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PROJECT MANAGEMENT CONTROLS

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ABSTRACT

Project management controls are utilized to enhance the probability that a project will be successful. The control system used by a project manager can take many forms and can be applied at different times to varying degrees on a given project depending upon its complexity.

The Consolidated Incineration Facility (CIF) is one project of many at the Savannah River Site (SRS). The United States Department of Energy Order 4700.1 is a project management system that is applied on a site-wide basis, thus including the CIF. The control system required by this order is proceduralized to ensure that it is applied in a consistent manner and will produce reliable results. These results provide the project manager with a correlation of both costs and schedule within the defined scope to adequately assess the status of the project. This is an iterative process and can be simply stated: plan, actual, variance, corrective action, prediction, and revision.

This paper presents the basis for the project management controls applied at the Savannah River Site.

INTRODUCTION

The operating contractor at the Savannah River Site was changed in April 1989. At that time, the Consolidated Incineration Facility was approximately 50% designed. The CIF is a hazardous, low-level radioactive and mixed waste incinerator that is currently awaiting its Resource Conservation and Recovery Act (RCRA) permit. Because of its status and visibility, the CIF was chosen as one of the pilot projects for implementation of the control systems set forth by the DOE Order 2250.1C as required through Order 4700.1. This paper deals with the programmatic application of this order as pertaining to the Savannah River Site and not just on the specifics relating to the Consolidated Incineration Facility.

The systems used for planning and controlling the performance of specified projects at the SRS must meet the Cost/Schedule Control Systems Criteria (C/SCSC) set forth by the DOE. The purpose of imposing such criteria is to ensure that the visibility of project progress is sufficient to indicate results being obtained. The need for the criteria was realized by the fact that no single, common set of control systems will meet every DOE or contractor's management needs for performance measurement. Because there exist variations in corporate organization, products, and working relationships, it is not feasible to mandate a universal system for cost and schedule control. The DOE has adopted an approach pioneered by the Department of Defense which simply defines the criteria that subordinate management control systems must meet. As a minimum, this system is expected to provide a framework for defining and organizing work, establishment of budgets, and controlling costs with respect to scheduled versus actual

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accomplishments. Because the criteria requires the information reported to the DOE be produced from the same system used by internal management; summarization of detailed cost, schedule, and technical achievement information to appropriate levels of management is a necessary feature of this system. The criteria is divided into five major sections: Organization, Planning and Budgeting, Accounting, Analysis, and Revision and Access to Data. This layout encompasses the fundamentals of sound project controls and is generally in the order in which they should be accomplished.

ORGANIZATION

Organization of the project is principally concerned with the definition of work required to be performed and the assignment of tasks to those responsible for executing the work. The document which defines the total project objectives into increasingly smaller and manageable units of work is the Work Breakdown Structure (WBS). By the book, a WBS is a product-oriented family tree division of hardware, services, and other work tasks which organizes and graphically displays the product to be produced. Refer to Appendix I, which shows a typical WBS with multiple levels. The uppermost structure is termed the Project Summary Work Breakdown Structure and is generally associated with the acronym WBS. As the tree is expanded by the contractor, these elements -- including the upper levels -- define the Contract Work Breakdown Structure (CWBS).

In order to give meaning to the short, sometimes cryptic descriptions common to work breakdown structures, a complete description of the scope and objectives is created. This document is titled the WBS Dictionary and is intended to describe "what" will be accomplished, not "how" it will be accomplished.

Careful consideration should be given to the development of the work breakdown structure and its continual expansion. This document facilitates planning by providing a formal structure for identifying work; simplifies the confusions associated with summarizing project data; and establishes the reporting structure for both internal and government management.

Whereas the WBS defines and organizes the work to be performed, the Organizational Breakdown Structure (OBS) reflects the way the contractor has organized the people who will accomplish the work.

By relating the lowest levels of the WBS and OBS, a matrix can be constructed. Appendix II shows such a relationship. The point of interrelationship defines a potential cost account. In the event that work scope defined at the lowest level of the WBS is required to be performed by the intersecting organization, a cost account is realized. Virtually all aspects of the cost/schedule system come together at this point including budgets, schedules, work assignment, problem identification, and corrective actions. Considering the magnitude and importance placed upon the cost account, the necessity for a comprehensive strategy to develop its content is vital. This is accomplished through planning.

Below the delineation of cost accounts are specific tasks grouped into work packages which are required to accomplish the work scope, milestones, and deliverable items. These are scheduled segments of work; and by applying budgets, a time-phased plan against which actual accomplishments can be compared is produced. It is the establishment, maintenance, and use of this plan which are extremely important aspects of the criteria. It is crucial to the success and usefulness of the cost/schedule system that the planning be comprehensive and thorough at the onset and be

maintained and executed with discipline. Any change to the plan, be it in duration or resource requirements, should be carefully controlled and documented.

While planning and scheduling are required at all levels of the work and organizational breakdown structures, they become progressively more detailed at the lower levels. Because schedules must be summarized to the appropriate level of visibility, the establishment of a schedule hierarchy is necessary. The system defined by Westinghouse at the Savannah River Site includes five such levels delineated by the customer/ ownership relationship. Appendix III is a graphical representation of this hierarchy.

PLANNING

Because the Savannah River Site is so diverse in its products and the organizations responsible to execute the services, it is not practical to establish or maintain an entire project schedule database at a central location. For this reason, schedule traceability (vertical integration) of project interaction (horizontal integration) are accomplished by use of scheduled milestones. To assist the project manager in determining what might be a useful milestone, management consultants at Bertram N. Abramson, Inc., offer this advice: "A milestone is a significant point in development and is an accomplishment which must be obtained in order to meet a stated objective. It is a point of project evolution which singularly defines the progress of an organization and can be verifiable by others. [A milestone may also be described as] ... an event which requires approval before proceeding further or will affect the course of future project activity. If it does not meet these conditions, it is not a milestone."

The criteria is reasonable clear regarding the expectations of a scheduling system. In general, the system should time phase all project work within the confines of major project milestones and be meaningful in terms of technical requirements. Schedules should contain key milestones and activities which recognize significant constraints and relationships (logical predecessors and successors) and, as stated, be able to summarize to various levels. Inherent in sound scheduling is the ability to measure progress at any given point in time, and the network should have the ability to forecast completion dates. There are various scheduling techniques and computer software programs available to make this once laborious task easier, faster, and more accurate.

In many cases, all of the project scope cannot be planned or scheduled in detail from the start. For example, construction strategies and methods cannot be finalized until definitive design is complete; yet, detailed design may not be available for several years. When it is clearly impractical to plan work in cost accounts, it is desirable to isolate the work scope and resource requirements in to planning accounts. This summary level planning will eventually be planned to the appropriate level of detail as project conditions warrant. A Key point to summary level planning is that it is no substitute for early and comprehensive planning. Without timely work definition and budget allocation, the validity of the project baseline is in question.

BUDGETING

Upon completion of planning and scheduling, a solid foundation exists for establishment of budgets. A solid plan demands the consideration of resources available and limitations; and at this point, detailed scheduling has balanced these two factors. Before describing the process of budget strategy within the context of C/SCSC, it is necessary to describe the overall budget structure and terminology. Appendix IV represents a typical budget tree and corresponding definitions.

In general, criteria discussion on project budgeting states that direct budgets should be allocated to the organization performing the work. Indirect budgets should be allocated to organizations responsible for controlling these costs; and undefinitized cost, such as management reserve and undistributed budget, should be identified.

For most management teams, the areas of confusion revolve around the proper use of management reserve and undistributed budget. By the book, management reserve is an amount of the total budget withheld for control purposed rather than designated for the accomplishment of a specific task. For most large projects, particularly in the design phase, there is uncertainty regarding timing or magnitude of future difficulties. The criteria permit the use of management reserve provided that adequate control of distribution and accountability is made. The primary purpose of such reserve is to provide funds for authorized but undefinitized work or other modifications to existing authorized work. Management reserve should never be used in an attempt to camouflage cost variances.

Cost variances can be compared to an instrument that gauges the amount of product or productivity passing through a pipeline. While the allocation of management reserve will almost always cure the symptom of a variance it will seldom correct the cause.

Undistributed budget are those funds which are definitized in terms of work scope, but as yet, are not identifiable to the contractor's work breakdown structure. A typical example of this situation might be when work is authorized to be performed, but reporting deadlines prohibit detailed planning to cost or planning account.

ACCOUNTING

While the budget process is concerned primarily with planning how a project's funds are "supposed" to be spent, the accounting system will reveal how they are "indeed" spent. While it is perhaps the most complicated section of the criteria, it is indeed the most important. As the name implies, it provides accountability; a traceable history (and justification) of the taxpayer's dollar. The criteria expects accountability of costs on various levels which are termed Elements of Cost. Most predominate of these elements are Labor, Material, Subcontracts, Travel, etc. In addition to collecting the direct and indirect cost associated with the project, it is required that cost, price, and usage variances be calculated and justified.

ANALYSIS

Analysis of data produced from the C/SCSC system is to a large extent formulized. There are five basic elements or variables of analysis, and they are summarized as follows:

Budgeted Cost of Work Schedule (BCWS) - hours and/or dollar amounts which have been budgeted for all work necessary to complete the project.

Budgeted Cost of Work Performed (BCWP) - Hours and/or dollar amounts which have been budgeted for completed or partially completed work packages.

Actual Cost of Work Performed (ACWP) - An "applied" actual hour and/or dollar amount spent to accomplish work.

Budget at Completion (BAC) - The negotiated project cost plus the estimated cost of authorized changes to the original cost. Applies to G&A, Undistributed Budget, and Management Reserve.

Estimate to Complete (ETC) - The total estimated cost of all remaining work necessary to complete the total project.

Estimate at Completion (EAC) - The total cost of all work performed to date (ACWP) plus the Estimate to Complete (ETC).

The data elements most problematic for management and control teams to master are Budgeted Cost of Work Performed (BCWP) and Estimate at Completion (EAC). BCWP represents the anticipated to budgeted costs of the work actually performed. Determination of the quantity of work actually performed is generally done by an earned value system, wherein the performers can take credit only for discrete, identifiable units of work with specific deliverables. Some work cannot be measured in this fashion. In these cases, a "level of effort" can be used to make this determination. Comparison of the BCWP to the actual costs collected through the accounting system provides management a measure of the cost variances on the project. These variances are analyzed, and corrective actions are planned. If corrective actions cannot mitigate the variance trend, the project's EAC will be affected. The EAC is an estimate of the final cost of the project based upon the variances identified to date.

This system also provides for determination of schedule variances correlated by dollars. Comparing the BCWP to the BCWS provides information on how the project schedule is being met. The establishment of the BCWS is an integral part of the planning and budgeting section previously discussed. This comparison provides a measure of the schedule variance in terms of dollars, but without cost variances due to non-schedule-related interferences. As with the cost information, variances on the schedule are identified and corrective actions identified.

REVISION AND ACCESS TO DATA

The final section of the criteria pertains to revisions to planning and budgeting which are necessitated through the normal evolution of the project. There are four basic condition which call upon the maintenance of the baseline; and in order of impact they are: Formal Reprogramming, Contract Changes, Internal Replanning, and Management Reserve Transactions.

Formal Reprogramming is an undesirable condition of the project. The necessity of reprogramming indicates that the project baselines are unrealistic and performance measurement is meaningless. In the event of this condition, the project is rebaselined to represent a reasonable plan for completing the remaining scope.

Contract Changes are government-directed changes and impact nearly all aspects of internal planning and control systems. Such changes could add or delete scope, or compress or expand scheduled durations.

Internal Replanning is considered a normal and continual occurrence. Internal replanning refers to actions within the project scope to compensate for cost, schedule, and technical problems routine in the life of the contract. In many instances, this process is aided by management reserve transactions to fund in-scope and technical modifications throughout the process of data revision.

Baseline maintenance is essential and contractor discipline is mandatory through all levels of the organization. Maintenance procedures, especially in regard to budgeting practices, should clearly define those practices which are acceptable.

APPENDIX

- Appendix I Typical Work Breakdown Structure
- Appendix II Responsibility Assignment Matrix
- Appendix III Westinghouse Savannah River Scheduling Hierarchy
- Appendix IV Typical Budget Tree with Definitions

ACKNOWLEDGEMENT

The information contained in the document was developed during the course of work under Contract No. DE-AC09-89SR18035 with the U.S. Department of Energy. By acceptance of this paper, the publisher and/or recipient acknowledges the U.S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper along with the right to reproduce, and to authorize others to reproduce all or part of the copyrighted document.

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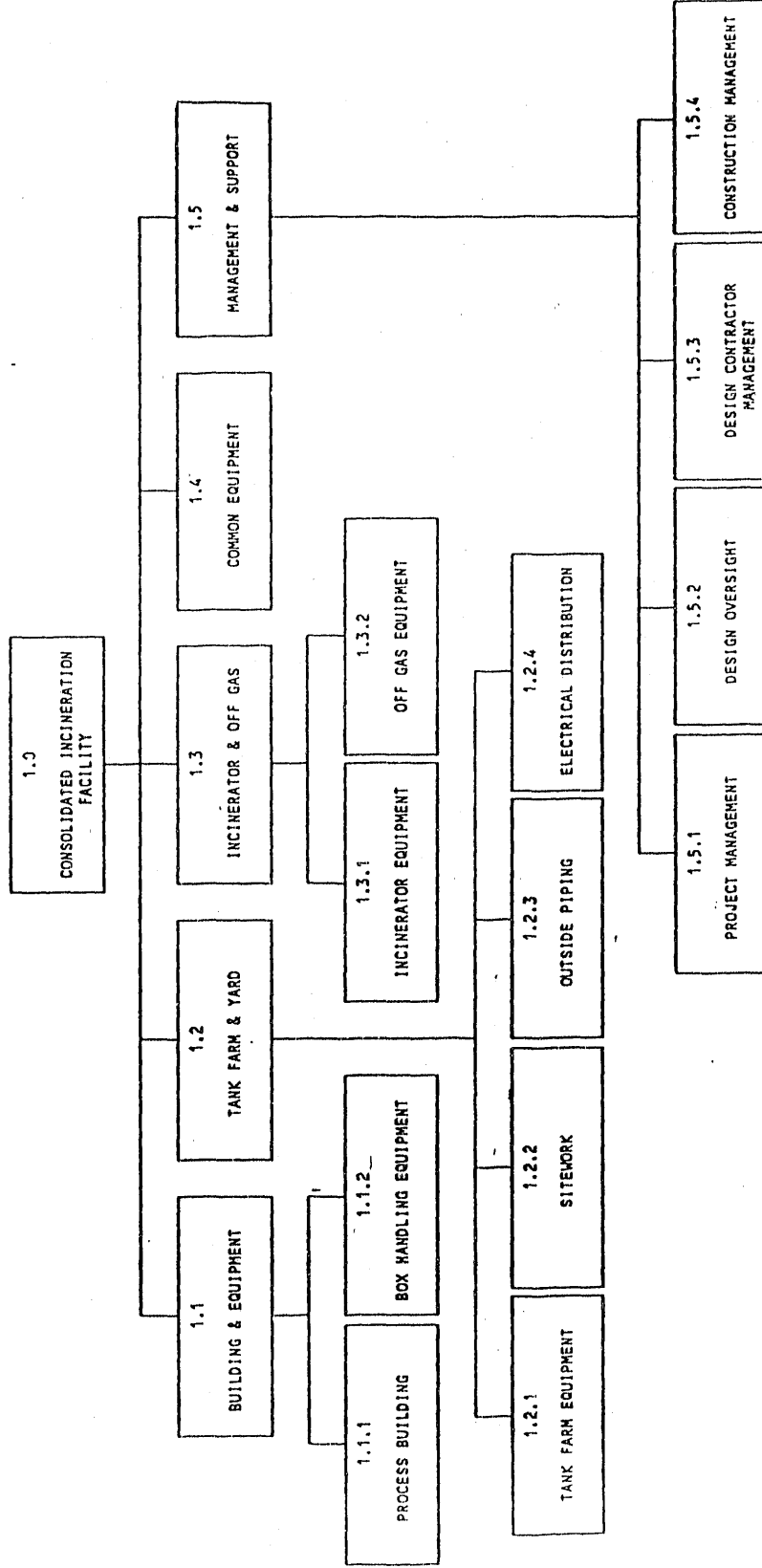
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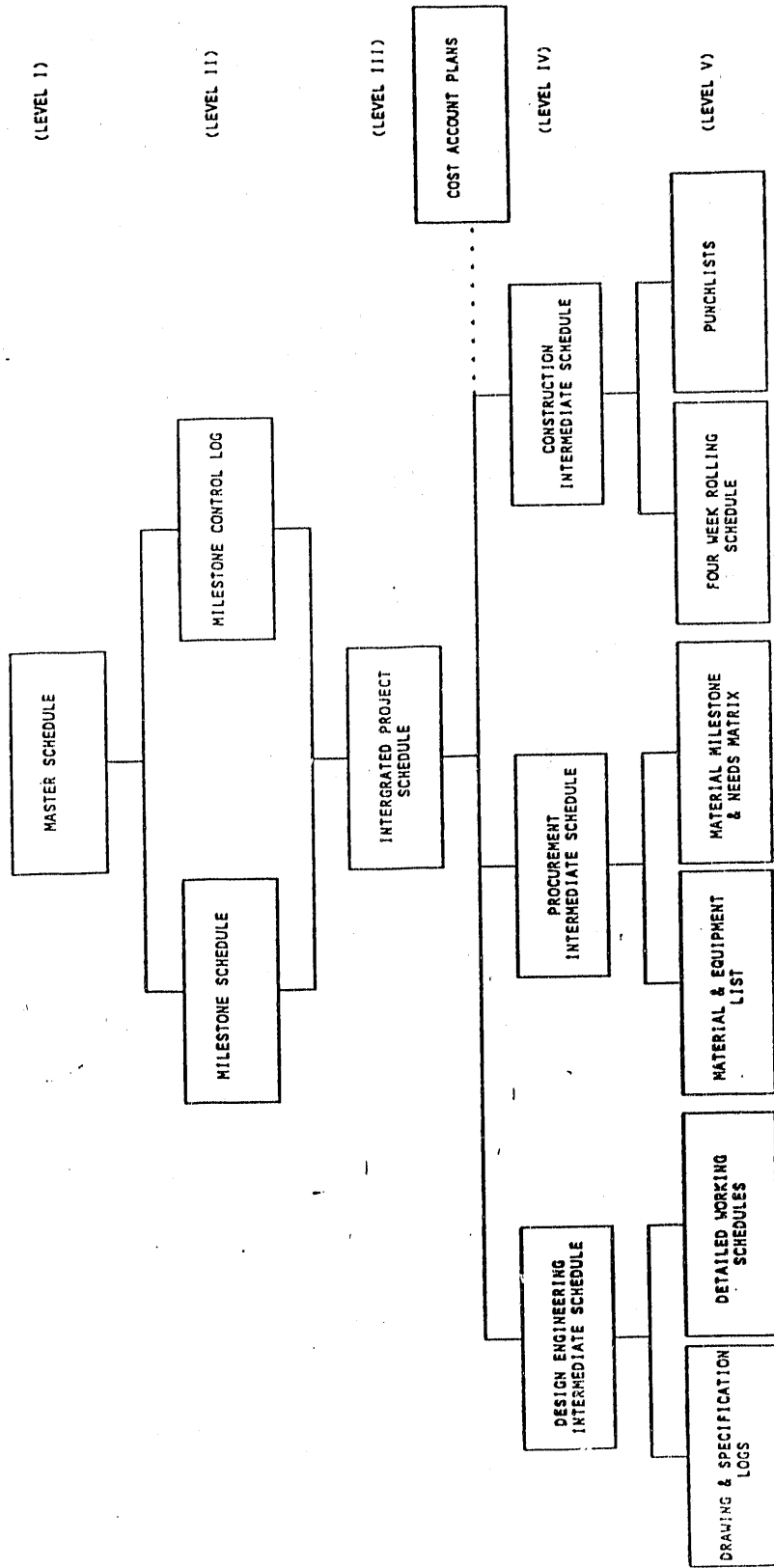
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Appendix I Typical Work Breakdown Structure



Appendix III Westinghouse Savannah River Scheduling Hierarchy

OPERATING COSTS - COST INCURRED PRIOR TO PROJECT AUTHORIZATION FOR ADVANCED STUDIES AND THOSE COST ASSOCIATED WITH THE OPERATION, MAINTENANCE AND DECOMMISSIONING OF THE FACILITY.

ESTIMATED COST OF AUTHORIZED UNPRICED WORK - OWNER AUTHORIZED WORK WHICH HAS NOT YET BEEN NEGOTIATED FOR FINAL COST.

PROJECT BUDGET BASE (PBB) - OWNER/CONTRACTOR NEGOTIATED PROJECT COST PLUS THOSE RESERVES SET ASIDE FOR MANAGEMENT CONTROL PURPOSES.

CONTINGENCY - THAT PORTION OF THE TOTAL ESTIMATED COST RETAINED BY THE OWNER TO COVER EXPENSES ASSOCIATED WITH UNFORESEEN OR UNCERTAIN EVENTS. ALSO USED TO FUND ADDITIONAL PROJECT SCOPE.

PERFORMANCE MEASUREMENT BASELINE (PMB) - THE TIME-PHASED BUDGET PLAN AGAINST WHICH PROJECT PERFORMANCE IS MEASURED. IT IS FORMED BY THE BUDGETS ASSIGNED TO SCHEDULED COST ACCOUNTS, SUMMARY PLANNING ACCOUNTS AND UNDISTRIBUTED BUDGET.

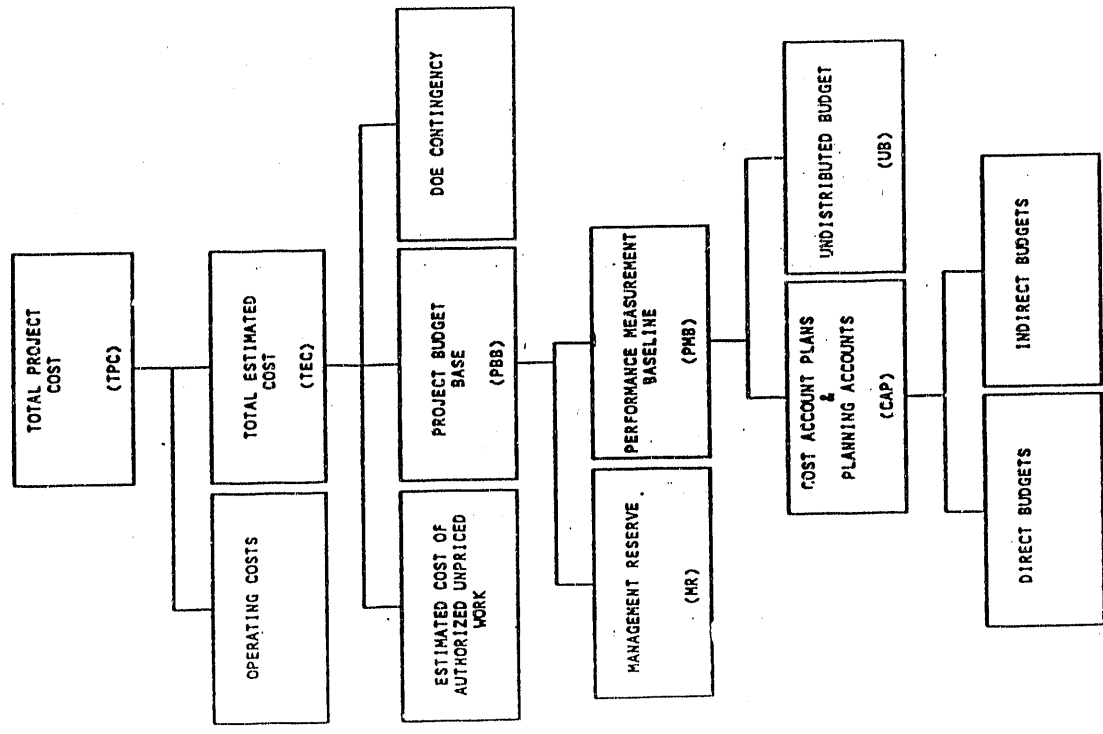
MANAGEMENT RESERVE (MR) - AN AMOUNT OF THE TOTAL ALLOCATED BUDGET WITHHELD FOR MANAGEMENT CONTROL PURPOSES RATHER THAN DESIGNATED FOR THE ACCOMPLISHMENT OF A TASK OR SET OF TASKS.

COST ACCOUNT PLAN (CAP) - A MANAGEMENT CONTROL POINT AT WHICH BUDGETS, EARNED VALUE, ESTIMATES AND ACTUAL COSTS ARE ACCUMULATED AND COMPUTED FOR VARIANCE ANALYSIS.

UNDISTRIBUTED BUDGET (UB) - A PORTION OF THE PROJECT BUDGET NOT YET ASSIGNED TO A SPECIFIC WBS ELEMENT.

DIRECT COSTS - THE UNBURDENED COST OF LABOR, MATERIALS, ETC. WHICH IS DIRECTLY RELATED TO A SPECIFIC WBS ELEMENT AND IS CHARGED DIRECTLY TO THE PROJECT.

INDIRECT COSTS - BURDEN, USUALLY OVERHEAD AND GENERAL & ADMINISTRATIVE COSTS ALLOCATED TO AN ACCOUNTING BASE AND CHARGED OVER THE PROJECT EFFORT.



Appendix IV Typical Budget Tree with Definitions

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