Restoration
and Waste Management Program

Contract No. 9-XG3-8822F-1

Monthly Status Report
for December, 1992

January 4, 1993

Project Time & Cost

Status Report for Period Ending December 31, 1992

This subcontract, signed November 16, 1992, was in effect for the full month of December. The total manhours expended during December are:

Principal	0.0 Hours
Manager	131.0 Hours
Clerical	17.5 Hours
Total	148.5 Hours

This compares to a planned rate of 4 hours principal, 88 hours manager, and 40 hours clerical for the time period of December 1 through December 31, 1992. Although LANL is officially closed from December 25, 1992 through January 3, 1993, PT&C was operating during that time.

The first task for December was a meeting at Oak Ridge National Laboratory (ORNL) on December 1, 1992. This meeting involved the review of an independent check estimate (ICE) prepared for the Oak Ridge TSCA Incinerator Operations. This all day meeting resulted in follow-up discussions and a plan to meet again in January, 1993.

The second task began on December 2, 1992 and involved work at DOE Headquarters in Germantown, MD until December 4, 1992. This task included items under subcontract category 1.0 Rapid Response Capability, and 3.0 Meeting Attendance. The PT&C Manager assisted the DOE EM-333 personnel in drafting memos and scheduling future projects. On Friday, December 4, 1992, a meeting was held at the Bellemead building in Germantown, MD to discuss the EM-30 Cost Guide. This meeting was attended by representatives from PT&C, LANL, and other subcontractors.

The third task accomplished at various times during December included sorting and filing of information and data shipped from DOE Headquarters in Germantown, MD to the PT&C project office in Albuquerque, NM.

The fourth task involved a trip to the Kansas City Plant on December 9, through December 11, 1992. This was also attended by a LANL representative. The purpose of the trip was to attend the first pilot training of the EM-30 Cost Estimating Guide.

Project Time & Cost

The fifth task commenced on December 14, 1992 and involved a two day meeting with EM-30 and EM-60 personnel (DOE and contractor) at Hanford. This series of meetings involved the transfer of landlord activities from EM-30 to EM-60 and was run by Jim Keenan (EM-34).

The sixth task involves continued program support for the Hanford Tank Waste Remediation System (TWRS) and began with another trip to Hanford on December 20 through December 23, 1992. This trip was specifically planned to outline additional help from LANL to DOE/RL and involved meetings, briefings, and discussions with Westinghouse Hanford and DOE/RL.

The last task for December was the first activity under the TWRS plan that began December 23, 1992 and involves the writing of a TWRS specific cost guide. This task will continue in January, 1993.

Locations Visited:	Dates:
Oak Ridge National Laboratory	12/01
DOE Headquarters, Germantown, MD	12/02 - 12/04
Kansas City Plant	12/09 - 12/11
Hanford Site, Richland, WA	12/14 - 12/16
Hanford Site, Richland, WA	12/20 - 12/23

PROJECT TIME & COST, INC.
6501 Americas Parkway, N.E.
Suite 665
Albuquerque, New Mexico 87110
(505) 884-2929
FAX (505) 884-7672

Project Time & Cost

February 01, 1993

University of California
Los Almaos National Laboratory
ATTN: R.N. Tokay
REF: 9-XG3-8822F-1
P.O. Box 990 MS P274
Los Alamos, New Mexico 87545

Dear Ron:

Enclosed is the monthly report for January, 1993 under subcontract No. 9-XG3-8822F-1 which originated November 16, 1992.

If you have any questions, please do not hesitate to call.

Sincerely,

PROJECT TIME & COST

Marc A. Zocher
Manager, Western Operations

Enclosures

cc: Gary Thompson, LANL

MAZ:lj

U.S. Department of Energy
Los Alamos National Laboratory

Project Management Support and Services for the Environmental Restoration and Waste Management Program

Contract No. 9-XG3-8822F-1

Monthly Status Report for January, 1993

February 1, 1993

Status report for Period ending January 31, 1993

This subcontract, signed November 16, 1992, was in effect for the full month of January. Total manhours expended during January are:

Principal	3.0 Hours
Manager	159.0 Hours
Clerical	60.0 Hours
Total	222.0 Hours

This compares to a planned rate of 4 hours principal, 88 hours manager, and 40 hours clerical for the time period of January 1 through January 31, 1993.

The tasks in January centered around two major activities. The first task involved participation in the training for the EM-30 Cost and Schedule Estimating Guide and associated site visits at DOE in Idaho, Washington and California (see Locations Visited). This was a planned and scheduled activity, and will continue in February.

The second task involved program management support at DOE-RL, specifically on the Tank Waste Remediation System (TWRS) Program at Richland. This task was approved as an activity by EM-TSO in conjunction with DOE-HQ. Approximently 60% of the hours worked in January are associated with that task. TWRS work has stopped, by direction of LANL EM-TSO, on Friday, January 29, 1993, and will continue in February if work authorization is received.

Locations Visited	Dates
Idaho Falls, ID (DOE-ID)	1/4 - 1/5
Richland, WA (DOE-RL)	1/6 - 1/7
Richland, WA	1/12 - 1/16
Richland, WA	1/18 - 1/20
Oakland, CA (DOE-SAN)	1/21 - 1/22

PROJECT TIME & COST, INC.
6501 Americas Parkway, N.E.
Suite 665
Albuquerque, New Mexico 87110
(505) 884-2929
FAX (505) 884-7672

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March 5, 1993

University of California
Los Alamos National Laboratory
ATTN: R.N. Tokay
REF: 9-XG3-8822F-1
P.O. Box 990 MS P274
Los Alamos, New Mexico 87545

Dear Ron:

Enclosed is the monthly report for February, 1993 under subcontract No. 9-XG3 -8822F-1 which originated November 16, 1992. We have continued to provide services under this contract at an accelerated rate due to the tasks assigned by LANL EES-14. We will keep Gary Thompson appraised of the situation to avoid any cost overruns.

If you have any questions, please do not hesitate to call.

Sincerely,

PROJECT TIME & COST

Marc A. Zocher
Manager, Western Operations

MAZ:bg

Enclosure

cc: Gary Thompson, LANL

U.S. Department of Energy
Los Alamos National Laboratory

Project Management Support and Services for the Environmental Restoration and Waste Management Program

Contract No. 9-XG3-8822F-1

Monthly Status Report for February, 1993

March 5, 1993

Status Report for Period Ending February 28, 1993

The subcontract between Los Alamos National Laboratory (LANL) and Project Time & Cost, Inc. (PT&C) was signed in Los Alamos on November 16, 1992.

The total manhours expended during February, 1993 are:

Principal	3.5	Hours
Manager	148	Hours
Clerical	8	Hours
Total	159.5	Hours

The first task for February involved the participation in the EM-30 Cost Guide training in Albuquerque. This was the last planned session and follows other sessions attended at Idaho, Richland, and San Francisco under this contract.

The second task involved travel to EM-30 Headquarter offices in Germantown to begin to schedule the EM-30 Program Cost Reviews (PCR's). This task continued the following week at LANL. A preliminary scope document was prepared for the PCR's and meetings were held at Los Alamos to discuss roles and responsibilities. This task continued the following week and a draft review schedule was prepared based on meetings with eighteen EM-32 Program Managers.

The third task involved participation in the EM-30 Industry Support Experts (ISE II) forum in Washington, DC. The meeting was held to discuss industry and DOE partnerships.

Locations Visited:	Dates:
Albuquerque, NM - EM-30 Cost Training	2/2 - 2/3
Los Alamos National Laboratory	2/16 - 2/19
Germantown, MD	2/7 - 2/12 and 2/22 - 2/26

PROJECT TIME & COST, INC.
6501 Americas Parkway, N.E.
Suite 665
Albuquerque, New Mexico 87110
(505) 884-2929
FAX (505) 884-7672

Project Time & Cost

April 12, 1993

University of California
Los Alamos National Laboratory
ATTN: R.N. Tokay
REF: 9-XG3-8822F-1
P.O. Box 990 MS P274
Los Alamos, New Mexico 87545

Dear Ron:

Enclosed is the monthly report for March, 1993 under subcontract No. 9-XG3 - 8822F-1 which originated November 16, 1992. Activity slowed for the month of March due primarily to the slippage of the Program Cost Reviews in EM-30.

If you have any questions, please do not hesitate to call.

Sincerely,

PROJECT TIME & COST

Marc A. Zocher

Marc A. Zocher
Manager, Western Operations

MAZ:bg

Enclosure

cc: Gary Thompson, LANL

U.S. Department of Energy
Los Alamos National Laboratory

Project Management Support and Services for the Environmental Restoration and Waste Management Program

Contract No. 9-XG3-8822F-1

Monthly Status Report for March, 1993

April 12, 1993

Status Report for Period Ending March 31, 1993

The subcontract between Los Alamos National Laboratory (LANL) and Project Time & Cost, Inc. (PT&C) was signed in Los Alamos on November 16, 1992.

The total manhours expended during March, 1993 are:

Principal	0	Hours
Manager	71	Hours
Clerical	1	Hours
Total	72	Hours

Activity slowed on the contract due to the slip in the schedule for the Program Cost Reviews (PCRs) planned to start in March. Activity occurred on the review of the EM-30 Cost Guides. This work was originally planned for February, but slipped out due to the heavy workload on other tasks.

At Richland, DOE-RL requested review of the current Purex Plant scope, schedule and estimates for the shutdown of Purex. This activity will conclude in April with a status report and recommendations.

Locations Visited:	Dates:
Richland, WA	3/24 - 3/26 3/31 - 4/02

INFORMAL MEMORANDUM

November 19, 1992

TO: Gene Higgins, DOE-RL

FROM: Marc Zocher, Project Time & Cost
Gary Thompson, LANL

RE: OBSERVATIONS AND RECOMMENDATIONS

Thank you for the opportunity to come visit TWRS and look at the major project you have underway in the rebaselining of TWRS. The staff from WHC was helpful and the visit quite productive.

The following observations were made:

- Presently, no real overall baseline exists for TWRS
- A dedicated team has been formed to address the rebaselining
- The TPA is the primary driver for the schedule, and DOE is the primary customer for the rebaselined product
- The WHC financial system is robust enough to handle major project control issues
- A culture change needs to occur, training needs to happen, and the end result is a site with self-sustaining resources to manage, plan, estimate, and schedule TWRS activities
- site specific procedures are needed to maintain continuity and have a base for understanding customer requirements
- A rebaseline will be successful if 1) the effort meets the stated goals this year and, 2) procedures and resources are in place to replicate the activity in the future

The following recommendations are based on observations to date:

- Develop one representative ADS through to completion in the early January timeframe (In parallel, keep the effort on the other end functions moving). Present

INFORMAL MEMORANDUM

January 7, 1993

Via Facsimile

TO: Renee Finke, WHC

FROM: Marc Zocher, Project Time & Cost

RE: **Draft TWRS Cost Estimating Guide**

I am forwarding the first sections of the TWRS Cost Estimating Guide for your review. As you know, we originally agreed to a date of January 5, 1993 for delivery of the first draft, and the inclusive dates of January 3-7 were set aside for activities directed by EM-333. The current planned schedule slip is based on the loss of three working days during the week of December 29. Approximately 40% of the text and thinking is complete to date, and 90% of the TWRS material review was competed prior to January 1. I have also started development of the slides and handouts for the class next week.

I need some information from you that will assist me in continuing both the presentation and the guide. Specifically -

- What is the desired length of the training? I am planning for two hours with one additional hour for questions. Please redirect duration, if needed.
- How large and who is the intended audience? Will I need to give a short briefing on the HQ guidance prior to the talk?
- Please choose one real TWRS activity that would make sense for an example for the class. Does any one stand out in your mind as a representative ADS?
- I briefly met and spoke with the gentleman (Lynn McMahn {sp}) from Mactec about the "desktop guide" he is preparing. Could you get some more information on that effort and how it relates to this guide? If you wish, just send me his phone number and I will call him.
- I am also sending you a copy of the latest review criteria that will need comments and modification to fit TWRS and section 6 of the Guide. Please review and comment on this section as well.
- The agreed date for the training was Wednesday the 13th. Gary indicated that Thursday might be acceptable to you, and you said that Fridays are not great. What is your preference?

I will be unavailable on Friday morning, but you can fax answers/comments to (505) 829-3143. I will not know my schedule for next week until the afternoon (Based on AM appointment). You can also reach my secretary at (505) 884-2929 and I will call in for messages.

I understand from Gary Thompson that the current agreement with EM-333 is to allow funding for this project to continue until January 15, 1993. Any help you can lend to that process is greatly appreciated, since I currently do not have any internal help under contract to provide assistance on this project.

CC:
Gary Thompson, LANL EM-TSO
Gene Higgins, DOE-RL
Ken Roberts, PT&C

Outline Draft 1.0

TWRS Cost Estimating Handbook
for Operations Activities

I. Introduction
- Purpose
- Intended Audience
- Introduction to Cost Estimating for TWRS ~~Operations~~

II. General Requirements

Description of the overall estimating requirements for TWRS and the role of estimates in the planning process.

III. Scoping TWRS Activities

Includes the importance of estimate back-up documentation, the type of information required, and the formats for input.

IV. Scheduling TWRS Activities

This section covers scheduling as it relates to the estimating process. In-depth discussion of scheduling will not be addressed.

V. Estimating TWRS Activities

The primary focus of the document, this section will cover the application of ABC estimating to TWRS ~~operations~~ ACTIVITIES.

VI. Self-assessment Criteria and Process

This section deals with the SPET ~~new~~ peer review concept and sets up criteria for checking the completeness and quality of the TWRS estimates.

VII. Example estimate

A TWRS estimate, on the appropriate forms, will be included to illustrate the concepts outlined in the guide.

Appendix A.

TWRS Activity Dictionary

PROJECT TIME & COST, INC.
6501 Americas Parkway, N.E.
Suite 665
Albuquerque, New Mexico 87110
(505) 884-2929
FAX (505) 884-7672

Project Time & Cost

January 29, 1993

Westinghouse Hanford Company
TWRS Baseline Development Team
1305 Mansfield, Suite 6
Richland, WA 99352

Attention: Ms. Renee Finke

Subject: DRAFT MANUALS

Dear Renee:

Transmitted herewith is the first draft of the Tank Waste Remediation System Cost Estimation Manual. I have put under separate binder, the Cost Estimate Validation and Reviews and Cost Estimation Standards and Practices. I would appreciate you giving one set to DOE RL for their concurrent review.

As you and I have discussed, I would appreciate comments back no later than Monday, February 8, 1993. This will allow you a full work week to review the documents.

I have not yet completed a full sample estimate for your review. I would like to use a real TWRS example because the generic estimate I have produced on tank farms will not contain activities familiar to preparers of the TWRS estimates. I feel that a sample estimate is best completed in Richland when I come up to complete the task with Len McMahon on the desk-top audit section.

If you have any questions, please do not hesitate to contact me.

Regards,

PROJECT TIME & COST

Marc J. Zocher
Manager,
Western Operations

cc w/a: Gary Thompson, LANL EM-TSO

DRAFT

U.S. Department of Energy
DOE Hanford Reservation

Tank Waste Remediation System
(TWRS)

COST ESTIMATION MANUAL

- Cost Estimate Validation and Reviews -

Draft 1.0

January, 1993

TITLE:

COST ESTIMATE VALIDATION AND REVIEWS

Approved by

XXXX, Manager
XXXX

1.0 PURPOSE

To introduce the policies, practices and methods for conducting self-assessment and cost estimate reviews by Westinghouse Hanford Company on the TWRS baselines. These methods include peer review, mock review, independent check estimates, benchmarking and other self-assessment techniques. The ultimate purpose of employing these techniques is to arrive at credible, defensible cost estimates that meet WHC quality objectives on an ongoing basis. Other techniques for assessing project performance against a baseline, such as desk performance audits on milestone or cost element attainment, are also included.

A central theme of the internal assessment and review process promoted by DOE EM-30 is the desirability of capturing issues, findings, and recommendations from lower level reviews and passing such information up to the next highest level of review. Higher level reviews in the past were often conducted by reviewers who did not have access to the results of lower level reviews. This practice, partially the result of review schedule constraints and partially the result of poor communication, often resulted in the same issues being covered by several different review organizations and in lower and higher level reviews being conducted at a similar level of detail.

A cost estimate review, as defined in DOE Order 5700.2D is:

> "a review of a previous estimate for completeness, reasonableness, and consistency. The completeness relates to the inclusion of all relevant costs. Reasonableness relates to a balance between discernible optimism and pessimism in the estimate. Consistency relates to the general acceptability of applied ground rules or the employment of the same methods in going from one estimate to another. A review may be accomplished by comparing the estimate to an independent estimate; however, reviewers generally will not have these available. Therefore, cost reviewers will generally use such tools as historical rules of thumb to check unit prices, parametric cost estimating relationships, and sampling. Also, the estimate can be examined for appropriateness and consistency."

1.1 Applicability

This section is applicable to all planned work activities under the TWRS Division Charter (09/03/92). This includes the Waste Tank Project, Tank Waste Safety and Technology, Tank Waste Disposal, TWR Projects/HWVP, TWR Program Integration, and Business Management and Administration. Both TWRS program and project elements are covered.

2.0 SCOPE

The major self-assessment techniques described herein are peer review, mock review, check estimates, benchmarking, and desk performance audits. All five methods can be employed singularly or in concert depending on the size and complexity of the work elements under review.

3.0 PEER REVIEWS

The use of a peer review process was suggested in the Office of Waste Management (EM-30) Cost and Schedule Estimating Guide, Working Draft (12/08/92) as a means of checking estimate format and content quality. The guidance for conducting independent estimate reviews (ICERs) in the *General Procedures for Preparing Cost and Schedule Estimates and Conducting Independent Estimate Reviews for the Five-Year Plan* is the same as the definition for a peer review, described below. When conducting the peer review, no less than 80% of the cost numbers should be reviewed for any given estimate.

3.1 Definition

A peer review is a review conducted by a group of estimators and technical advisors that did not work on the original estimate, but are an advocate of the activity. For TWRS, this would include team members from both Westinghouse Hanford and contractors to Westinghouse, as appropriate.

3.2 Purpose

The primary purpose of the peer review is to provide an internal, quality control mechanism on the production of TWRS estimates. The secondary purpose is to provide a peer review document that is then available for other internal and external reviewers to base their reviews on. This will allow for more productive reviews from other parties and an audit and quality control trail on the TWRS estimates.

3.3 Procedure

The peer review procedure is based on a standard review checklist as shown in Appendix A. This checklist is used to document the basis, type, and preparation of the scope, schedule and cost components of the estimate. It is possible to review just one component, such as scope, at one peer review session. The interaction of the three components (scope, schedule & cost) cannot be ascertained using that method, however.

The procedure is broken into the following activities:

- o determining the estimate(s) that will be reviewed;
- o selecting the peer review team, including team leader and report generator;
- o creating a short scope and schedule of the peer review;
- o scheduling the review session;
- o studying the estimate material, including back-up documentation and summary information (such as the Activity Data Sheet);
- o preparing for the meeting;
- o conducting the review meeting; and
- o preparing and disseminating the peer review report.

The review meeting duration will depend on the number of estimates under review, as well as the scope (full or partial) of the review. As a rule, one-half to one hour should be spent briefing the review team on the history and background of each estimate to be reviewed. The checklist should be completed prior to the review by the individuals being reviewed (defenders) so that each section can be examined in an expeditious and thorough

manner by the peer review team. The review can then proceed based on exception to compliance and an explanation of areas of noncompliance within the review criteria. As an example, the question may ask for the estimate specific Work Breakdown Structure (WBS) and the defenders will have it available for review. By having the checklist ahead of time, these questions can be anticipated and the response organized by the defending group. If an answer is "No" or "N/A" to a question, the teams should be prepared to discuss and explain these answers.

3.4 Documentation Requirements

A report shall be prepared after each peer review and one copy shall remain with the cost estimate as a record of the review. The report will contain:

- o the name of the team members;
- o the date, agenda, scope and reason for the review;
- o the name and date of the report preparer;
- o a general description of the scope, schedule and estimate;
- o a list of findings;
- o a list of recommendations based on those findings;
- o an appendix with the completed review sheets; and
- o an appendix with the resumes and qualifications of the review team members.

4.0 MOCK REVIEWS

The word "mock" is used to show that this review is conducted under the exact conditions of an upcoming review or validation, except that the parties conducting the review are internal personnel assigned in the role of "reviewers". If a different checklist will be used for the upcoming reviews (as is often the case), this checklist should be obtained as soon as possible and used in the mock review. The idea is to simulate the review to both enhance the quality of the estimate and to try out communication techniques and documentation formats.

4.1 Definition

A mock review is an internal review with the sole purpose of gauging readiness for an upcoming internal (e.g., DOE-RL) or external (e.g., OMB) review or validation. It is conducted as a two team approach whereby one team takes on the reviewer role while the actual team that will be reviewed in the upcoming session participates as if the actual review was being conducted.

4.2 Purpose

As stated in 4.1, the primary purpose of the mock review process is to assess readiness for upcoming internal or external reviews. The expected outcome of a mock review is a better understanding of areas of deficiencies that are either programmatic or specific to one estimate under review. It should be conducted after a peer review has been completed on the estimate and the peer review findings have been incorporated. By showing a corrective action plan on the remaining findings from the mock review, the negative findings on the real review can be minimized.

4.3 Procedure

Depending on the size and scope of the upcoming review, the mock review will be conducted in a very similar manner to the peer review procedure outlined in Section 3.3, with the following exceptions:

- o the mock review will be based on the past peer review;
- o the mock review will include a session on how the estimate would be rated, and why;

- o an executive summary will be created that will explain the original estimate, the peer review findings and the corrections made to date on the estimate package; and
- o a plan for corrective measures will be developed, scheduled, approved and made available for the upcoming review team.

4.4 Documentation Requirements

The documentation required for the mock review will differ from the peer review only slightly. Similar to the peer review, it will include:

- o the name of the team members;
- o the date, agenda, scope and reason for the review;
- o the name and date of the report preparer;
- o a general description of the scope, schedule and estimate;
- o an appendix with the completed review sheets; and
- o an appendix with the resumes and qualifications of the review team members.

Rather than a section on recommendations and findings, the mock review will list each recommendation with a plan, including schedule and responsibilities, for correction of each finding. This is based on the premise that, due to the upcoming review, the time to complete these tasks prior to review will be limited. Again, by showing a corrective action plan, the negative findings on the real review can be minimized.

5.0 CHECK ESTIMATES

A check estimate differs radically from the normal estimate review process because a second estimate is prepared and compared to the original estimate. This is time consuming, but often worth the effort since a comparative basis adds to the credibility of the original estimate. The checklist (Appendix A) is not used - a separate estimate is prepared following the procedures in the *TWRS Cost Estimating Standards and Practices* Guide.

5.1 Definition

From DOE Order 5700.2D, a check estimate is:

> "a validating estimate. Its development and use is similar to an independent cost estimate, except it is developed by program/project or DOE Field Office personnel or their supporting contractor. A check estimate should be developed by someone who had no involvement in the original estimate, but who may be an advocate of the project."

5.2 Purpose

The primary purpose of the check estimate is to validate the reasonableness, completeness, and consistency of the original estimate. It also serves to corroborate assumptions and scope interpretation since both estimates are prepared from the same scope. Weaknesses in the scope documentation, schedule logic and cost estimate can be located by this direct comparison.

5.3 Procedure

Following standard estimating methodologies, prepare a cost estimate and schedule separate from the original

estimate for the program element or project. Use the same scope, assumptions and WBS to provide a framework for comparison of similar activities. Ensure that the estimate is consistent with DOE Order 5700.2D and in accordance with FAR 15.804, "Cost and Price Data Analysis", as applicable.

To choose a correct estimate methodology, refer to the *TWRS Cost Estimation Manual, Cost Estimating Standards and Practices*. Once the estimate is complete, a comparison will be made at the activity level for each activity shown in both estimates. Any activity with a +/- 10% deviation in labor hours or total cost should be explained and documented. A reconciliation report will show the two estimates and the final, "go forward" estimate that may include parts from each (the original and check estimate).

5.4 Documentation Requirements

The primary documents that are required are the complete check estimate and the reconciliation report. The complete estimate shall include all the estimate work sheets, summary sheets, scope, schedule and back-up documentation necessary to provide an activity by activity comparison of the estimates.

The reconciliation report shall have two sections. The executive summary shall contain the planned disposition of the estimate and explain how the final number was achieved. The appendix will contain an activity by activity comparison of the two estimates, and variance reports for those outside the activity thresholds (see 5.3). This report shall remain with the estimate file for future reference.

6.0 BENCHMARKING

In increasing use as an analytical tool in private industry, benchmarking is a way to verify the planning of a discrete activity or product, and using that comparison to arrive at the best possible plan. As an example, TWRS may wish to compare an activity such as tank maintenance to three or four other private firms or governmental agencies and see if productivity, materials, and other costs are in line with the TWRS predicted costs (estimates).

Not all activities within TWRS can be benchmarked due to the research nature and first-of-a-kind technologies employed in some of the activities within TWRS. For those activities that can, benchmarking is a powerful tool for picking up the best methods used in industry, and checking productivity at the same time. Most reviewers see benchmarking as a very solid technique for program justification, although it should be conducted as part of an overall peer review program.

6.1 Definition

Borrowed from the glossary of land surveying, a benchmark is a point of reference, clearly delineated so that measurements can be taken from that point of reference. As it applies to the TWRS Baseline, the verb "benchmarking" is the activity of supplying a point of reference to the program from an external source so that the TWRS estimate is compared and validated.

6.2 Purpose

The purpose of a benchmarking exercise is twofold. First, by looking at other practices and procedures in industry, it is possible to "glean" the best methods and practices for that activity within TWRS. This leads to a more cost effective, modern program. Second, the reasonableness of each activity can be verified. If four other industries produce the same service for essentially the same cost, and the TWRS activity is 50% higher, that

activity will need further research. It may be that the additional costs are justified. If, all things being equal, the TWRS activity is the same as the compared activities except for compliance to a DOE Order, it may be that the additional costs are due to compliance to that order, and no estimate modifications are required.

In any case, this self-assessment technique allows TWRS to take a proactive management posture and streamline the TWRS Program.

6.3 Procedure

The procedure, in order, that must be followed to produce a benchmark analysis is:

- to select an appropriate activity to benchmark;
- to decide on parameters that should be compared (e.g., labor hours vs. labor hours);
- to research firms, other laboratories or other agencies that also perform that activity at about the same scale and scope;
- to visit these facilities that would allow the study; and
- document and record the parameters from a benchmark checklist, and prepare a benchmark analysis report.

In preparing the estimate, benchmarking follows the allowable "specific analogy technique". The estimate is developed, and adjustments are made to known costs to account for differences in relative complexities of performance, design, and operational characteristics.

It is important to recognize that cost vs. cost may not be an accurate picture of two operations. The overhead, contingency, labor rates and other factors will influence a summary cost comparison. The preferred method is to compare labor hours to labor hours, material unit costs, percentages of training time, impact of safety requirements, and other measurable quantities.

An appropriate activity may be standard surveillance, security, sampling, analysis, site maintenance, filter replacement, monitor well development, and so on. Remember that comparisons should be made as close to TWRS scope as possible. The development of a monitoring well, for instance, should compare the same type of well, dug for similar purpose to roughly the same depth, and in very similar geological strata.

6.4 Documentation Requirements

The benchmark checklist is a tool to document the actual or estimated costs for the similar activity being benchmarked. The key is to use the same checklist from site to site so that direct comparisons are made. For instance, if a comparison is made on barrel purchase costs, the cost (discount) may be affected by the quantities purchased by that industry in a given time period. The checklist should capture the "quantity purchased" data as part of the head-to-head comparison.

Due to the specific nature of each activity being benchmarked, development of one master checklist is not feasible. As a rule of thumb, capture all scope, schedule and estimate items that you would normally need to prepare a detailed cost estimate, and you will have the correct data elements that you need to capture in the benchmark exercise.

The second part of the report should contain the analysis of the data gathered, findings and recommendations. This document should include an action plan, if necessary, based on the results of the findings. It should also be kept with the estimate for future reference.

7.0 DESK PERFORMANCE AUDITS

[Per phone conversation 1/27/93, Len M. to provide detail or will be pulled together in Richland in February]

8.0 REVIEW PERFORMANCE CRITERIA

The conduct of any review must be based on accepted and understood performance criteria. The following criteria contained in Appendix A, TWRS Master Checklist, is a synopsis of:

- The EM-30 Validation Guidelines (used in FY 1992)
- The EM-30 Validation Guidelines (planned for FY 1993)
- The EM-30 Cost and Schedule Estimating Guide, Working Draft, Appendix F.
- FY 1995 Project Review/Validation Criteria (PR-241, November 19, 1992)

This criteria describes the acceptable level of documentation, performance, and content of the scope, schedule and cost elements of the TWRS Program.

APPENDIX A

TWRS MASTER CHECKLIST

ADS Number: _____

WBS Number: _____

Program Name: _____

_____

Program Location: _____

Program Manager: _____

Review Date: _____

Review Location: _____

Reviewer's Names
& Organizations:

_____

_____

_____

_____

Review Type:
(circle one)

Peer Review

Mock Review

A. Planning **Yes No N/A**

1. Has the site waste management mission been defined and summarized in the Planning Documentation?
   Comments:_____

2. Is the planning methodology used to develop the program definition described in the Planning Documentation?
   Comments:_____

3. Are the major elements of the program defined and consistent with overall site mission and program goals?
   Comments:_____

4. Has the DOE EM programmatic and contractor WBS applicable to the program been identified?
   Comments:_____

5. Does the WBS conform the EM-30 approved WBS, and show each ADS and TDD?
   Comments:_____

6. Is the level of detail of the DOE programmatic and contractor WBS Dictionary and WBS Index in the documentation for the program sufficient to allow a review of specific broad-level elements of the program?
   Comments:_____

7. Does the Master Schedule show the ADS and TDD activities within the context of an overall TWRS Program?
   Comments:_____

A. Planning (Continued) **Yes No N/A**

8. Does the Master Schedule contain DOE HQ controlled milestones?
Comments:_____
_____
_____

9. Does the Master Schedule contain DOE Field Office controlled milestones?
Comments:_____
_____
_____

10. Has a Responsibility Assignment Matrix (RAM) been developed based on the DOE EM programmatic and contractor WBS and organizational structure for the program identified during the planning process?
Comments:_____
_____
_____

11. Has a Document Hierarchy been developed for the program?
Comments:_____
_____
_____

12. Have document control procedures been developed and implemented?
Comments:_____
_____
_____

13. Are planning change control documentation and planning and programming history documentation available for review?
Comments:_____
_____
_____

14. Does the ADS completely identify all legal drivers (title, section, para.)?
Comments:_____
_____
_____

A. Planning (Continued) **Yes No N/A**

15. Have regulatory drivers and constraints and other internal and external drivers and constraints relevant to the work to be performed been identified and included in the Planning Documentation?
Comments:_____
_____
_____

B. Technical Scope

1. Is the scope of the estimate consistent with an overall installation Mission Plan, Operations Plan, or similar technical baseline document?
Comments:_____
_____
_____

2. The scope of the estimate is:
____ A. Highly speculative.
____ B. Moderately speculative.
Comments:_____
_____
_____

3. Identify basis of scope (P = Primary; S = Secondary)
____ A. Historical practices/related site experience(s).
____ B. Best engineering/professional judgement (no related site experience).
____ C. State/EPA/DOE approved compliance agreement(s).
____ D. Applicable environmental legislation (CERCLA, RCRA, CAA, etc.).
____ E. Internal DOE Mission statement or directive.
Comments:_____
_____
_____

B. Technical Scope (Continued) **Yes No N/A**

4. Has a complete Technical Scope Documentation, including the following elements, been prepared for the program?
___Description of the work to be performed;
___End condition or end product of work;
___Performance criteria and requirements;
___Discrete tasks and deliverables;
___Resource requirements;
___Sequence of events and discrete milestones;
___Performance methodology and task plans; and
___Work not included in the scope.
Comments:_____
_____
_____

5. Are the major assumptions used in developing the technical scope for the program clearly identified and justified in the Technical Scope Documentation?
Comments:_____
_____
_____

6. Are Technical Logic Diagrams and/or Process Flow Diagrams, where appropriate, included in the Technical Scope Documentation?
Comments:_____
_____
_____

7. Have Milestone Log and Milestone Description Sheets been developed that contain descriptions of each milestone associated with the program?
Comments:_____
_____
_____

8. Is the rationale used to develop task descriptions and logic diagrams, milestones, and resource requirements explained in the Technical Scope Documentation?
Comments:_____
_____
_____

B. Technical Scope (Continued) **Yes No N/A**

9. Does the Technical Scope Documentation for the program include specific activities associated with the work to be performed and activity-based resource descriptions?
Comments:_____

10. Has an Activity Dictionary been developed for the program, including detailed descriptions of activities associated with the work to be performed?
Comments:_____

11. Does the Technical Scope Documentation for the program include descriptions of support activities (e.g., occupational health and safety, quality assurance, security, etc.) associated with the work to be performed?
Comments:_____

12. Are back-up documentation (such as production or waste management plans, process technical and engineering data, process output or throughput projections, and historical operating data) available for review, used in scope development, and referenced in the Technical Scope Documentation?
Comments:_____

13. Is the technical scope for the program consistent with the site mission, regulatory drivers and constraints, and internal and external drivers and constraints (e.g., consent orders, permit conditions, regulations, orders, etc.) identified during the planning process?
Comments:_____

C. Cost Estimate | **Yes** | **No** | **N/A**

1. When was the current cost estimate prepared?
   Comments:_____
   _____
   _____

2. Has the estimate been revised/updated? Why?
   Comments:_____
   _____
   _____

3. Was the cost estimate independently peer reviewed by the M&O contractor? What documentation exists? What methodology was used? When?
   Comments:_____
   _____
   _____

4. How would you characterize the maturity of the estimate?
   Comments:_____
   _____
   _____

5. Is the estimate detail commensurate with the level of requested funding?
   Comments:_____
   _____
   _____

6. Are historical cost data included in the cost estimate for the activities for which costs have been estimated?
   Comments:_____
   _____
   _____

7. Do the historical data used to prepare the cost estimate show each activity costed and show the cost of conducting that activity, broken down into the quantity associated with each activity and the labor cost, material cost, and other costs incurred per unit quantity?
   Comments:_____
   _____
   _____

C. Cost Estimate (Continued) **Yes** **No** **N/A**

8. Are indirect, overhead, or other costs that are distributed among activities included in the cost estimate clearly and individually identified?
Comments:_____
_____
_____

9. Are direct costs that are associated with individual activities included in the cost estimate clearly and individually identified?
Comments:_____
_____
_____

10. Are the indirect labor costs used throughout the cost estimate approved and audited, and appropriately and correctly identified?
Comments:_____
_____
_____

11. Are unit labor costs broken down into direct costs and indirect costs?
Comments:_____
_____
_____

12. Has the cost estimate been updated in a timely manner in response to relevant changes in its basis, background data, or assumptions?
Comments:_____
_____
_____

13. Are an appropriate Change Control Document and an Estimate Development History attached to the cost estimate?
Comments:_____
_____
_____

C. Cost Estimate (Continued) **Yes No N/A**

14. Does the Estimate Development History include an itemized and chronological list of the changes made to the cost estimate since initiation of its preparation, and the rationale for each change?
Comments:_____
_____
_____

15. Is an Estimate Purpose Statement included in the cost estimate? Does the Estimate Purpose Statement clearly describe the purpose of the estimate?
Comments:_____
_____
_____

16. Is the scope of work for the program for which the cost estimate was prepared adequately described and consistent with the planning and Technical Scope Documentation developed through the planning and scoping process?
Comments:_____
_____
_____

17. Has an estimate-specific Work Breakdown Structure been developed for the program?
Comments:_____
_____
_____

18. Does the estimate format follow the WBS?
Comments:_____
_____
_____

19. Does the estimate-specific WBS organize the work to be performed in a logical and consistent manner?
Comments:_____
_____
_____

C. Cost Estimate (Continued) **Yes No N/A**

20. Were activity-based costing (ABC) methods used? If not, briefly describe the estimating method.
Comments:_____
_____
_____

21. Are activities, quantities, and unit costs associated with the work to be performed clearly identified and defined in the cost estimate?
Comments:_____
_____
_____

22. Has an estimate-specific Activity Dictionary been developed for the program?
Comments:_____
_____
_____

23. Does the estimate-specific Activity Dictionary describe all activities associated with the work to be performed in a logical and consistent manner?
Comments:_____
_____
_____

24. Are the assumptions and exclusions upon which the cost estimate is based clearly identified and defined in the cost estimate?
Comments:_____
_____
_____

25. Are time and cost assumptions and cost elements associated with each activity clearly identified, defined, and documented in the cost estimate? Cost elements for program activities include:
___Quantity;
___Unit of measure;
___Labor hours per unit;
___Total labor hours;

C. Cost Estimate (Continued) **Yes No N/A**

25. (Continued)
___Material usage rate per unit;
___Total material cost;
___Equipment usage rate per unit;
___Total equipment cost;
___Overhead rate; and
___Total overhead allocated cost.
Comments:_____
_____
_____

26. Indicate which of the following were documented as part of the estimating basis:
A. Capacity/sizing of systems/components.
B. Regulatory uncertainty.
C. High cost growth areas (labor, etc.).
D. Training.
E. Conduct of Operations.
F. Quality Assurance.
G. Mission changes.
H. Funds availability.
I. Funds carryover.
J. Resource availability.
K. Infrastructure considerations (WIPP, etc.).
Comments:_____
_____
_____

27. Are significant findings of the cost estimate preparer identified during preparation of the cost estimate included in the cost estimate?
Comments:_____
_____
_____

28. Have estimate factors been used to adjust the cost estimate? If so, have they been adequately documented and appropriately applied?
Comments:_____
_____
_____

C. Cost Estimate (Continued) **Yes No N/A**

29. Have escalation factors been used to escalate the cost estimate?
Comments:_____

30. If escalation factors provided by DOE Headquarters have been used, have they been adequately documented and appropriately applied?
Comments:_____

31. If escalation rates other than those provided by DOE Headquarters have been used, have they been audited and approved by DOE Headquarters?
Comments:_____

32. Describe how contingency was calculated and managed.
Comments:_____

33. Was contingency applied to operating expense (non-construction) dollars?
Comments:_____

34. Are indirect rates used in the cost estimate adequately documented and appropriately applied?
Comments:_____

35. Are Estimate Summary and Detailed Reports included in the cost estimate?
Comments:_____

C. Cost Estimate (Continued) **Yes No N/A**

36. Do the Estimate Summary and Detailed Reports provide cost totals for each activity in the Activity Dictionary and for each cost element in the cost estimate?
Comments:_____

37. Is a schedule included with the cost estimate?
Comments:_____

38. Are activities included in the schedule consistent with those included in the Technical Scope Documentation, Activity Dictionary, and cost estimate?
Comments:_____

39. Are milestones and deliverables included in the schedule consistent with those included in the Technical Scope Documentation and cost estimate?
Comments:_____

40. Does the funding profile correspond to the timing evident in the schedule?
Comments:_____

41. Are areas of cost and schedule risk identified in the estimate?
Comments:_____

42. Is an Estimate Criteria Document included in the cost estimate?
Comments:_____

C. Cost Estimate (Continued) **Yes No N/A**

43. Does the Estimate Criteria Document clearly describe the methodology by which the cost estimate was developed?
Comments:_____
_____
_____

44. Does the Estimate Criteria Document clearly describe the basis for the cost estimate and the assumptions made in developing the cost estimate?
Comments:_____
_____
_____

45. Has the entire cost estimate package (including technical scope and schedule) for the program been subject to peer review by individuals who were not involved in preparation of the cost estimate, but who are qualified to have prepared the cost estimate themselves?
Comments:_____
_____
_____

46. Has the peer review considered the elements listed below?
___The basis for the assumptions made in developing the cost estimate;
___Consistency of assumptions made in the cost estimate, technical scope, and schedule;
___Consistency of definitions of activities in the cost estimate, technical scope, and schedule;
___Consistency of durations of activities in the cost estimate, technical scope, and schedule;
___Documentation of productivity and unit cost data for program activities; and
___Appropriate use of indirect rates, escalation factors, and other factors used by the cost estimate preparer.
Comments:_____
_____
_____

C. Cost Estimate (Continued) **Yes No N/A**

47. Have the document findings and recommendations of the peer review been documented in a Peer Review Document?
Comments:_____
_____
_____

48. Is the Peer Review Document included with the cost estimate documentation?
Comments:_____
_____
_____

49. Have the findings and recommendations of the peer review been addressed in revisions to the cost estimate?
Comments:_____
_____
_____

50. Are activities included in the schedule consistent with those included in the Technical Scope Documentation, Activity Dictionary, and cost estimate?
Comments:_____
_____
_____

51. Could an independent cost estimate be prepared based on information contained or referenced in the estimate?
Comments:_____
_____
_____

52. Are appropriate computer software packages employed in estimating the program?
Comments:_____
_____
_____

D. Schedule **Yes No N/A**

1. Was a network logic diagram prepared for the estimate?
Comments:_____
_____
_____

2. Is the level of detail in the schedule adequate to separate dissimilar activities and divide the work effort into quantifiable elements?
Comments:_____
_____
_____

3. Are internal or external constraints outside the manager's control (e.g., issuance of a permit, award of a contract, start-up or shut-down of a related facility) identified principally in the planning and scoping process, described in the Technical Scope Documentation, and recognized in the schedule?
Comments:_____
_____
_____

4. Have the following factors been considered in developing the program schedule?
___Milestone Log and Milestone Description Sheets;
___Milestone responsibilities (program, contractor);
___Budget cycle timing and funding sources;
___Contractor selection process and selection duration;
___Regulatory drivers and other internal and external constraints:
___DOE Field Office, DOE Headquarters, and external review schedule;
___Prerequisite technology research and development constraints;
___Required training and certifications; and
___Operational constraints.
Comments:_____
_____
_____

D. Schedule (Continued) **Yes No N/A**

5. Are top-level milestones traceable down to lower level schedules?
Comments:_____
_____
_____

6. Indicate which of the following details have corresponding schedule activities or milestones:
A. Long Lead Procurement.
B. Training.
C. Field Office and Headquarters Reviews.
D. Regulatory Documentation.
E. Mission Plan Approval.
Comments:_____
_____
_____

7. Are the durations allowed for each activity reasonable, justifiable, and consistent with the program technical scope and cost estimate, allowing each schedule duration to be documented from records and studies maintained at the site?
Comments:_____
_____
_____

8. If a facility is operated by a contractor other than the on-site M&O contractor, is sufficient time allowed in the schedule for the procurement action to bring that contractor's work force on to the site and establish site operations?
Comments:_____
_____
_____

9. Are appropriate operator training cycles incorporated into the schedule for the program?
Comments:_____
_____
_____

D. Schedule (Continued) **Yes No N/A**

10. Does the schedule take into account any operational constraints, including restricted working hours, permit conditions, programmed shut-down or start-up, that may influence the schedule?
Comments:_____
_____
_____

11. Is it possible to document each schedule duration from records and studies maintained at the site?
Comments:_____
_____
_____

12. Has the schedule been resource-loaded?
Comments:_____
_____
_____

13. Does the schedule contain the same resource description and allocations that are in the estimate?
Comments:_____
_____
_____

14. Estimate the percentage of schedule activities falling into the following categories:
____ A. Level-of-Effort entire year.
____ B. Level-of-Effort less than an entire year.
____ C. Discrete activities; no milestones.
____ D. Discrete activities; milestones.
Comments:_____
_____
_____

15. Applicable DOE Orders:
___Do the schedule sequencing and timing of the program correlate to the planning, reporting, documentation and review criteria of DOE 4700.1 (Project

D. Schedule (Continued) **Yes No N/A**

15. (Continued)
Management System) DOE 5100.5 (Office of Management and Budget--Budget Process), and DOE 5100.3 (Field Budget Process), as applicable?
___Does the schedule incorporate elements for application to DOE 1332.1A (Uniform Reporting System)?
___Does the schedule meet resource, documentation, and reporting requirements of DOE N4700.5 (Project Control System Guidelines)?
Comments:_____
_____
_____

16. Is management commitment to the scheduling process evident?
Comments:_____
_____
_____

17. Are appropriate computer software packages employed in scheduling the program?
Comments:_____
_____
_____

18. Is the level of detail of the schedule appropriate considering the maturity of the program?
Comments:_____
_____
_____

Project Validation Checklist - TWRS Project Checklists

The following questions are applicable for projects under the TWRS Program. All non-capital estimates do not require screening through the following criteria (adapted from attachment 4, PR-241 FY 1995 Project Review/Validation Guidance).

		Yes	No	N/A
I.	**SCOPE**			
A.	**General**			
1.	Where necessary, has agreement been reached between the program division, field office, and/or operating contractor on the facility operating (performance) requirements?			
2.	Are facility requirements defined in terms of real property requirements, process definition, arrangement, system layout, operations, maintenance, utility supply, distribution, and cost?			
3a.	Has DOE Order 6430.1A, GENERAL DESIGN CRITERIA, been used in developing the Conceptual Design Report (CDR)?			
3b.	For areas not covered by DOE Order 6430.1A, what criteria are used?			
3c.	Has the intention to conduct a DOE 6430.1A compliance analysis and review been expressed? (Required per DOE Order 5481.1B, Safety Analysis & Review System).			
4.	Have safeguards and security requirements been considered in the development of the CDR? Have they been reviewed and accepted by safeguard and security personnel, and are they in accordance with the latest Master Safeguards and Security Agreement?			
5.	A site plan(s) of the project shall be forwarded for review by the validator. Is the project location predetermined by existing facilities or is site selection necessary? What is the basis for the site selection and what alternatives were considered? Is the project site shown on the current approved baseline Five-Year Plan from the Technical Site Information as described in DOE Order 4320.1B of 1-7-91, SITE DEVELOPMENT PLANNING? If not, has			

		Yes	No	N/A
5.	(Continued) an Engineering Control Change to the baseline Five-Year Plan been completed, approved by the Department of Energy (DOE) Field Offices, and distributed to Headquarters? If land acquisition is required, has the implementation of DOE Order 4300.1, REAL PROPERTY AND SITE DEVELOPMENT PLANNING been initiated?			
6.	Are functions of structures, systems, and major components defined? Have value engineering techniques been utilized to analyze these functions.			
7.	Has the procurement strategy been coordinated with Headquarters Procurement Operations staff?			
8.	Have facility demands been matched with site utilities, roads and support facilities? Will utilities, roads and/ or support facilities require future upgrades/modifications to match infrastructure demand?			
9.	Have requirements for initial complement of equipment been defined?			
10.	Are quality levels and program requirements established?			
11.	With present knowledge of the proposed facility, can emissions and wastes be treated or disposed of in compliance with Federal and State standards?			
12.	Have State, local or national codes and standards applicable to the work and operation of the facility been defined; can the facility operate within these codes and standards?			
13.	Does facility provide office space for operating staff and does the amount of space conform to guidelines issued by General Services Administration?			

		Yes	No	N/A
14.	Are space requirements in addition to current space available, or is it replacement for substandard space? What is the disposition of the building/space being replaced, demolished, converted, etc.?			
15.	Do projects meet the SEN-15-90, NATIONAL ENVIRONMENTAL POLICY ACT requirements, or have Environmental Assessment (EA), Environmental Impact Statement (EIS) or Categorical Exclusions been prepared, as required by the Assistant Secretary for Environment, Safety and Health?			
16.	Have the requirements been met for ensuring that new DOE facilities demonstrate new or emerging energy efficient technologies as presented in DOE Notice 4330.3, ENERGY EFFICIENCY.			
17.	Have Construction Project Data Sheets been submitted for "Operation Expense Funded" projects over $1.5 million and, in particular, those that are listed as Major System Acquisitions?			

B. Design (Conceptual, Title I, Title II)

1.	What is the status of the design? The engineering must be developed to the point of establishing initial scope, cost, and schedule baselines at CDR. The following should be included as part of the design documents: - site development plans including utilities - building layouts - major equipment arrangement - piping and instrumentation diagrams - process and heating, ventilating, and air-conditioning layouts - electrical single-line diagrams			

		Yes	No	N/A
1.	(Continued) - major mechanical, electrical, and experimental equipment list with sizing and codes, standards, Quality Assurance (QA), and other principal special provisions - most reasonable utility supply option selected - utility requirements impacts; availability of outside sources; the most reasonable utility supply option selected - DOE 6430.1A compliance analyses and review			
2.	Have there been any scope changes since the last validation? If so, have rationale, cost and schedule impact been identified?			
3.	Are site conditions understood (e.g., legal encumbrances and restrictions, soil borings, water table, borrow and spoil areas, railroad bridge and road access, utility sources and routing restrictions, construction site layout and limitations)?			
4.	Have safety hazards and risks been determined and have appropriate safety evaluations been performed?			
5.	Has the design undergone a value engineering study, and if so, have design alternatives been incorporated which are life-cycle cost effective?			
6.	Has an environmental assessment been performed? What is the status of environmental documentation?			
7.	Has Research and Development (R&D) prerequisite to facility design and construction been identified, scoped, scheduled and funded?			

		Yes	No	N/A
8.	Have all those who could influence the design participated in development/ preparation and approval of the concept?			
9.	What are major areas of uncertainty (e.g., R&D, design feasibility, schedule, etc.)? Has this been factored into the risk assessment to determine the contingency?			
10.	Has the Energy Conservation Report as required by DOE Order 6430.1A been prepared as a part of the design?			
11.	For applicable buildings, or building areas, does design meet Title 10, Code of Federal Regulation Part 435, Energy Conservation Voluntary Performance Standards for Commercial and Multi-Family High Rise Residential Buildings, mandatory for new Federal Buildings?			
12.	Have maintainability considerations been built into the design, and does the design contain a good maintainability checklist specifically oriented to this project? The maintainability concerns that should be addressed are: - accessibility - operator/user friendly - documentation - standardization/interchangeability - flexibility - desirable levels of quality			

		Yes	No	N/A

II SCHEDULE

1. Have the following factors been considered in developing the schedule?
   - effects of weather and season
   - resource loading and leveling
   - milestone responsibilities (AE, program, project, contractor)
   - budget cycle timing
   - contractor selection durations
   - Headquarters reviews and approvals (including NEPA and Safety)
   - prerequisite R&D schedule constraints
   - dependency upon timing and amount of operating funds
   - historical experience on design, procurement, construction, technical reviews, National Environmental Policy Act documentation, etc.
   - development of environmental documentation
   - procurement lead times for equipment (particularly reflecting vendor quotes)
   - logical sequence of design, procurement, and construction
   - realistic obligation and costing rates
   - workplace space constraints
   - exposure constraints
   - operational constraints
   - maintainability reviews and deliverables
   - milestone dictionary

III. Cost Estimate

Details provided should be consistent with complexity, scope nature (first-of-a-kind vs. repetitive), and status of the design (conceptual, Title I/II, etc.). Cost estimates and summaries should be understandable and be provided in a single volume if possible. Computerized CS2 reports are not acceptable. Provide assumptions, basis of the estimate and narrative as required to furnish complete explanations. For major technical projects, the following estimating practices are pertinent:

		Yes	No	N/A
A.	**General**			
1.	When was estimate prepared? Are estimates provided in both base year and then year dollars?			
2.	Basis of estimate; vendor quotes, similar projects, engineering calculations, etc.			
3.	Are estimates traceable and supportable, where necessary, with vendor quotes?			
4.	Do contingency and escalation reflect the guidance issued (Cost Estimating Guide for Application of Contingency, Note Contingency Guideline Implementation, paragraph 5.b)? Does contingency reflect level of confidence in scope of work, development features, pricing methodology and complexity of project. Does contingency analysis provide for varying degrees of certainty in the estimate?			
5.	What escalation rates are being used? What documentation or analysis was used to support these assumptions? Have they been included and applied in a logical and consistent manner? What changes in estimates have occurred as a result of changes in escalation assumptions used in previous estimates? Have program-related changes been identified and crosswalked (schedule, technical, scope, or economic condition)?			

		Yes	No	N/A
6.	Have there been independent reviews of the project estimate? When was the estimate updated? How was the estimate updated? (i.e., trends "bottoms-up," only changed work, etc.). When was the last "bottoms-up" estimate performed?			
7.	Where unique construction or fabrication practices are required, has pricing advice been obtained from experienced firms knowledgeable in the field?			
8.	Where attempts are made to use estimating guides based on conventional construction items, have they been properly interpreted with required geographic, quantity, and complexity adjustments?			
9.	Are indirect costs, profit, fees, etc., included? Are reasonable rates used? Have these been audited?			
10.	In the case of Title I/II design estimate, were all the specifications and drawings available for development of the cost estimate?			
11.	Are all required experimental components included in estimate?			
	Has a procurement strategy been developed, i.e., Government Furnished Equipment, Cost Sharing, Cost-Plus-Fixed-Fee, Cost-Plus-Award-Fee, etc., for contracts and major cost items?			
13.	Are materials and systems selections, especially as they concern maintainability, based on life cycle costs rather than first costs identified?			
14.	Have Total Estimated Cost and Total Project Cost definitions been properly applied? Do the estimates reflect proper financial management practices and procedures?			

		Yes	No	N/A
B.	**Construction**			
1.	Were bulk material quantities, established by takeoffs from conceptual drawings, based on engineering estimates or factored from previous work?			
2.	Are allowances for quantity growth needed or provided?			
3.	Is bulk material pricing current and reflecting local conditions where appropriate?			
4.	Is labor estimated using local rates, including applicable fringe benefits, travel allowance, and reasonable crew or craft mix? Was the availability of construction labor critical skill categories in the local labor market considered?			
5.	Is pricing of equipment supported by current vendor quotes or recent actual experience?			
6.	Have indirect construction costs been included for normal support, field engineering, temporary construction, mobilization, warehousing, etc.?			
7.	Is labor productivity based on historical experience adjusted or appropriate for site or unusual facility features?			
8.	If labor availability would be a problem, have allowances been included for attracting adequate work force? Have construction of classified projects been addressed relative to cleared work force?			
9.	Does pricing reflect code, QA, scheduling, climatic, geographic, and other unique specification requirements?			

		Yes	No	N/A
10.	If unitized pricing has been applied, are the raw material and labor cost, equations and other backup data provided or available?			
11.	Are operational cost estimates and basis for overhead cost included and explained?			
12.	Has a transition plan from construction to operations been developed along with procedures for controlling costs?			

C. Engineering and Management

1.	Do the Engineering, Design, and Inspection (ED&I) Costs follow the guidance, The Definition and Treatment of Engineering, Design, and Inspection Costs, August 23, 1985?			
2.	Are contractor project management and engineering costs appropriately chargeable to the project included?			
3.	Was ED&I built up by assessment of drawings, specifications, analysis, comparable experience, or a percentage of construction?			
4.	Are Title III inspection, QA and Quality Control costs included for Architect/ Engineer, operator and construction, as appropriate?			
5.	Is the management system organized and planned reasonable and responsive to project/program needs? Is authority at the proper levels? Are there duplicative or overlapping responsibilities? Is a cost and schedule deviation evaluation system in place?			

		Yes	No	N/A
6.	Is an effective baseline change control system in place including board charters and responsibilities? Are project baselines change procedures and process defined and understood?			

IV. Funding and Cost Status

1.	What is the basis for the planned authorization, appropriation, and costing schedule? What alternatives were considered?			
2.	What are the other associated project costs?			
3.	Is the proposed annual funding consistent with a realistic project schedule? Is it based on an evaluation of planned contract awards delivery lead times, and logical critical path activity sequencing?			
4.	Have alternatives been considered in the event of a Continuing Resolution or reduced funding? Impacts?			
5.	Are any of the fixed-price construction contracts in the project incrementally funded?			
6.	Has the funding by client or consultant agencies been identified?			
7.	Have any reductions in project funding or funding requests resulted in the elimination or reduction of energy conservation or maintainability items?			

U.S. Department of Energy
DOE Hanford Reservation

DRAFT

Tank Waste Remediation System
(TWRS)

COST ESTIMATION MANUAL

- Cost Estimating Standards and Practices -

Draft 1.0

January, 1993

TITLE:

COST ESTIMATING STANDARDS AND PRACTICES

Approved by

_____

XXXX, Manager
XXXX

1.0 PURPOSE

The activities associated with the Tank Waste Remediation System (TWRS) at Hanford include both project and program efforts that are large and complex. Planning at TWRS is a challenging task; risk areas such as regulations, technologies, management practices, other requirements and uncertainties are an integral part of TWRS. The purpose of this guide is to delineate the estimating activities required for TWRS planning and to ease implementation of the recently promulgated *Office of Waste Management (EM-30) Cost and Schedule Estimating Guide* as it applies to the TWRS Program.

The ultimate purpose of this manual is to supply the necessary direction to prepare defensible, credible TWRS cost estimates. These estimates can then undergo review scrutiny, be rolled up to feed the budget process, and survive to form the basis of a historical record for TWRS changes and decisions.

1.1 Intended Audience

TWRS Division, under the management of the U.S. Department of Energy - Richland (DOE-RL), is authorized as a work activity conducted by Westinghouse Hanford Company. This guide is to be used by TWRS and/or their associated subcontractors as a working document and estimate preparation reference.

Estimators, schedulers, Cost Account Managers (CAMs), program element and program managers, and program reviewers will find the TWRS Cost Estimating Manual to be a practical management reference tool. The list of users includes anyone who (1) prepares TWRS cost estimates, (2) validates the estimates and the estimating process, (3) reports the estimates to the customer(s) such as DOE-RL and DOE-HQ, (4) measures actual cost and schedule progress against the estimates, or (5) provides ideas into future revisions of the process.

1.2 Future Development of the Guide

Throughout this document, reference is made to historical costs and historical estimate basis as a preferred supply of estimate data. This original cost guide, while incorporating the innovative techniques of Activity Based Costing (ABC), does little for providing a sound historical basis for costs. A major revision will include:

- a historical cost gathering procedure;
- a TWRS activity dictionary (code of accounts);
- validated cost estimating relationships (CERs);
- activity tracking on repetitive scope (e.g., Conceptual Design Report); and
- a method for documenting, publishing, and revising the TWRS Unit Cost Book.

The benefits of initiating complete estimates are both short and long term. Initially, the process of an activity by activity look at the TWRS Program will result in better planning and decision making by both the contractor and DOE. Increased likelihood of programmatic funding and budget approval is a positive outcome of higher quality estimates. Long term, the benefits of better program management and performance measurement as well as the collection and use of historical cost data will substantially improve the overall TWRS program.

1.3 Local Cost Guide Criteria

This guide conforms to the local cost guide criteria set forth in DOE Order 5700.2D, attachment 2., with the following exceptions:

- Section e., cost codes of account, will be added since sufficient reasons exist for development of local cost codes of account (activity dictionary);
- Section f., contingency, is defined and discussed, but a procedure for contingency analysis is missing; and
- Section k., collecting actual cost data, is only briefly addressed.

2.0 SCOPE - COST ESTIMATE BASELINES

The mission of the TWRS Division Charter (September 3, 1992) is to "manage plants and facilities cost-effectively and in compliance with applicable nuclear facility operating standards". The key to cost-effective management is cost effective, comprehensive planning. The management of TWRS has chosen the baseline concept as the tool to meet the demands of this charter.

Any activity, either program (non-capital) or project (capital) based in the TWRS Program, requires a series of cost estimates with associated scopes and schedules throughout the life of the program or project. On a fundamental level, remember that an estimate is just that; an estimate. The activity of predicting future events and associated costs and schedules is both an art and a science. The better estimates are based on better predictions. Prediction is based on the ability to assimilate history, experience and judgment in a format that is easy to express and understand. Although estimating concepts and methods are not new to those familiar with projects, the application of estimates to non-capital operations is new. As a non-capital estimating methodology, the *Office of Waste Management (EM-30) Cost and Schedule Estimating Guide* discusses the idea of Activity Based Costing (ABC) in detail. This concept, introduced in November, 1991 by EM-30, uses common estimating techniques and methods borrowed from the construction industry and applies those to operations. For example, one of the first planning activities is to develop a Work Breakdown Structure (WBS) for the operations activities to be executed. Until recently, a WBS was not seen in the operations planning arena at a level conducive to cost estimation.

It is essential that TWRS cost and schedule estimates be developed consistently using accepted methodologies. Each estimate should have a well-documented basis that identifies all known program/project data and assumptions. It is recognized that many TWRS activities and operations are not yet fully defined and that definition will improve over time. However, known elements must be provided.

Estimates must be based on concepts, operations, and/or designs that are cost effective, even when the major parameters and characteristics can only be assumed. It is understood that program concepts, operations, and designs will evolve and that, consequently, cost estimates will become more firm. However, "plug numbers" or allowance amounts instead of cost estimates are not acceptable. Even if little is known about the scope, as often happens in the out-years, all assumptions are to be documented and the estimate developed to the greatest level of detail possible commensurate with the level of information available.

2.1 Baseline Definition

A Baseline is a quantitative expression of projected costs, schedule, and technical requirements. Baseline establishment should include criteria to serve as a base or standard for measurement during the performance of an effort. A baseline is also the data plan against which the status of resources and the progress of a project can be measured.

TWRS does not distinguish between program (expense) or project (capital funded) activities under the baseline concept. Any activity, including those conducted by DOE within the TWRS Program, is subject to technical scope, schedule, and cost scrutiny.

2.2 Near Term Versus Out-Year Cost Estimates

TWRS is faced with project and program elements that require life cycle cost estimates that span decades. To conduct sensible planning, out-year estimates are treated differently than near term estimates. The method chosen for an estimate will also depend on this crucial timing factor - it doesn't make sense to do a "bottoms-up" estimate on a TWRS activity scheduled for 2015. To establish this relationship, near term estimates and out-year estimates are defined.

Near term estimates apply to activities forecasted for the next two operating years. This "window" on the total TWRS Program begins with the current execution year and "slides" one year out at a time to update the plans and estimates as time moves on. Because they are based on reasonably accurate knowledge of the work to be accomplished, the estimator has a relatively high degree of confidence in the work scope, logic and schedule and is more willing to identify as many individual cost components as possible.

Near term estimates are based on (1) identification of the lowest possible level of individual cost components of a particular activity, (2) their quantities, and (3) their individual costs. A TWRS Unit Price Book will be developed to help specifically in the near term estimating process by providing a sound "basis for estimate" at the required component level.

Cost estimates for out-year activities are less detailed and more "scoping" in nature. Methods such as Activity Based Costing (ABC) are more difficult to apply here, although some aspects, like a program WBS, should still be developed. Out-year cost estimates contain less detail because (1) the work scope and schedule are far less certain and (2) the cost to perform that work is less certain due to potential changes in legal or other requirements. Out-year scoping estimates will not generally include as much detailed backup information, but will be based on a combination of projected work scope and the near term cost estimates for similar work scope. Out-year cost estimates rely heavily on assumptions, especially in work scope. Assumed work scope must be clearly articulated in all planning documents in order for scoping estimates to be of value. Remember, it is crucial that these assumptions are well articulated and documented. These out-year estimates will get revised; it is important to understand the original scope, schedule and cost thinking upon revision. As with near term estimates, estimators are encouraged to seek opportunities for generating "economies of scale" for projects or programs with many similar activities that are scheduled in parallel time frames.

3.0 ESTIMATING METHODS

As discussed earlier in the near term versus out-year estimating, the estimating method used is based on several factors and on the basis of the estimate. Different methods are more desirable at different times. Figure 1 illustrates the relationship between accepted methods and the basis of the estimate. The trend is obvious; the nearer the term and the more definitive the basis, the more likely that a full bottoms-up or ABC type estimate is required. Conversely, as shown in Figure 1, it does not make sense to force a preliminary estimate into a definitive, bottoms-up approach if another method (e.g., parametric computer model) would produce results.

Estimating Methods Vs. Basis
TWRS Program

Estimating Basis	Estimating Methods: ABC & Bottoms-Up	Specific Analogy	Parametric	Cost Review & Update	Trend Analysis	Expert Opinion
Planning/Feasibility Study	•	√	√	√	■	■
Pre-Conceptual/Budget/CDR	■	√	√	√	•	■
Title I	√	■	■	•		•
Title II	√	•	•			•
Government/Engineers'	√					
Current Working Estimate	√					

Method Preference

√ High ■ Medium • Low

Draft 1.0

Figure 1

Six major technique categories are shown as accepted estimating methodologies. Many are known by other names, for instance the bottoms-up technique is also known as the definitive estimate technique or as an Activity Based Cost (ABC) Estimate (non-capital activities). Some estimate types are based on a combination of techniques. For example, a Rough Order-of-Magnitude (ROM) estimate uses parametric, trend analysis, comparative and expert opinion techniques, depending on the scope to be estimated.

3.1 Rough Order-of-Magnitude (ROM) Method

In the process of preparing an estimate for either bidding or negotiation purposes, no substitute exists for using a detailed quantity take-off as a costing basis. Still, specific situations may dictate a different approach, such as when the high cost of preparing the detailed estimate may outweigh the benefits received, or when time constraints do not allow a detailed estimate to be prepared. In those situations, rough order-of-magnitude estimating may be the solution, since it allows a project's cost range to be obtained in a relatively short period of time and at minimal expense. ROM cost estimating may, therefore, be defined as a quick method of determining an approximate probable cost of a project without the benefit of detailed scope definition.

Rough order-of-magnitude estimates may be prepared for:

- o establishing the probable costs of a program budget;
- o evaluating the general feasibility of a project;
- o evaluating cost consequences of proposed design modifications;
- o updating a previously prepared rough order-of-magnitude estimate;
- o establishing a preliminary budget for control purposes during the design phase; and
- o screening a number of alternative projects so one or more can be given a more detailed examination.

ROM estimates are based on limited information and are thus subject to considerable variation. Their accuracy also depends on the amount and quality of information available as well as the judgment and experience of the estimator. Users must recognize these limitations and not "hang their hats" on the resultant estimates.

The ROM estimate category encompasses a number of methods. Several of the more commonly used methods are End-Product Units, Scale-of-Operations, various Ratio or Factor methods, and Physical Dimensions.

End-Product Units Method - This method is used when the estimator has enough historical data available from experience on a particular type of project to relate some end-product units to construction costs. This allows an estimate to be prepared for a similar project when the only major difference between the projects is their size. Examples of the relationship between construction cost and end-product units are:

- The construction cost of an electric generating plant and the plant's capacity in kilowatts
- The construction cost of a hospital and the number of beds
- The construction cost of an tank and the tank capacity
- The construction costs of a processing plant and the plant throughput

Scale of Operation Method - This method uses historically derived empirical equations to obtain an estimate of approximate cost for different sizes of the same type industrial facility. This method is sometimes known as the six-tenths rule. A common form of this equation is:

$$C2 = C1 * (Q2/Q1)x$$

where: C2 = Cost of desired plant or piece of equipment
C1 = Known cost of plant or piece of equipment
Q2 = Capacity of desired plant or item
Q1 = Capacity of known plant or item
X = Constant, usually in the range of 0.6 to 0.8

This mathematical relationship reflects the non-linear increase in cost with size, and shows economy of scale where the construction cost per unit of capacity decreases as the project size increases.

For example, if the known cost of a 300 HP aeration tank blower is $50,000, then the approximate cost for a 500 HP blower would be:

$$C2 = \$50,000 * (500/300).8 = \$75,000$$

Ratio or Factor Methods. Many specialized Ratio or Factor methods are available to the estimator. Several of those typically used are described below.

Multiple of Equipment Cost. This method is commonly used in constructing process and chemical plant where the cost of specialized equipment makes up a major portion of the total project cost. Approximate project costs may be estimated by totalling the cost of all major items of equipment and then multiplying this sum by a single ratio obtained from either historical data or other reliable sources. The estimate should be accurate form +15% to -30% .

For example, if the total cost of all equipment for a chemical manufacturing plant is $10,000,000 and the plant cost ratio (developed from reliable historical data) is 5.0, then the estimated total cost will be:

$10,000,000 x 5.0 = $50,000,000

Lang Factors. Lang Factors are simply standard multipliers (factors) for use in specific situations. Sample factors are:

3.10 For solid process plants
3.63 For solid fluid plants
4.74 For fluid process plants

Hand Factors. Hand Factors expand on the Lang Factors approach by using the individual components of permanent equipment or systems. Each factor converts the cost of the equipment item to its share of total construction cost (including labor, materials, construction equipment, and overhead). When all line items are factored and added together, the estimator has a total estimate cost for the project. Some of the factors proposed for process plant equipment are:

8.5	For electric motors
4.8	For instruments
4.0	For fractionating columns, pressure vessels, pumps, and instruments
3.5	For heat exchangers
2.5	For compressors
2.0	For centrifuges

The Physical Dimensions Method. This type of estimate is based on physical dimensions such as length, area, or volume. For instance, an estimate can be made for a building using the building's floor area or its volume; pipe lines, roadways and railroads may be estimated on a linear basis.

The physical dimensions method depends on historical data from comparable facilities. For example, to prepare an estimate using the square foot method, the total cost and square footage of one or more comparable structures must be known. The cost per square foot is obtained by dividing the total cost of the building by the number of square feet. The cost of a new comparable building is then estimated by multiplying the area of the proposed building by the cost per square foot obtained from the completed building(s).

3.2 Bottoms-Up Technique

The bottoms-up technique is generally based on a work statement and set of drawings or specifications. This documentation is used to "take off" (see definitions) materials quantities required to perform each discrete activity. From these quantities, direct labor, equipment, subcontracts, and overhead costs are derived and added thereto.

3.3 Specific Analogy Technique

Specific analogies depend on the known cost of an item used in prior systems as the basis for the cost of a similar item in a new system. Adjustments are made to known costs to account for differences in relative complexities of performance, design, operational characteristics, or other quantifiable measures.

3.4 Parametric Technique

Parametric estimating requires historical databases on similar systems or subsystems. Statistical analysis is performed on the data to find correlations between cost drivers and other system parameters, such as design or performance. The analysis produces cost equations or cost estimating relationships (CERs) which can be used individually or grouped into more complex models.

This type of estimate, as the name implies, is based on certain parameters that reflect the size or scope of a project. Parametric estimates are commonly used in the facilities construction industry for preparing approximate estimates. These estimates are usually prepared after the preliminary design phase is complete and the project's key features and dimensions have been defined. They can be more accurate than other order-of-magnitude estimates because the project can be broken down into more detail.

The first phase is the Data Collection Phase. This phase consists of four main activities.

1. Describing the project in general terms, including information such as:
   - Type of facility (tank, incinerator, power plant, office)
   - Location (city and state)
   - Project duration (starting and completion dates)
   - Type of owner (government, private)
   - Structural parameters (stainless steel, metal deck, reinforced concrete)
   - Type of exterior walls (glass, metal curtain wall, masonry)
   - Special site conditions (rock excavation, dewatering)

2. Listing the standard parameters that can be measured, such as the ones shown below, which are used by Engineering News-Record in reporting parametric costs:
   - Gross enclosed floor area
   - Gross area supported (excluding slab on grade)

- Total basement floor area (if applicable)
- Roof area
- Net finished area
- Number of floors
- Area of face brick
- Area of other exterior wall
- Area of curtain wall (including glass)
- Interior partitions
- HVAC
- Parking areas

3. Establishing specific design characteristics relating to the type of structure which become additional parameters.
   - Area of typical floor
   - Story height, typical floor
   - Entrance area
   - Number of plumbing fixtures
   - Number of elevators
   - Number of rooms
   - Number of occupants

4. Determining selected design ratios which become additional parameters.
   - A/C ton per building square foot
   - Parking square foot per building square foot
   - Plumbing fixtures per building square foot

The next phase is the Data Application Phase. The data application phase consists of five main activities:

1. Listing trade sections or cost elements - the selected list must incorporate all cost elements in the project.
   - General Conditions
   - Overhead
   - Risk - Mark-Up
   - Risk - Contingency
   - Trades
     - Sitework
     - Foundations
     - Concrete
     - Structural
     - Carpentry
     - Glass
     - Studs & Drywall
     - Ceilings
     - Equipment
     - Plumbing
     - Mechanical & HVAC
     - Electrical
     - Finish Work

2. Listing the total cost of each cost element from the reference project.

3. Relating each cost element to a parameter considered to affect its cost most closely. This consists of assigning each element a code number (or parameter title) that corresponds to one of the parameters selected.

4. Determining cost element unit prices (unit prices related to the selected parameters of the project). For example, painting costs may be considered most related to the square feet of net finished area of a structure; the unit price is calculated by dividing actual costs of the reference project by square feet of that project's net finished area (e.g., if total painting costs = $6,000; net finished area = 12,000 SF; unit price = $0.50/SF).

5. Determining the percentage of each cost element expressed in terms of the entire project cost. This is obtained by dividing the total amount for each trade by the total project cost and multiplying the result by 100. The resulting percentages, while not normally used directly in estimating a new project, are helpful in analyzing cost trends of the various cost elements among multiple projects.

Once the above reference data is compiled, it can be used to estimate a comparable new project. The new project is classified by the same cost elements used in the reference project, and the unit prices of the reference project are multiplied by the actual number of units on the new project. For example, assuming the new project has 10,000 SF net finished area, its painting costs would be estimated to be $5,000 (10,000 x $0.50/SF). This process would be repeated for all cost elements and the results totalled to generate a total estimated cost of the new project. Still, the estimator should consider adjusting the final estimate to reflect area and time cost indices.

3.5 Cost Review and Update Technique

An estimate is constructed by examining previous estimates of the same project for internal logic, completeness of scope assumptions and estimating methodology. The estimates are then updated to reflect the cost impact of new conditions or estimating approaches.

3.6 Trend Analysis Technique

A contractor efficiency index is derived by comparing originally projected contract costs against actual costs on work performed to date. The index is used to adjust the cost estimate of work not yet completed.

A cost index relates the cost of an item at one time and place to its cost at another time and place. The four main types of cost indices are:

- **General Purpose Cost Indices,** such as those published by the Engineering News Record, the Department of Commerce, and the Bureau of Reclamation
- **Contractor Price Indices,** including those compiled by the Austin Company, Fruin-Colnon, Turner Construction Company, Smith Hinchman & Grylls Associates, Inc., and H.F. Campbell
- **Valuation Indices,** such as those complied by the American Appraisal Company, Boeckh Company, Marshall and Swift Services, and Handy-Whitman
- **Special Purpose Indices,** including those compiled by Nelson Refinery, Port of New York Authority, the Environmental Protection Agency, the Bureau of Labor Statistics, and State Highway Departments

Since the indices compiled by the Engineering News Record are probably among the most widely disseminated, they will be discussed in the following paragraphs.

The Engineering News Record compiles and publishes the following three kinds of indices (among others):

- Construction Cost Indices
- Building Cost Indices
- Wage and Materials Indices

These indices are compiled and published monthly, and reflect average costs from twenty cities in the United States and two cities in Canada. They are based on weighted skilled labor, structural steel, lumber, and cement, and use a base of 1913 = 100; other presentations, such as the ENR Quarterly Cost Roundup issue where use a base of 1967 = 100 is used.

To illustrate the use of cost indices, assume that the following information is available:

- A prospective client contemplates building a warehouse in 1992 and wants an order-of-magnitude estimate.
- An estimate is on file for a similar structure, completed in 1988 for $4,200,000.
- The ENR index for 1988 building costs was 2600.
- The projected index for 1992 is 2850.
- The estimated cost of a project of similar size will be: (2850/2600) x $4,200,000 = $4,604,000.

The estimator must know and understand the limitations that may exist on using indices in preparing order-of-magnitude estimates:

- A cost index is based on historical averages and does not take into account changes in technology that will naturally occur. For example, concrete bridges and overpasses built twenty years ago are vastly different than those constructed today.
- Short-term economic cycle swings, especially in small geographic areas, can be significant. Therefore, indices can lack sensitivity.
- There can be a reporting time-lag associated with the database, so a complex index containing many factors may not be representative of actual conditions at the time stated.
- A cost index database is a composite average and consequently has a range of "acceptable" numbers associated with it. Even though most indices do not include that range, the estimator must be aware that it exists and accurately judge when to adjust the index numbers used.
- The industry is awash with cost indices, but the estimator has little, if any, information and guidelines for their use. Thus the estimator must carefully document the use of an index so that others may have the same understanding of its use in that particular application.

A location index or city cost index relates the known cost of an item or project in one location to the same type of item or project in another location by using location indices such as those available through R.S. Means Construction Cost Data and Engineering News-Record.

3.7 Expert Opinion Technique

May be used when other techniques or data are not available. Several specialists can be consulted reiteratively until a consensus cost estimate is established.

4.0 BASIS FOR THE PROJECT COST ESTIMATES

When a cost estimate is prepared for a project or program activity, a description of the basis for the cost estimate shall be made and included in the estimate documentation. The general requirements for each type of cost estimate are included herein.

4.1 Planning/Feasibility Study Estimates

The basis for the cost estimate shall comprise a description of the project's purpose, relation to the overall program mission, general design criteria, significant features and components, proposed methods of accomplishment, proposed construction schedule, research and development requirements, and any other pertinent cost experiences.

4.2 Budget or Conceptual Design Estimates

These cost estimates shall be based on all the detailed requirements in the budget, pre-conceptual or conceptual design report (CDR) such as the design parameters, applicable codes, specifications and standards. Quality assurance requirements, space requirements, research and development requirements, methods of performance, operations interfaces, safety requirements, and so forth, should be considered.

4.3 Title I Design Estimates

The basis for these cost estimates shall include 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.

4.4 Title II Design Estimates

The basis for these cost estimates shall include all the approved engineering data, methods of performance, final project definition and parameters, project schedule, and final exact detailed requirements. The statement of "basis" shall include a complete list of all engineering data used; (i.e., drawing data sheets, specifications, bills of material, job instructions, proposed schedules, and so forth).

4.5 Government or Engineers' Estimate

Since this estimate is simply a refinement of a Title II design estimate, the basis used to make adjustments or refinements shall be listed and made part of the file.

4.6 Current Working Estimates

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

5.0 TWRS ESTIMATING AND THE DOE BUDGET AND PLANNING PROCESS

The DOE budget cycle is based on the Congressional budget cycle, a three-year period that includes the Execution Year, the Budget Year, and the Planning Year. The FYP and corresponding Activity Data Sheets (ADSs) establishes budget for all TWRS activities.

The DOE-HQ Five Year Plan covers a five year period beginning with the DOE Budget Year (current planning year plus two) and documents the requirements for the current and next fiscal year. The current year (Execution

Year) is outlined in the TWRS Fiscal Year Work Plan (FYWP). The Multi-Year Program Plan includes the Execution Year, the Budget Year, the Planning Year and subsequent four years. The plans put into writing the steps, cost estimates and schedules required over the next five years to accomplish TWRS mission goals.

The basis of the Five Year Plan process includes the preparation of the Activity Data Sheets (ADS) which describe in detail the budget requirements and milestones of individual activities. The ADSs are an integral part of the process DOE uses to prepare its budget request for Waste Management and Environmental Restoration and the way DOE allocates the funds provided by Congress. Budgets established in the ADSs will go through an independent cost estimating validation and review process (at DOE's request) to test the completeness and accuracy of these funding requests.

6.0 TWRS ESTIMATE DOCUMENTATION

While it is recognized that some programs/projects may not be able to achieve in-full the documentation listed below due to that particular program's/project's maturity, the basis that supports TWRS funding requests must be provided and maintained throughout the life of the program/project and the level of detailed supporting documentation must increase as the effort progresses.

The funding levels included in the ADSs must be supported by documented and reviewed estimates. Estimate documentation is essential to cost management including cost control, cost tracking, development and maintenance of cost databases, and estimate validation processes. The level of information available at the time the estimate is made determines the extent of documentation. The following recommended requirements are not intended to reduce or limit any existing practices:

6.1 Work Breakdown Structure (WBS)

A WBS is a product-oriented description of the work and the resources required to complete an activity. A WBS is developed and used because it is a critical element in organizing the work and building cost and schedule estimates and is essential for reporting, tracking, and control.

6.2 TWRS Estimate Work Sheets

All Estimate Work Sheets and "roll-up" sheets for Total Estimated Cost (TEC), Total Project Cost (TPC), Operations Cost (OC), Level-of-Effort (LOE), indirect and overhead calculations, risk and/or contingency analysis, etc., are to be prepared and, as appropriate, updated and maintained.

6.3 Scope Descriptions

A description of the scope of work, concept and/or task, that the estimate covers is to be documented on the Activity Planning Form and kept with the estimate. This includes both programmatic and project specific requirements such as program objectives, funding probabilities, media and contaminants, regulatory constraints, assumed technology, design, special capital equipment requirements, etc. If the work is a smaller component of a larger program/project, the estimate documentation includes a brief description of the larger program/project.

6.4 Ground Rules and Assumptions

Identify and document those costs imposed by circumstances facing the program/project as well as those made by the estimator. Examples of those imposed by circumstances are funding constraints, changing regulatory requirements, directed changes or imposed priorities. Examples of those within the purview of the estimator include:

Database source(s), estimating tool(s) used, material cost, wage rates, all unit costs including sampling and analytical costs, crew make-up, productivity, worker benefits included, and handling of taxes.

The rationale for handling anticipated technology development, long-lead-time procurement, special studies, sequencing of tasks, imposed milestone requirements, vendor quotations, and resource availability.

6.5 Schedules and Milestones

All activities are to be documented with identified milestones and detailed descriptions. Based on line organization guidance, activities will be resource-loaded and time-phased to facilitate tracking, actual vs. estimated. Activities are to be scheduled at the lowest feasible level.

6.6 Cost and Schedule Risk and Contingency

Document the risks identified, how they were developed and the contingencies associated with each risk.

APPENDIX A

DEFINITIONS

Account Structure. A formal organization of accounting codes used to collect costs for control account work which provides needed information, segregated as necessary, for reporting costs.

Activity-Based Cost (ABC) Estimating consists of defining the overall task(s) or activities and providing a unit of measure, quantity, labor-hours required, labor cost, material, subcontract, equipment usage, equipment, and overhead value(s) for that activity.

Activity or estimate activities are defined in sufficient detail to identify components included in the estimate. The activity is defined in terms of a quantity of cost elements (e.g., quantity, labor-hours, labor cost, materials, subcontracts, equipment usage, and overhead percentage).

Activity Data Sheets (ADSs) are the principal planning and budgeting informational link between the Field Offices and Headquarters. The ADSs are used as a vehicle by EM Field Offices to develop and describe the various components of their programs and to project budget needs to HQ. The ADSs provide information about scope of work, funding estimates, regulatory drivers, milestones, and other data. The ADSs are used and classified as budget formulation documents because they are highly visible throughout the entire budget cycle; as presentation materials to justify and verify program-specific costs to OMB; and as budget execution documents. Accurate and prudent completion of the ADSs is imperative and results in an expedited negotiations process.

Actual Cost. The Actual Cost of Work Performed (ACWP) is the cost incurred and recorded in the accounting system for accomplishing the work performed within a specific time period.

Advanced Development is the effort guided by the principle that the work should lead ultimately to a particular application or product. Advanced development can cut across several scientific disciplines and is intended to explore focused innovation in a particular area of one or more energy technologies.

Allowances are additional resources included in estimates to cover the cost of known but undefined requirements for an individual activity, work item, account, or subaccount. Used primarily when little is known about proposed quantities or design criteria, and where activities cannot be defined in enough detail to support Activity Based Cost estimating.

Applied Research Systematic study directed towards fuller scientific knowledge or understanding for direct use in fulfilling specific TWRS requirements.

Authorized Work. Work that has been definitized and is included in the contract value as well as work that has been authorized in writing, but contract value has not been determined and agreed.

Baseline is a quantitative expression of projected costs, schedule, and technical requirements. Baseline establishment should include criteria to serve as a base or standard for measurement during the performance of an effort. It is the data plan against which the status of resources and the progress of a project can be measured.

Budgeted Cost. The Budgeted Cost of Work Scheduled (BCWS) is the sum of budgets for all control accounts for work scheduled to be accomplished within a given time period.

Certified Cost Engineer (CCE) or Certified Cost Consultant (CCC) are cost engineering professionals

recognized as such by AACE International (formerly the American Association of Cost Engineers). The certification requires an examination and years of verifiable work experience in the cost engineering field.

Change Control. A documented process applying technical and management review and approval of changes to technical, schedule, and cost baselines.

Change Order is a document requesting a scope change or correction; a written change made by the architect/engineer or in-house engineering support to the contract drawings and/or specifications after the baseline has been set.

Check Estimate is a validating estimate. Its development and use is similar to an independent cost estimate, except it is developed by program/project or DOE Field Office personnel or their supporting contractor. A check estimate should be developed by someone who had no involvement in the original estimate, but who may be an advocate of the project.

Contingency is an amount added to the cost estimate or schedule duration to allow for changes that experience shows will likely be required. This may be derived either through statistical or risk analysis of past-project costs or by applying experience gained on similar projects. Contingency usually does not include changes in scope or unforeseeable major events such as strikes or earthquakes.

Cost Estimate is a statement of costs estimated to be incurred in the conduct of an activity such as a program, or the acquisition of a project or system. The cost estimate covers only the elements of a project or effort included within an agreed-upon scope. Cost estimates provide baselines against which cost comparisons are made during the life of a project. The estimate can be in the form of proposals by contractors or Government agencies, a response to a program opportunity notice, or a DOE estimate. Methods for preparing cost estimates are detailed in the methodology section of this cost guide. Generally, each scheduled activity shall have a cost estimate.

Cost Estimate Review is a review of a previous estimate for completeness, reasonableness, and consistency. The completeness relates to the inclusion of all relevant costs. Reasonableness relates to a balance between discernible optimism and pessimism in the estimate. Consistency relates to the general acceptability of applied ground rules or the employment of the same methods in going from one estimate to another. A review may be accomplished by comparing the estimate to an independent estimate; however, reviewers generally will not have these available. Therefore, cost reviewers will generally use such tools as historical rules of thumb to check unit prices, parametric cost estimating relation ships, and sampling. Also, the estimate can be examined for appropriateness and consistency.

Compliance Review. An assessment of the contractor's project management control system. The assessment normally occurs in two steps: a. The contractor submits a description of its management control system to the Department of Energy (DOE) for review against specific applicable Project Control System Guidelines and the DOE Field Office or Program Office Implementation Plan; and b. A review team conducts a functional analysis of the contractor's system to determine adherence to the published description and integrity of contractor data.

Compliance Review Chairman. The chairman is normally a DOE Field Office or PSO representative. The chairman is responsible for day-to-day activities. Typical activities include planning and scheduling the review, organizing and leading the review team, resolving identified system discrepancies with the contractor, and preparing the review report.

Compliance Review Team. A team representing the DOE Field Office organization or PSO, as appropriate, which evaluates a contractor's project control system.

Costing is the process of using the take-off and the information presented in the scope documents to assign cost values to the elements of work previously cataloged.

Escalation is cost increase associated with unit price increase. Whereas the cost of projects can increase because of poor management, scope growth, and schedule delays; this cost estimating guide, as well as DOE Order 5700.2D, is concerned only with forecasting price increases caused by general or specific dollar devaluation. This is historically caused largely by an increase in the amount of currency in circulation relative to the goods and services available.

Fixed Costs are those costs independent of short term variations in output of the system under consideration. Generally seen as costs associated with a plant at zero output or throughput.

Government Cost Estimate is an estimate of costs to be incurred in the conduct of proposed activity, prepared by DOE proponent (or advocate) by the measurable and definable elements of cost, consistent with the level that a responding contractor would be required to estimate, e.g., task, subtask, line item, and work breakdown structure. It should be sufficiently documented to show clearly the rationale used in developing the quantitative elements as well as the rates. The Government cost estimate usually is used as a tool in evaluating the reasonableness of the proposal(s) for the particular procurement action. This estimate is generally performed to support negotiations and competitive bid proposals at the individual contract level rather than at the total project level.

Independent Cost Analysis is a documented analysis developed by the Office of Procurement, Assistance and Program Management (PR-24) (or its contractors) for the purpose of assessing the reasonableness of proponent cost estimates and for identifying sensitive areas of cost risk. Generally, an independent cost estimate is accomplished and is used as a tool to preform an independent cost analysis; however, an independent cost analysis may be performed without first performing an independent cost estimate.

Independent Cost Estimate is an estimate developed by PR-24 (or its contractors) that has the express purpose of serving as an analytical tool to validate, cross-check, or analyze estimates developed in proponency channels. An independent cost estimate also serves as a basis for verifying risk assessments. The term "independent cost estimate" in this cost guide means independent of the project office or advocate. This cost guide does not usurp manager's prerogatives and responsibilities to direct check estimates (see below) to validate, improve, or review current project estimates.

Interface Point. The functional, physical, or system characteristics at a common boundary between two or more project participants.

Labor Burden is the sum of the taxes and insurance costs based on labor payroll that the employer pays on behalf of or for the benefit of its employees. These include social security, federal unemployment insurance tax, state unemployment tax, workers' compensation, holiday and vacation accrual, company sponsored insurance programs, etc.

Labor Cost is the base salary, plus labor burdens associated with labor, that can be definitely assigned to one activity, product, process, or cost center.

Lead Program Secretarial Officer (Lead PSO). The PSO assigned line management responsibility and accountability for Headquarters and field operations and to which one or more multi-program DOE Field Offices report directly.

Level Of Effort (LOE). Support effort that cannot be measured in terms of discrete accomplishment. LOE is characterized by a sustained rate of activity for a specific period of time.

Life Cycle Cost is the total of the direct, indirect, recurring, nonrecurring, and other related costs incurred or estimated to be incurred in the design, development, production, operation, maintenance, support, deactivation, and/or disposition of a project or system over its anticipated useful life span. For example, if a demonstration project is operated beyond the demonstration period, those costs are also included in the life cycle cost estimate. Where system or project planning anticipates use of existing sites or facilities, restoration and refurbishment costs should be included.

Management Reserve (MR). That portion of the contract or project budget controlled by the contractor for management purposes and not designated for the accomplishment of specific tasks; when MR is used it is distributed to specific accounts.

Milestone is an important or critical event and/or activity that must occur in the project cycle in order to achieve the project objective(s).

Organizational Breakdown Structure (OBS). The hierarchical arrangement for a company's management organization, graphically depicting the reporting relationships. Normally, the OBS is limited to showing only managerial positions, but may depict lower organizational levels. The structure may also show subcontract relationships depending upon the purpose of the OBS.

Performance Measurement Baseline (PMB). The total allocated budget less management reserve. It is the time phased budget plan against which contract performance is formally measured. The performance measurement baseline includes budgets assigned to control accounts and undistributed budgets.

Pricing is the determination of the amount to be charged to the DOE so as to fully include direct and indirect cost items as well as contingency and profit. See also Government Cost Estimate.

Project. A unique major effort within a program which has firmly scheduled beginning, intermediate, and ending date milestones; prescribed performance requirements, prescribed costs; and close management, planning, and control. A project is a basic building block in relation to a program which is individually planned, approved, and managed. A project is not constrained to any specific element of the budget structure (e.g., operating expense or plant and capital equipment). Construction, if required, is part of the total project. Authorized, and at least partially appropriated, project will be divided into three categories: MSAs, Major Projects, and Other Projects.

Project Control System. The planning, scheduling, budgeting, estimating, work authorization, cost accumulation, performance measurement, reporting, change control, and other systems used by a contractor to plan and control the work.

Project Control System Guidelines. DOE established characteristics that contractors' internal management control systems must possess to assure effective planning, management, and control of projects and contracts.

Project Control System Guidelines Implementation Plan. A DOE Field Office or PSO plan for implementing the Project Control System Guidelines. The plan includes implementation policy, describes the graded application of guideline elements to projects and contracts, delineates responsibilities, and outlines the compliance review process.

Project Risk. A factor, element, constraint, or course of action on a project that introduces an uncertainty of outcome and the possibility of technical deficiencies, inadequate performance, schedule delays, or cost overruns which could impact a Departmental mission. Evaluation of project risk must consider the potential impact and the probability of occurrence.
Scope is the equipment and materials to be provided, and the work to be done. Scope is documented by the

contract parameters for a project to which the company is committed. In baseline management terminology, the term "scope" refers to those performance and design requirements, criteria, and characteristics derived from technical mission needs that provide the basis for project direction and execution.

Schedule Baseline. The time phased plan with a logical sequence of interdependent activities, milestones and events necessary to complete the project. The schedule baseline shall be formally changed during the execution of the project when required.

Semi-Variable Costs are costs that are partially fixed (independent of production level) and are partially variable (dependent upon production level). Fuels which are used for space heat and production would be semi-variable, as well as maintenance, general expense, and plant overhead costs are usually semi-variable. It is estimated that semi-variable costs at zero production are 20-40 percent of the semi-variable costs at full production. See also variable costs, fixed costs.

Take-Off is the process of measuring and cataloging the quantities of work derived from the scope documents.

Technical Baseline. A configuration identification document or set of documents formally designated and approved by DOE. The Conceptual Design Report (CDR) will become the initial project technical baseline. The initial technical baseline, plus DOE approved changes to that baseline, constitutes the current technical baseline.

Total Allocated Budget (TAB). The sum of all budgets allocated to the contract or project, as applicable. Total Allocated Budget consists of the performance measurement baseline plus management reserve.

Total Estimated Cost (TEC) is the construction costs of the project, including: the costs of land and land rights; engineering, design, and inspection costs; direct and indirect construction costs; and initial equipment necessary to place the plant or installation in operation.

Total Project Cost (TPC) is all generic research and development, operating, and plant and capital costs specifically associated with a project. It is the sum of the total estimated cost plus all other costs identifiable to the project. Project costs are mutually exclusive; i.e., if research and development is required to complete a given project that is also supporting a second follow-on project, the cost will only be charged to the first project. If the first project should be terminated, the cumulative costs of research and development support to that point will be considered sunk costs, and all costs from that point forward would be charged to the follow-on project. In no instance should the same research and development costs be charged to more than one project.

Undistributed Budget (UB). Budget within the performance measurement baseline applicable to the work effort that has not yet been identified to both a responsible organization and a WBS element.

Validation is the process of evaluating project planning, development, baselines and funding prior to inclusion of funds for a project or system acquisition in the DOE budget. It requires a review of project planning and conceptual development documentation, as well as discussion with the program or field element and principle contributing contractors to determine the source basis, procedures, and validity of proposed requirements,scope, cost, schedule, funding, and so forth. Findings and recommendations resulting from the validation process will be provided for use in the annual budget formulation.

Variable Costs are the costs that are a function of production, e.g., raw material costs, by-product credits, and those processing costs that vary with output (such as utilities, catalysts and chemicals, packaging, and labor for batch operations. See also Semi-Variable Costs.

Variance. The difference between planned and actual performance. Variances that exceed established

thresholds should be revised during the life of a project to ensure meaningful analysis.

Work Authorization. A contractor's internally documented process or system that ensures work is properly authorized and assigned at the appropriate organizational levels prior to beginning the work.

Work Breakdown Structure. (WBS) A multi-tiered framework which organizes and graphically displays elements representing work to be accomplished in logical relationships. The WBS may or may not be product-oriented; orientation may be towards products, project phases, key decision points, various budgeting units of measure, e.g., activity data sheets, or a combination. The WBS should be organized such that each element can be estimated, scheduled, budgeted, and work progress reported.

Work Package. Subdivisions of the lowest level WBS element accorded detailed scope, schedule (start and completion points), budget, a description of scope (including activities) and responsible manager.

APPENDIX B

SAMPLE ESTIMATE

ESTIMATE WORK SHEET

DATE	SCHEDULE ACTIVITY #	ADS #	ACTIVITY TITLE	ACTIVITY WBS #	ESTIMATED BY	CHECKED BY	SHEET OF

NO.	RESOURCE SCOPE / DESCRIPTION	COST ELE.	JOB CAT.	ORG. CODE	QUANTITY	UNIT	UNIT/QTY	MANHOURS TOTAL	MANHOURS $/MH	TOTAL COST	ESTIMATING ASSUMPTIONS

CALCULATION BASIS

REFERENCE:

NO.	RESOURCE SCOPE / DESCRIPTION	COST ELE.	JOB CAT.	ORG. CODE	QUANTITY	UNIT	UNIT/QTY	MANHOURS TOTAL	MANHOURS $/MH	TOTAL COST	ESTIMATING ASSUMPTIONS

CALCULATION BASIS

REFERENCE:

NO.	RESOURCE SCOPE / DESCRIPTION	COST ELE.	JOB CAT.	ORG. CODE	QUANTITY	UNIT	UNIT/QTY	MANHOURS TOTAL	MANHOURS $/MH	TOTAL COST	ESTIMATING ASSUMPTIONS

CALCULATION BASIS

REFERENCE:

APPENDIX C

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U.S. Department of Energy
DOE Hanford Reservation

Tank Waste Remediation System
(TWRS)
Operations

COST ESTIMATING GUIDE

Draft 1.0

January, 1993

TWRS Cost Estimating Guide
Draft 1.0

2. WITH RESPECT TO WHAT, #?

1.0 INTRODUCTION

Purpose of the TWRS Operations Specific Cost Estimating Guide

The activities associated with the Tank Waste Remediation System (TWRS) at Hanford include both project and program efforts that are large and complex. Planning for the future at TWRS is a challenging task; risk areas such as regulations, technologies, management practices and other changes and uncertainties all are an integral part of TWRS. The purpose of this guide is to delineate the estimating activities required in support of TWRS and facilitate implementation of the recently promulgated EM-30 Cost and Schedule Estimating Guide ~~on the TWRS Program.~~

Two major points are made relative to the EM-30 Cost Guide from Headquarters. First, the Headquarters Guide is the primary tool for development of TWRS estimates. Sections of the Headquarters Guide, especially those that relate to estimating methods and Activity Based Costing (ABC), will not be restated in the TWRS Guide. The intent of the ~~T~~TWRS Guide is to "tier under" the HQ Guide to be more responsive to TWRS. Second, the TWRS Guide is intended to cover only ongoing and planned ~~operations~~ activities at TWRS, and not projects. Projects in the DOE realm have been successfully governed by well established DOE Orders and procedures for some time, and the control mechanisms do not need restatement here.

The ultimate purpose of this Guide is to supply the necessary direction to prepare defensible, credible TWRS cost estimates. These estimates can then undergo review scrutiny, be rolled up to feed the budget process, and survive to form the basis of a historical track record of TWRS changes and decisions. The purpose of inclusion of the review criteria is to internally check estimate development performance in a TWRS self-assessment program and to improve estimate quality on an ongoing, iterative basis.

Intended Audience

The ~~TWRS~~ (TWRS) under the management of DOE-RL, is authorized as a work activity conducted by the Tank Waste Remediation System Division of the Westinghouse Hanford Company. This guide is to be used by the ~~WHC~~ TWRS Division or their associated subcontractors as a working document and estimate preparation reference. Estimators, schedulers, cost account managers (CAMs), end function managers and program planners and reviewers will find the TWRS Guide to be a practical management reference tool.

TWRS Cost Estimating Guide
Draft 1.0

Introduction to TWRS Operations Estimating

The benefits of initiating complete estimates are both short and long term. Initially, just the process of an activity by activity look at the TWRS Program will result in better planning and decision making by both the contractor and DOE. This has already occurred to some degree by the initiation of resource loaded scheduling techniques on TWRS, and has produced positive results. Increased likelihood of programmatic funding and budget approval is also a positive outcome of adaptation of the DOE EM-30 operations estimating methodology. Long term, the benefits of better program management and performance measurement, as well as the collection and use of historical cost data, will substantially improve the overall program.

Operations are defined as the activities required to plan, manage, operate, produce, manufacture, store, treat, transfer and maintain existing or planned facilities, waste, materials and infrastructure. The construction of a new facility is treated under DOE definition as a project, but the initial planning of the facility is a programmatic activity. Research and development (R&D) activities, such as those required for new TWRS pretreatment technologies, are also operations activities. The areas of a project life-cycle that are considered to be subject to TWRS operations estimating are shown in Figure 1. This "block diagram" illustrates the activities subject to operations estimates and are covered in this guide.

[[FIGURE 1 Here gph3.dwg insert 6.0 X 6.5]

Coupled with the brief definition of operations, an introduction to estimating is also in order here. Remember, however trite, that an estimate is an estimate. The activity of predicting future events and associated costs is both an art and a science. The better estimates are based on better predictions. Prediction is based on the ability to assimilate history, experience and judgement in a format that is easy to communicate and understand. The EM-30 Headquarters Guide discusses the concept of Activity Based Costing (ABC) in detail. This concept, introduced in November, 1991 by EM-30, utilizes common estimating techniques and methods borrowed from the construction industry and applies those to operations. For example, one of the first planning activities is to develop a Work Breakdown Structure (WBS) for the operations activities to be executed. Until recently, a WBS was not seen in the operations planning arena at a level for estimation.

A stated responsibility in the WHC TWRS Division Charter (September 3, 1992) is to "manage plants and facilities cost-effectively and in compliance with applicable nuclear facility operating standards". The key to cost effective management is cost effective planning.

The following sections discuss the necessary components of general requirements, scopes, schedules, estimates and self-assessment activities to allow TWRS the mechanisms for sound planning.

2.0. GENERAL REQUIREMENTS

Overall Mission
[Adapt from TWRS Division Charter OR obtain from DOE=RL or WHC?]

Master Schedule

[History from Renee]

Master WBS

[Top down meets bottom up - explain]

Overall Estimate Management

The use of an estimate update log is required for continuity of planning. This log can also show a reviewer why an estimate was updated, as well as other important update data. The log should look like the one illustrated in Figure 2. Note that the log will stay with the original estimate and estimate file. If the work is later split, ~~say by a~~ restructuring of an ADS or organization, the log should note that and be split as well. The log sheet should also note reviews and findings as illustrated.

[Figure 2 - gph4b.dwg estimate log sample]

3.0 SCOPING TWRS ACTIVITIES

Includes the importance of estimate back-up documentation, the type of information required, and the formats for input.

4.0 SCHEDULING TWRS ACTIVITIES

This section covers scheduling as it relates to the estimating process. In-depth discussion of scheduling will not be addressed.

5.0 ESTIMATING TWRS ACTIVITIES

[ABC Approach
What's reasonable for TWRS?
Use block diagram again - Gph3.dwg
RPM module]

[Augment EM-30 approach with TWRS approach from resource loaded schedules]

6.0 TWRS SELF-ASSESSMENT CRITERIA AND PROCESS

This section deals with the new peer review concept and sets up criteria for checking the completeness and quality of the TWRS estimates.

[Insert Updated Criteria and blend w/ EM-30 Cost Guide Appendix]
[Bring in Ops ICE and benchmarking process]

7.0 EXAMPLE ESTIMATE

A TWRS estimate, on the appropriate forms, will be included to illustrate the concepts outlined in the guide. Intended as a step approach.]

[NOTE: This is roughed out - need to word process 1/7/93]

APPENDIX A

TWRS ACTIVITY DICTIONARY

[Code of Accounts for Std activities plus descriptors]
[Incl CDRs, ORRs and other std configuration TWRS activities]
[Gary do???]

PROJECT TIME & COST, INC.
6501 Americas Parkway, N.E.
Suite 665
Albuquerque, New Mexico 87110
(505) 884-2929
FAX (505) 884-7672

Project Time & Cost

February 22, 1993

Environmental Restoration Technical Support Office (ER-TSO)
Los Alamos National Laboratory
P.O. Box 1663, MS J493
Los Alamos, New Mexico 87545

Attention: Mr. Gary Thompson

Dear Gary:

I received a request last Thursday for the disks and back-up documentation for the two manuals I prepared in first draft for TWRS from Renee Finke, Westinghouse Hanford. These two guides were delivered to you and Renee on the requested due date of January 29, 1993 (see enclosed cover letter). I was issued a stop work order from Los Alamos National Laboratory (LANL) on that date, pending a contract with TWRS to continue working on the agreed upon scope, which included the bulk of the work to finalize these guides.

I did receive one set of comments back from Bill Edwards, DOE-RL during the week of February 1, 1993. Since the authorized contract was through LANL, I was asked by you to have the comments sent to LANL instead of to me directly. To date, I have not received any additional comments through that arrangement.

I am not aware of any contract proceedings on continuance of this work. Based on the stop work order, the request for the disks, and the lack of comments on the first drafts, I an concluding that no desire exists to continue this work for TWRS. Could you please verify that Project Time & Cost, Inc. is no longer requested?

Although I have relayed the following concern verbally to both Renee Finke and Bill Edwards, I feel that it is necessary to transcribe my opinion of expectations on the quality of the first draft. When I last spoke to Bill, he used works like "salvageable" and "non-working document" and indicated that , with immediate response, it may be possible to "rescue" the cost guide. With less than 100 manhours of effort on both of these documents, and the redirection of the initial start of the guides by Gene Higgins in our meeting of January 6, 1993, I felt that the first draft of these guides represented both a good faith effort and a logical starting point. DOE currently has less that 10K invested in the guides. For perspective, the recently promulgated EM-30 Cost Guide represents an investment by DOE of over one-half million dollars to date. In order to complete these guides, additional time must be spent incorporating comments and detailing a "how to" path to estimate activities within TWRS. In summary, DOE-RL did receive a fair value product for the monies invested.

I have indicated in a phone conversation last Friday with Renee Finke that the request for the disks must come from LANL. She has indicated a desire to obtain the disks as soon as possible. I am awaiting your direction on both the continuance of the project and the request from Renee.

Sincerely,

PROJECT TIME & COST, INC.

Marc Zocher
Manager, Western Operations

cc: w/Enclosure

Gene Broks, PT&C
Ken Roberts, PT&C
Renee Finke, WHC
Gene Higgins, DOE-RL
Bill Edwards, DOE-RL
Jim Turi, DOE EM-33

Informal Note

February 26, 1993

TO: Pramod Mallick
FROM: Marc Zocher

RE: Program Cost Review Schedule - First Cut

Attached is the first cut at scheduling the Program Cost Reviews (PCR). I have told the Program Managers that we are trying to firm up a schedule by March 5, 1993 in order to make team assignments and handle logistics (e.g., security).

I will be calling next week to complete this schedule. If you have questions, please contact me.

Program Cost Reviews
Draft Review Dates
as of February 26,1993

DRAFT

SITE	HQ CONTACT(S)	HQ PHONE	REVIEW DATES	TEAM
DOE AL (AL ADSs)	GEORGE KLIPA	3-7129	4/22	TBD
WIPP	DOUG TONKAY ED WADE	3-7212 3-7207	4/8-4/9	TBD
LOS ALAMOS	PETE SIEBACH	3-7128	4/14-4/16	TBD
SANDIA NM (+ITRI)	PETE SIEBACH	3-7128	4/12-4/14	TBD
SANDIA CA	JANE TALARICO	3-7131	4/19	TBD
PANTEX	GEORGE KLIPA	3-7129	4/19-4/20	TBD
GRAND JUNCTION	GEORGE KLIPA	3-7129	4/22	TBD
KANSAS CITY	GEORGE KLIPA	3-7129	4/21	TBD
MOUND	JANE TALARICO	3-7131	4/20-421	TBD
DOE CH	MARY BURANDT	3-7113	TBD	TBD
DOE SAN	GORDON LANGLIE	3-7119	TBD	TBD
DOE NV	WARREN BLACK	3-7122	4/28-4/29	TBD
DOE OR	MICHAEL TORBERT BRIAN WESTICH CARL PILJ	3-7109 3-7110 3-7998	4/12-4/16	TBD
DOE SR	JENNIFER SANDS	3-7115	4/12-4/16	TBD
DOE RL (+TWRS)	GENE CHOU ANDY GRIFFITH JIM KEENAN RICK MARTINEZ + EM-36	3-7159 3-7120 3-7121 3-7648	4/26-4/30	TBD, MULTIPLE
DOE ID	JOHN NEAVE	3-7678	4/5-4/6 or 4/19-4/20	TBD
DOE RF	ROBIN SWEENEY RON DUVALL	3-7991	4/5-4/7	TBD