DOE/ET-0050/6
RDD/PMS-6

RRT Management Control System

Performance Measurement System

Work Breakdown Structure (WBS) Guide

REVISION OF FEBRUARY 4, 1977

Note: This document was previously published by the Energy Research and Development Administration (ERDA) prior to the activation of the U.S. Department of Energy (DOE) and is being reprinted without any substantive changes. Therefore, wherever ERDA is mentioned, its functions have been transferred to DOE. Furthermore, the Division of Reactor Development and Demonstration has been renamed the Division of Reactor Research and Technology.

U.S. Department of Energy
Assistant Secretary for Energy Technology
Division of Reactor Research & Technology
Washington, D.C. 20545

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CHAPTER 2

WBS TERMINOLOGY

2-1 General

The LMFBR Program overall objective is pursued through subprograms under Plant Development (FFTF, CRBRP etc.) and Technology and Safety (Materials, Safety, Fuel, etc.) (Figure 2-1). For purposes of this guide, the activities conducted under the subprograms are referred to as projects. Projects usually start as a result of efforts on advance studies, advance research and technology, or as a derivative of on-going projects. A project is then defined by the technical or operational objectives to be achieved, the time allotted for its completion, and the resources allocated. A project's products may be hardware (facilities, reactors, steam generators, etc.), services (plant operation, test and evaluation, project management, etc.), data (technical reports, engineering data, management data, etc.) or other quantified objectives. The WBS technique serves as the unifying theme between the program and its supporting projects. It reflects the detailed products and the work to be accomplished and provides the conceptual framework for planning and controlling the project work. In order to apply the WBS concept correctly, it is essential that the terminology associated with WBS preparation, revision, and maintenance be fully understood and used in the proper context. The following discussion assists in interpreting WBS requirements and terminology as used by RDD.

2-2 WBS Levels

The hierarchy of tasks that compose the project work to be accomplished are identified within a WBS by a level designation. Descending levels provide increasingly detailed definition of the individual work tasks. The number of levels depends on the scope and complexity of the individual project. The top three levels of WBS for a project would be typically subdivided as follows:

A. Level 1. Level 1 is the quantified project objective, e.g., CRBRP, SAREF, Physics Technology, Steam Generator System. It is usually directly identified in the ERDA planning, programming and budgeting system.

B. Level 2. Level 2 contains the major work segments (subsystems) of the project such as Nuclear Steam Supply System, Experimental Breeder Reactor, Mathematical Model, Evaporator, aggregations of services (Test and Evaluation), and data.

C. Level 3. Level 3 work is subordinate to the Level 2 major work segments. Examples are Reactor Systems, Decay Heat Removal System, Computer Program, Evaporator Shell, a type of service (Systems Engineering), and an item of data (Technical Reports).

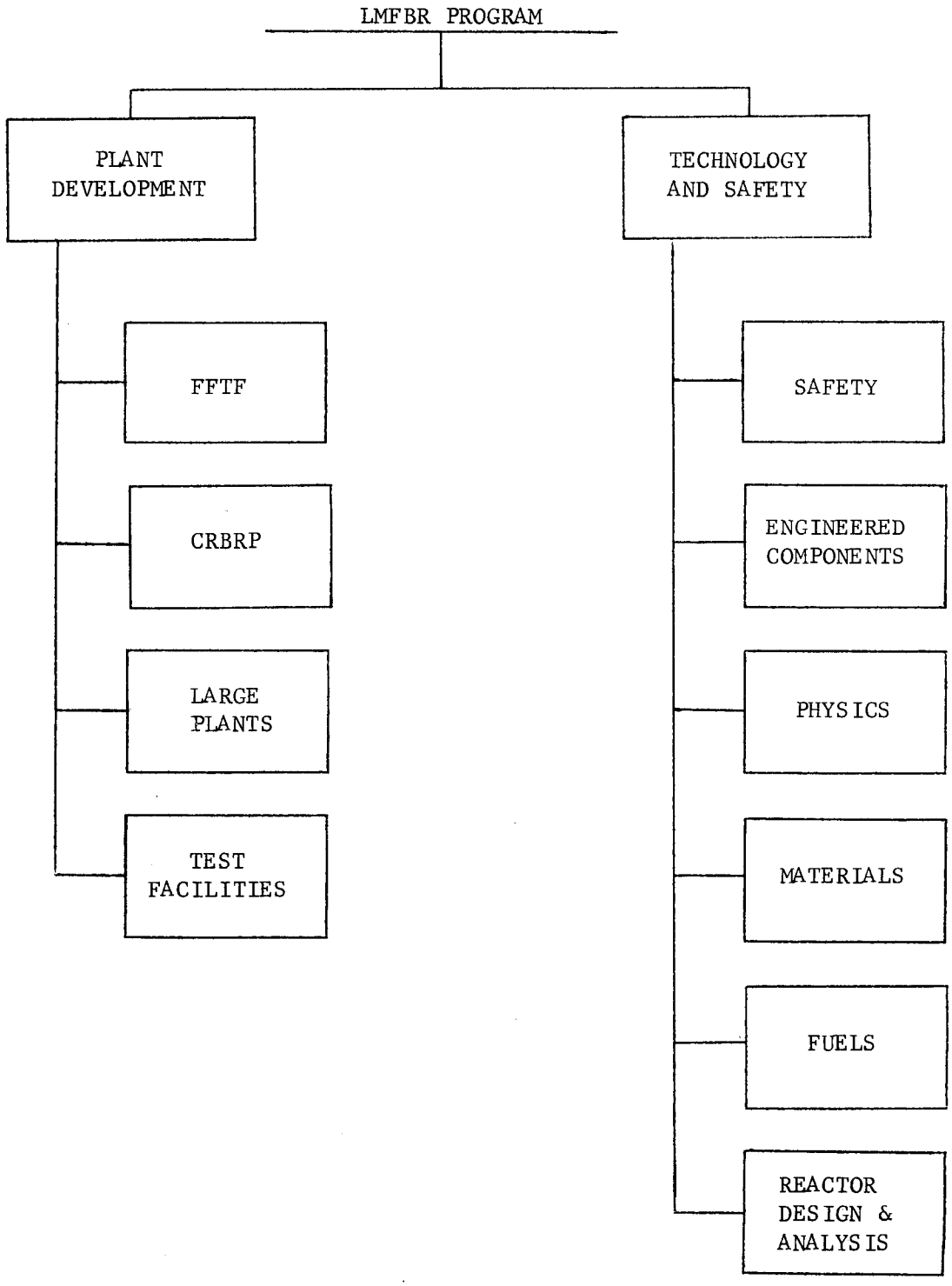


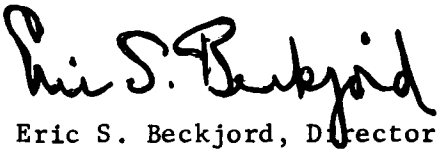
Figure 2-1 LMFBR PROGRAM

FOREWORD

One of the most important goals of this Division is improved management of the Liquid Metal Fast Breeder Reactor (LMFBR) Program, its projects and supporting activities. This goal must be rigorously pursued if we are to accomplish the objectives of the LMFBR Program in today's environment of budgetary constraints and schedular discipline. In moving toward an improved management capability, we are instituting a number of policy and procedural changes and will continue to investigate new ways and techniques to further improve the way we do business.

The application of the Performance Measurement System (PMS) on major contracts and the Mini-Performance Measurement System (Mini-PMS) on smaller contracts is a significant step toward the accomplishment of our management improvement goal. Incorporation of the cost and schedule control system criteria approach within the PMS will insure that a contractor's progress is sufficiently visible to reliably evaluate accomplishments and to provide the basis for timely and meaningful management decisions. For contracts that do not meet the requirements for PMS application, a less rigid version of PMS known as Mini-PMS may be applied. Using either PMS or Mini-PMS, project status will be presented in terms of established project objectives and contract values which provide a baseline from which project accomplishment can be measured.

This document is one of a series of guides and instructions on contract performance measurement that has been prepared to assist ERDA and industry personnel. The Performance Measurement System Work Breakdown Structure Guide contained herein describes the Work Breakdown Structure (WBS) technique as a tool for project management, particularly within the PMS and Mini-PMS.



Eric S. Beckjord, Director
Division of Reactor Development
and Demonstration

Summary of Revised, Deleted, or Added Material

This revision includes a new sample solicitation clause (Appendix E) and a new sample contract clause (Appendix F). It also incorporates minor editorial changes and an updated list of references (par. 1-5).

Reactor Development and Demonstration Division
Energy Research and Development Administration
Washington, DC 20545

RDD/PMS-6
2/77 Revision

PERFORMANCE MEASUREMENT SYSTEM
WORK BREAKDOWN STRUCTURE GUIDE

This document provides guidance approved by the Director/RDD for preparing and using Work Breakdown Structures. Users of this guide are encouraged to submit recommendations for refined procedures, through channels, to the Assistant Director for Administration (AD/A) at the address above.

TABLE OF CONTENTS

E. RDD/PMS-5, Performance Measurement System Surveillance Guide, March 30, 1976

Provides guidance to government and contractors concerning continuing government review of systems required to meet the PMS criteria for management control systems. Includes discussion of administrative aspects of surveillance, surveillance responsibilities, and procedures for planning and performing surveillance. Includes a sample Memorandum of Agreement and Surveillance Plan Outline.

F. RDD/PMS-7, Mini-PMS Guide, January 14, 1977

Describes the application, implementation, and operation of Mini-PMS, a derivative of the PMS, that may be applied to contracts requiring visibility and control, but that do not warrant use of PMS. Mini-PMS may also be used by prime contractors on subcontracts.

G. RDD/PMS-8, Performance Measurement System Review Team Handbook, March, 1977

Provides guidance for government participants reviewing contractor's management control systems that are required to meet the requirements of PMS or Mini-PMS. It discusses review activities and participant's duties and responsibilities. Various review checklists are included.

H. ERDA Handbook 0805.3 Part 1, Work Breakdown Structures

Describes in general terms the preparation and employment of Work Breakdown Structures.

I. MIL-STD-881A, Work Breakdown Structures for Defense Material Items

This standard establishes criteria governing the preparation and employment of Work Breakdown Structures for use during the acquisition of designated defense material items.

CHAPTER 1

INTRODUCTION

1-1 Purpose of the Guide

This guide provides guidance on the use of the Work Breakdown Structure (WBS) technique to Reactor Development and Demonstration Division (RDD) managers responsible for projects supporting the LMFBR Program. The guide covers the types of WBSs, how and by whom they are prepared, and how they should be used by RDD and contractors for effective management and control.

1-2 Application

The WBS technique is used in the application of the RDD Performance Measurement System (PMS) and the Mini-Performance Measurement System (Mini-PMS). Its roles within the PMS and Mini-PMS are discussed in RDD/PMS-1, PMS Summary Description; RDD/PMS-2, PMS Implementation Guide; and RDD/PMS-7, Mini-PMS Guide. The WBS method of defining and organizing work may also be used on projects/contracts when the PMS or Mini-PMS are not applied. In these cases the WBS technique can be used to definite advantage in accomplishing the project/contract objectives.

1-3 Scope

The WBS technique is used to:

A. Identify the major end items or end products needed to accomplish the project/contract objectives;

B. Identify and define the detailed tasks required for the research, development, construction, demonstration, operation, or production of the major end item/product;

C. Assign responsibility for task accomplishment to specific project and contractor organizations and individuals;

D. Provide the framework for planning and scheduling of work, and the allocation of resources to that work;

E. Assist in monitoring project cost, schedule, and technical performance;

F. Provide a structure for the orderly summarization of work performance to selected levels of detail; and

G. Identify work requiring special attention and its reprogramming when necessary.

1-4 Revisions and Additions

Persons using this guide are encouraged to submit suggestions for improvements to the Assistant Director for Administration (AD/A), RDD/ERDA, Washington, DC 20545.

1-5 References

Persons interested in additional information regarding the WBS technique and the PMS or Mini-PMS should read the following documents:

A. RDD/PMS-1, Performance Measurement System Summary Description, Revision of January 28, 1977

Provides an overview of PMS and Mini-PMS application, implementation, and operation.

B. RDD/PMS-2, Performance Measurement System Implementation Guide, March 30, 1976

Provides guidance to ERDA and contractors concerning PMS requirements for contractors' management control systems. Contains criteria for these systems. Also contains detailed discussion of the criteria, organizational relationships, and implementation procedures. Includes samples of PMS solicitation and contract clauses, a review report format, and a Memorandum of Understanding. Also includes an Evaluation/Review Checklist and Work Sheets.

C. RDD/PMS-3, Performance Measurement System Contractor Reporting Instructions, Revision of January 14, 1977

Provides guidance for preparation of the PMS and Mini-PMS reports required from contractors. These reports include the PMS Management Control System Description, the Mini-PMS Summary System Description, the Work Breakdown Structure Dictionary, the Cost Performance Report, the Cost/Schedule Status Report, the Schedule Status Report, and the Contract Funds Status Report. The reports provide the means to collect summary level cost and schedule performance data and funding data for project management purposes. Includes are the data item descriptions for placing the reports on contract.

D. RDD/PMS-4, Performance Measurement System Data Analysis Guide, March 30, 1976

Contains a collection of techniques to determine cost and schedule status, identify trends, and forecast future status using PMS and Mini-PMS reports from contractors. Includes examples for deriving performance indices, performing trend analyses, etc.

2-3 WBS Elements

The individual work tasks specified at each level in the WBS are defined as WBS elements. Each element is a discrete portion of the WBS, comprising either an item of hardware, service, or data. The WBS should include all the necessary elements to achieve the project end objective. If necessary, an Integration and Assembly element is used to describe the technical and functional effort required to combine all other elements at a given level into their parent element at the next higher level.

2-4 WBS Dictionary

The WBS Dictionary lists and defines the WBS elements. This Dictionary is initially prepared by Project Management and then expanded by supporting contractors. It consists of two parts. Part I is an index which lists WBS elements extended in accordance with the guidance contained herein. Part II contains individual entries to describe the content and the type of effort associated with the WBS element. The WBS Dictionary is maintained in a current status throughout the life of the project. Appendix G contains the Data Item Description for preparing the WBS Dictionary.

2-5 Summary WBS

A Summary WBS serves as the starting point in preparing a WBS for a project. It illustrates the general hierarchy of systems, subsystems, and supporting elements. It contains three levels and is characterized by uniform WBS elements placed in a family-tree type arrangement. The Summary WBSs in Appendices A through D have been prepared for guidance and use for the following types of projects:

A. Appendix A LMFBR Generating Plant Project
B. Appendix B LMFBR Test Facility Project
C. Appendix C LMFBR Component Project
D. Appendix D LMFBR Research Project

2-6 Project Summary WBS (PSWBS)

The tailoring of the Summary WBSs (i.e., selection of appropriate Summary WBS elements for the specific project) and addition of unique project elements by Project Management results in the PSWBS. Generally, the PSWBS identifies WBS elements through the third level.

2-7 Contract WBS (CWBS)

The CWBS is the WBS for the products or services to be furnished under the contract. It is developed and used by the contractor in accordance with this guide and the contract statement of work. The CWBS includes the PSWBS elements selected by Project Management for the contracted work and the extensions of these elements by the contractor to define the lower level detailed tasks. Normally, the CWBS is extended to include the cost account

or comparable management control level. It provides a consistent and visible framework that facilitates uniform planning, assignment of responsibilities, and reporting of status.

2-8 Project WBS

The Project WBS is the complete WBS for the project, containing the WBS elements related to the research, development, construction, demonstration, operation, or production of project objectives. It evolves from the PSWBS extended to include all CWBSs.

2-9 WBS Coding

Each WBS element should be assigned a code to be used for identification of the elements throughout the life of the project. A simple decimal or alphanumeric coding system should be applied that logically indicates the elements by level and relates lower level supporting elements to their parent upper level elements. The coding system must accommodate the coding of CWBSs which may appear at various levels within the Project WBS. If such a coding system is not possible, a coding interface conversion system may be applied. Where possible, the first number in the WBS code should be the ERDA Budget and Reporting (B&R) Classification number. For example, a third level element of an LMFBR Generating Plant Project with a B&R number of "40", might be coded 40.6.4. Referring to Appendix A, this element would be Test and Evaluation work (Level 3) within Project Support (Level 2) of the "40" LMFBR Generating Plant Project (Level 1).

2-10 Additional Terminology

Following are definitions of terms used in this guide:

A. Apportioned Effort. Effort (e.g., quality assurance) that by itself is not readily divisible into short-span work packages but which is related in direct proportion to a specific measured effort.

B. Contracting Officer. The ERDA Contracting Officer responsible for administering an existing contract. Typically has additional responsibilities, e.g., contract negotiation and execution.

C. Contractor. A private or public entity which enters into contracts with the Government. In this guide, the work also applies to government-owned, contractor-operated activities which perform work on major energy projects.

D. Cost Account. A management control point at which actual costs can be accumulated and work performance evaluated. A cost account is a natural control point for cost/schedule planning and control since it represents the work assigned to one responsible organizational element on one CWBS element (see paragraph 3-4B. (2) and Figure 3-2).

E. Level of Effort (LOE). Support type effort (e.g., vendor liaison) that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of activity over a specific period of time.

F. Project Director. The individual within the Division, Field Operations Office, or designated Project Office responsible for executing an approved RDD project within well defined boundaries of time, resources, and performance requirements.

G. Project Management. The Division Office, Field Operations Office, or designated Project Office responsible for directing an RDD project and headed by a Project Director or equivalent.

H. Source Evaluation Board (SEB). A board composed of qualified ERDA technical and business personnel, including a Project Management representative, that (1) determines the most appropriate method of choosing, applying, and reporting on the criteria which best assists the Source Selection Official in selecting or approving the source with which negotiations are to be initiated, (2) uses its best judgement in application of such criteria to the proposals, and (3) reports on the results of its work to the Source Selection Official. The Source Selection Official is the ERDA official who selects the contractor which he considers can perform the contract in a manner most advantageous to the Government based on the SEB proceedings.

I. Work Packages. Detailed short-span jobs, or material items identified by the contractor for accomplishing work required to complete the contract. A work package has the following characteristics:

(1) It represents units of work at levels where work is performed.

(2) It is clearly distinguished from all other work packages.

(3) It is assignable to a single organizational element and cost account.

(4) It has scheduled start and completion dates and, as applicable, interim milestones all of which are representative of physical accomplishment.

(5) It has a budget or assigned value expressed in terms of dollars manhours or other measurable units.

(6) Its duration is limited to a relatively short span of time or it is subdivided by discrete milestones to facilitate the objective measurement of work performed.

(7) It is integrated with detailed engineering, construction, or other schedules.

CHAPTER 3

PREPARATION OF WBSs

3-1 General

This chapter discusses the preparation of the various WBSs defined in Chapter 2. Project Management is responsible for developing the complete task structure and element definition for all project-related work. To prepare the Project WBS, Project Management develops first the PSWBS based on the project objective and the appropriate Summary WBS elements. Contractors supporting the project develop, coordinate, and submit individual CWBSs for the work required by their contracts. Finally, Project Management integrates the CWBSs with the PSWBS to obtain the Project WBS. The relationships of these WBSs in preliminary and final states are shown in Figure 3-1. Details on their preparation are covered in the following paragraphs.

3-2 Project Objective

The primary prerequisite to the preparation of any WBS is the clear understanding and statement of the project objective. The work activity directed towards satisfying this goal is hierarchical in nature. The project overall objective is the major end item or end product in support of the LMFBR program. For example, a project whose end item is a facility for safety research and testing would support two of the LMFBR Program specific objectives, e.g., utility confidence and public acceptance. Similarly, a project whose end product is a research study report on a fuel recycling technique would support another LMFBR Program specific objective, energy resource assurance.

Once the project overall objective is established, it provides insight into and guidelines for the identification of the project subobjectives by Project Management. These subobjectives interact to support the project overall objective in the same manner that subsystems support a total system capability. Project Management should identify subobjectives by careful analysis of the project overall objective. This process of identification and definition of subobjectives assists in structuring the contributing elements during WBS preparation.

3-3 Project Summary WBS (PSWBS)

The PSWBS is prepared by Project Management initially as a preliminary PSWBS. In this preliminary state, the PSWBS is used to identify work for supporting contracts. The PSWBS elements assigned to contractors are subsequently extended by the contractors to derive the CWBSs. The preliminary PSWBS is based on the project overall objective and subobjectives and on the Summary WBSs as contained in Appendices A through D. Project Management selects the appropriate Summary WBS and tailors it to project needs by adding or deleting elements (Figure 3-1, box 1). While the

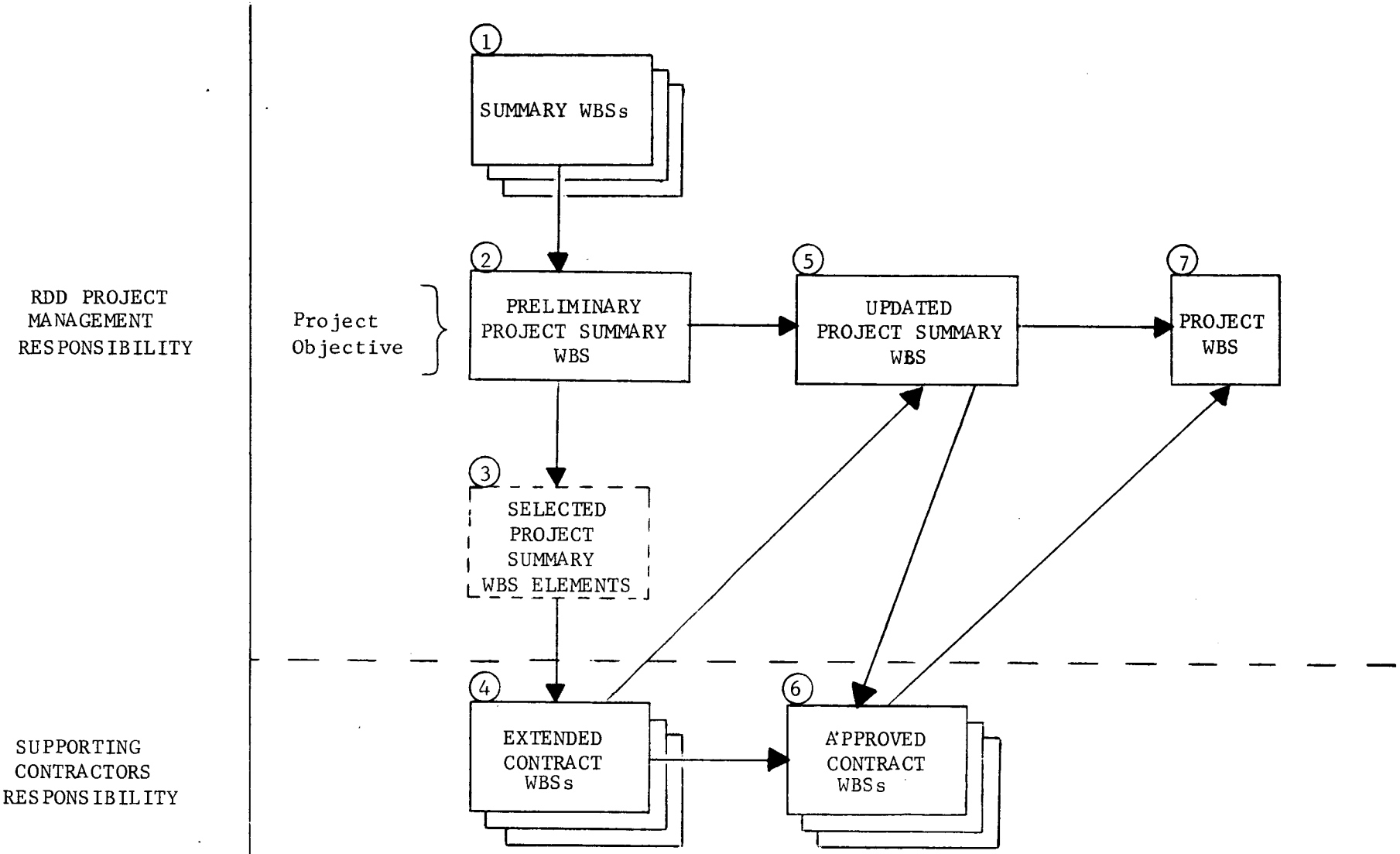


Figure 3-1

RELATIONSHIP OF THE TYPES OF WBSs

Summary WBSs and their elements specified in Appendices A through D normally provide the basis for constructing PSWBSs, changes may be made when they are based on unique needs determined through project concept studies and system engineering work.

When necessary, selection of the Level 2 and Level 3 elements may be made from one or more of the Summary WBSs. Those Summary WBS elements that are included in the PSWBS should be described uniformly to assure standardization of element description. Normally, the PSWBS is prepared with Levels 1 through 3. Lower level elements should be included only to address clearly all project requirements.

The WBS development process is iterative. The preliminary PSWBS is not intended to be rigid and may be changed, if appropriate. During the time contractors are developing their CWBSs, they may propose alternative approaches to better accomplish the project objectives. If the alternatives provide a better means toward attaining the project objectives, the preliminary PSWBS should be revised accordingly. Changes may also occur when it is determined that a different approach must be taken to satisfy the project objective.

The PSWBS should be prepared by Project Management early in project planning, (Figure 3-1, box 2). Care should be taken to assure that the PSWBS represents the needs of the various functions involved with Project Management (i.e., Construction, Procurement, Engineering, Project Control, etc.). Initially, the PSWBS is used to specify contract work supporting the project. It serves as the framework for the Project WBS and for the technical and management activities throughout the life of the project.

3-4 Contract WBS (CWBS)

A. Solicitation

Only one WBS is used in each Request for Proposal (RFP) and ensuing contract. Project Management structures the preliminary CWBS by selecting the appropriate PSWBS elements to be included in the RFP (Figure 3-1, box 3). The elements selected should permit maximum flexibility to proposers in preparing their proposals. Normally, the preliminary CWBS should not contain more than three levels because it may become unduly restrictive. If additional detailed levels are added, a proposer's organizational structure may be affected and his normal method of operation may be hampered. The proposers should be instructed in the RFP to extend the preliminary CWBS as low as necessary to identify and structure the work effort to achieve the contract purpose (Figure 3-1, box 4). The proposers should be allowed to suggest changes to the selected PSWBS elements when a change is needed to meet an essential requirement of the RFP or to enhance the effectiveness of the CWBS in satisfying the project objective.

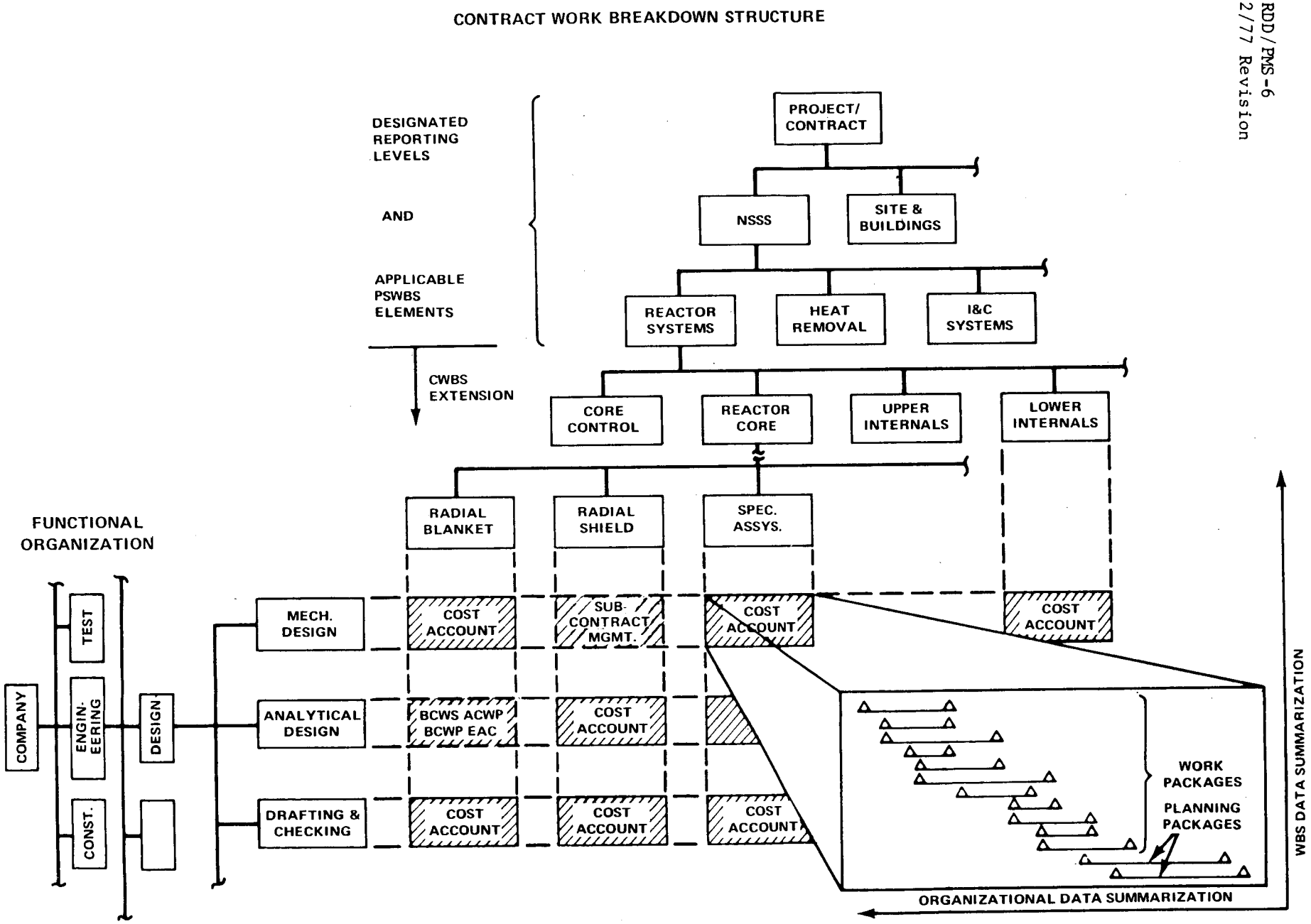


Figure 3-2 INTEGRATION OF WORK BREAKDOWN STRUCTURE AND ORGANIZATIONAL STRUCTURE

NOTE: This figure is applicable to a contract with PMS. For Mini-PMS cost accounts and work packages are not specifically required.

The preliminary CWBS in the RFP includes the initial WBS Dictionary of CWBS elements, prepared by Project Management, using the formats shown in Appendix G. Appendix E contains a sample clause for including the CWBS requirement in solicitations.

B. Response

When proposers prepare their CWBS in response to the solicitation, they should consider the following:

(1) The CWBS is not an end in itself. It is a tool used by project/contractor management. As such, management objectives and needs play a dominant role in the way and the level to which the CWBS is developed. The CWBS must reflect how the work is actually to be performed and must represent the manner in which work efforts are organized, managed, and reported. The lower levels may be configuration items, service elements, items of data, or meaningful product or management oriented lower indentures of a higher level element. The prospective contractor should have complete flexibility in extending a CWBS to reflect how his work is to be accomplished, assuring that lower elements support the next higher level element. Particular attention should be given by the proposer to ensure the correlation of lower levels of the CWBS to the work statement tasks and to the specification tree, contract line items, configuration items of the contract, data items, etc.

(2) Each CWBS element must interface with the proposer's organization responsible for accomplishing that element. There must be flexibility to establish these interfaces at meaningful and appropriate levels. Otherwise, his existing management systems and management by assigned responsibility may be impaired. Figure 3-2 illustrates the level at which the interface between the CWBS and the contractor's organization occurs when PMS or Mini-PMS is applied. This level is designated the cost account level and it is a natural management control point for cost/schedule planning and control. The cost account is composed of lower level tasks or job assignments.

At the cost account, all work is categorized into one of three different types of effort:

(a) Discrete work packages with a specific end product or result.

(b) Level of effort which does not result in a final product.

(c) Apportioned effort which can be directly related to other discrete tasks.

For those contracts where PMS or Mini-PMS do not apply, the levels selected for management control are identified by the proposer.

(3) Critical products or services which are to be subcontracted should be identified and treated as individual CWBS elements. Other subcontracted work should be identified in the WBS Dictionary under the appropriate element. In either case, the proposer should assure the traceable summarization of subcontractor data supporting his CWBS. The proposer may require the use of WBSs by subcontractors to permit him to fulfill his CWBS requirements and to provide adequate control of the subcontractors.

(4) A WBS Dictionary of the extended WBS elements is required from each proposer to fully explain:

(a) The work to be performed;

(b) How the work will be accomplished;

(c) Who will do the work; and

(d) Other significant data which further describes each CWBS element, e.g., an identifiable relationship between the CWBS element and a design specification.

(5) The CWBS coding method used by the proposer should enable meaningful summarization of related data from the lowest to the highest levels of the CWBS. The coding structure proposed for planning and accumulating costs must be compatible with the project coding structure so that contract reports can be incorporated directly into project reports.

C. Evaluation

The preliminary CWBSs submitted by the prospective contractors are evaluated by the Source Evaluation Board (SEB) as part of the proposal evaluation process. For evaluation purposes, the proposer must respond based on the RFP preliminary CWBS. Since this CWBS may not always be compatible with the way prospective contractors plan to organize and manage the contract work, the RFP should permit a proposer to suggest an alternate CWBS. If an alternate is proposed, it must be based on the RFP CWBS.

D. Negotiation

In the negotiation of an appropriate contractual document, the preliminary RFP CWBS, as extended and included in the successful proposal, serves as the basis for agreeing to a WBS for the contract. Project Management should specify the elements that require Contract Officer approval prior to revision by the contractor. Usually, these Project Management controlled elements are identical to those specified for contractor reporting. The agreed upon CWBS provides the common denominator for communication between Project Management and the contractor on work planning, control and contract reporting. This

CWBS provides the means for control of changes in project and contract needs. If the agreed to CWBS includes elements that impact the PSWBS, it should be updated accordingly (Figure 3-1, box 5).

Provision should be made to reference the CWBS in the contract through use of a contract clause similar to the sample clause in Appendix F. Project Management should negotiate the WBS Dictionary contents (see Appendix G) with the contractor. Part I - Index, normally, lists each WBS element including those at the cost account level (i.e., PMS applied) or those at the comparable selected management control level for other applications. Part II - Element Definition may or may not include these lowest levels depending on Project Management's needs. The contractor submits the WBS Dictionary to Project Management through the responsible Contracting Officer. Upon Project Management's recommendation, the Contracting Officer formally approves the CWBS (Figure 3-1, box 6).

E. Post Contract Award

The approved CWBS becomes the basis for further evolution by the contractor during the contracted effort and serves as the baseline for change control. The WBS Dictionary provides the reference required to assure that contract work and reporting are being accomplished in accordance with the approved CWBS. Processing of CWBS revisions varies depending on whether an element is classified as a project or contractor controlled element.

Project Controlled Elements. These are the CWBS elements specified by Project Management for its control and contractor reporting. Normally, these project controlled elements are in the upper three levels of the CWBS. Elements controlled below Level 3 should be characterized by having significant cost risk or technical risk or having a significant financial impact on the project. When a project is supported by multiple contractors, elements specified for project control may vary by contract. As the project progresses, Project Management should review the CWBS periodically to determine if elements should be added or deleted to those being controlled. Project Management, in any case, should provide for special (i.e., limited to as required) WBS element reporting for analysis of problem areas regardless of their position in the WBS. Any changes to the controlled elements should be submitted to the Contracting Officer in the WBS Dictionary format with supporting justification for review and approval. Based on Project Management's recommendations, the Contracting Officer notifies the contractor in writing of the acceptability of such changes.

Contractor Controlled Elements. Care should be exercised by Project Management to assure that only those CWBS elements essential to Project Management be specified for project control purposes. This permits contractor flexibility in making changes to low level elements without resorting to the revision approval process. The CWBS elements that Project Management has determined should be contractor controlled

are those located below the project controlled elements. When a contractor does revise an element under his control, the change is documented by an update to the WBS Dictionary and forwarded to the Contracting Officer.

3-5 Project Work Breakdown Structure

Project Management constructs the Project WBS (Figure 3-1, box 7) by combining the approved CWBSs for all supporting contracts and the updated PSWBS. All levels of the CWBSs need not be included in the Project WBS. Project Management should incorporate those elements that it considers necessary for its management purposes. After review and approval by the Project Director, the Project WBS in the WBS Dictionary format should be published and distributed to RDD organizations with defined project responsibilities and to contractor management. The approved Project WBS is maintained and revised to incorporate changes throughout the life of the project to ensure traceability of the project work efforts.

3-6 Summary of Functions and Responsibilities

Responsibilities for preparation of the various WBSs discussed in this chapter are summarized in Table 3-1. Users of this guide should understand that the sequence shown in Table 3-1 may be iterative as the project evolves and contracts are awarded. WBS revisions also result from expansion or contraction with project/contract scope changes and the movement of a project through its various phases (e.g., research, development, construction, demonstration, and operation).

Table 3-1

WBS PREPARATION

	Function	Responsibility ERDA	Responsibility Contractor
1.	Preliminary PSWBS Prepared (par. 3-3)	X	
2.	PSWBS Elements Selected for Solicitation (par. 3-4A.)	X	
3.	Preliminary CWBS Extended and Proposed Changes Submitted in Responses (par. 3-4B.)		X
4.	Evaluation Conducted by Source Evaluation Board (SEB)(par. 3-4C.)	X	
5.	Contractor Selected and Contract Negotiated (Including Changes to CWBS, if any)(par. 3-4D.)	X	X
6.	Contract Awarded, CWBS Approved (par. 3-4D.)	X	
7.	PSWBS Revised to Include Approved Changes (par. 3-4D.)	X	
8.	Project WBS Prepared (par. 3-5)	X	
9.	CWBS Maintained (par. 3-4E.)		X
	Change Submission		X
	Change Approval	X	
10.	Project WBS Maintained (par. 3-5)	X	

CHAPTER 4

USES OF THE WBS

4-1 Planning and Budgeting

The WBS technique assists Project Management in the planning and budgeting functions by providing a formal structure which identifies and relates all the work effort required to meet the project objective. By breaking the total project into successively smaller entities, Project Management can ensure that all required products and supporting work are identified and addressed. Furthermore, it can verify that all work identified on the WBS, and hence charged to the project, actually contributes to the project objective. In addition, a WBS simplifies the summarization of contract and project data for planning and budgeting purposes. The planning of work by WBS elements serves as the basis for budgeting resource requirements. Aggregation of the element resource needs, according to their relationship in the WBS, leads to total project budget requirements. Subsequently, the assignment of the budgets to scheduled segments of the work produces a time-phased plan against which actual performance can be compared and plans changed as needed.

4-2 Funding

A WBS can be used in developing the project' funding requirements, both for the next fiscal year and for future fiscal years' planned obligations. The information derived from a WBS can assist in establishing, justifying, and allocating project funds. Since the work and cost content, priority, and status of each WBS element is defined, a baseline exists for the planning of, controlling of, and accounting for project funds. The Contract Funds Status Report (CFSR) is a contractor-submitted report that supplies funding data based on the WBS (see References C and F of paragraph 1-5).

4-3 Estimating

Project cost estimating is facilitated by use of a WBS. The WBS technique provides a systematic approach to cost estimating that ensures relevant costs are not omitted. An estimate derived through a WBS helps Project Management to monitor, control, and coordinate the various activities that Project Management and contractors are conducting. In addition, it serves as a vehicle to constantly refine cost estimates for the planning and budgeting functions discussed in paragraph 4-1.

In day-to-day project operations, cost collection by WBS element can be used in estimating costs for pricing and negotiating contract changes and for follow-on procurements. In the long run, RDD can accumulate a cost data bank of similar WBS elements from different projects. This historical cost data can be used in estimating the financial requirements for like elements of new projects. For these new projects, the WBS can provide the framework for the estimating process. Subsequent performance data collection

by both the contractor and Project Management can be compared to the original estimates to establish their validity, to identify trends, and to re-estimate project future needs.

4-4 Scheduling

The WBS affords a framework for the aggregation of schedule information by WBS elements to establish overall and detailed schedules. The impact of schedule changes may be readily assessed when a WBS is used because each element's start and completion date is integrated with the other elements' schedules. This allows expedited review and approval of schedule changes by Project Management. Periodic schedule reports for selected WBS elements, complete with variance analyses, can be required of contractors. In contracts where the PMS or Mini-PMS is applied, the Schedule Status Report, Cost Performance Report, and Cost/Schedule Status Report (see Reference C, paragraph 1-5) fulfill this requirement. Project Management can use these types of reports to monitor progress and to control the project.

4-5 Performance Measurement

A. PMS Applicable

An initial step in the application of PMS and Mini-PMS is the preparation of a WBS. The WBS accomplishes the PMS and Mini-PMS objectives of work definition and provides the basis for performance measurement with a product orientation. The WBS is structured in accordance with the manner in which work will be performed and reflects how performance data (including earned value) is summarized and eventually reported to RDD. Contractors performing under PMS requirements report their performance to Project Management using the Cost Performance Report (CPR) (see Reference C. paragraph 1-5). This report contains performance data both by WBS and functional organization. Mini-PMS contractors report using the Cost/Schedule Status Report (C/SSR) (see Reference F. paragraph 1-5). Additional information on the use of WBS technique within PMS and Mini-PMS is contained in References A through G of paragraph 1-5.

B. PMS Not Applicable

When PMS is not applicable and the WBS technique is used, Project Management should negotiate with the contractor the type of WBS performance reporting to be submitted. The PMS definitions of RDD/PMS-2 (Reference B. of paragraph 1-5) provide data elements associated with performance measurement that can be used for this purpose.

4-6 Configuration Management

Configuration management is the task of managing, controlling and reporting the planned and actual design of items throughout their intended life. For configuration management, the CWBS is extended

sufficiently to identify the WBS elements selected for this purpose. It is not necessary that the CWBS level identified for project control purposes (e.g., contract reporting) also be the level used for configuration management.

4-7 Integrated Logistic Support

Integrated Logistic Support (ILS) is a composite of all support considerations necessary to assure the effective and economical support of a system or equipment for its life cycle. This function manifests itself in the WBS by provision of an element or a series of elements applicable to logistical support activities such as Support and Test Equipment, Spare and Repair Parts, Transportation and Handling, Technical Data, Personnel, and Training. Essential to incorporation of ILS in a WBS is the integration of support planning with hardware design. The WBS logistic elements should effectively provide the capabilities to support the prime system and its components. The elements should reflect schedule compatibility with the acquisition of the project products and lead time planning needs of the site or test facility activities receiving these items.

4-8 Test and Evaluation

If required, the WBS may specifically provide for test and evaluation of systems, subsystems, and components. A Test and Evaluation element is used to obtain or validate performance data on prototype or special hardware. This element includes the detailed planning, conduct, support, data reduction, and reports from such tests. Test and evaluation interrelationships require that determinations be made as to the organizational activities responsible for accomplishing development, reliability, and qualification tests. This necessitates a review of the testing requirements to establish the necessary supporting elements to the overall Test and Evaluation element. Only testing relating to more than one component should be included in a task type WBS element such as the Test and Evaluation element.

APPENDIX A

SUMMARY WORK BREAKDOWN STRUCTURE FOR LMFBR GENERATING PLANT PROJECT

Level 1	Level 2	Level 3
N.0 LMFBR Generating Plant		
	N.1 Plant Site & Buildings	
		N.1.1 Plant Site
		N.1.2 Plant Buildings
		N.1.3 Plant Auxiliary Structures
		N.1.4 Models and Mockups
	N.2 Plant Operations & Services	
		N.2.1 Plant Operations
		N.2.2 Maintenance
		N.2.3 Plant Security
		N.2.4 Personnel and Health Services
	N.3 Reactor & Steam Supply Mechanical & Electrical Systems	
		N.3.1 Reactor Systems
		N.3.2 Heat Removal System
		N.3.3 Instrumentation & Control Systems
		N.3.4 Maintenance Systems
		N.3.5 Fuel Handling Systems
		N.3.6 Auxiliary Systems
		N.3.7 Models and Mockups
	N.4 Turbine Generator Mechanical & Electrical Systems	
		N.4.1 Primary Generating System
		N.4.2 Auxiliary Systems
		N.4.3 Instrumentation & Control
		N.4.4 Models and Mockups
	N.5 Fuel System	
		N.5.1 Fuel Rods
		N.5.2 Fuel Pins
		N.5.3 Cladding
	N.6 Project Support	
		N.6.1 Project Management
		N.6.2 Supporting Studies, including Analytic Models
		N.6.3 System Engineering
		N.6.4 Test & Evaluation
		N.6.5 Safety Licensing
		N.6.6 Reliability
		N.6.7 Training
		N.6.8 Data
		N.6.9 Spares

APPENDIX B

SUMMARY WORK BREAKDOWN STRUCTURE FOR LMFBR TEST FACILITY PROJECT

Level 1	Level 2	Level 3
M.0 LMFBR Test Facility		
	M.1 Site and Buildings	
		M.1.1 Site
		M.1.2 Buildings
		M.1.3 Auxiliary Structures
		M.1.4 Models and Mockups
	M.2 Test, Handling & Instrumentation Equipment	
		M.2.1 Equipment System #1
		M.2.2 Equipment System #2
		.
		.
		.
		M.2.N Equipment System #N
	M.3 Facility Operations and Services	
		M.3.1 Facility Operations
		M.3.2 Maintenance
		M.3.3 Data Support Services
		M.3.4 Test Item Storage and Handling
		M.3.5 Facility Security
		M.3.6 Personnel and Health Services
	M.4 Project Support	
		M.4.1 Project Management
		M.4.2 Special Studies
		M.4.3 System Engineering
		M.4.4 Training
		M.4.5 Test Documentation
		M.4.6 Test Data and Reports

APPENDIX C

SUMMARY WORK BREAKDOWN STRUCTURE FOR LMFBR COMPONENT PROJECT

Level 1	Level 2	Level 3
P.0 LMFBR Component (e.g., Steam Generator)		
	P.1 Sub-Component #1 (e.g., Evaporator)	
		P.1.1 Assembly 1-1 (e.g., Shell)
		P.1.2 Assembly 1-2 (e.g., Tubes)
		.
		.
		.
		P.1.M Assembly 1-M
		P.1.N Sub-Component Integration
	P.2 Sub-Component #2 (e.g., Superheater)	
		P.2.1 Assembly 2-1 (e.g., Heating Elements)
		P.2.2 Assembly 2-2 (e.g., Alarms)
		.
		.
		.
		P.2.M Assembly 2-M
		P.2.N Sub-Component Integration
	(Additional Level 2 elements for each Sub-Component)	
	P.3 Component Test & Evaluation	
		P.3.1 Test Facilities
		P.3.2 Demonstration Tests
		P.3.3 Test Support
		P.3.4 Test Data
	P.4 Project Support	
		P.4.1 Project Management
		P.4.2 Supporting Studies
		P.4.3 System Engineering
		P.4.4 Data & Specifications
		P.4.5 Spares
		P.4.6 Transportation & Handling

APPENDIX D

SUMMARY WORK BREAKDOWN STRUCTURE FOR LMFBR RESEARCH PROJECT

Level 1	Level 2	Level 3
Q.0 LMFBR Research Project		
	Q.1 Concept Study	
		Q.1.1 State-of-the-Art Study
		Q.1.2 Concept Visualization
		Q.1.3 Data and Recommendations
	Q.2 Mathematical Model	
		Q.2.1 Mathematical Formulation
		Q.2.2 Computer Program
		Q.2.3 Test and Evaluation
	Q.3 Project Support	
		Q.3.1 Project Management
		Q.3.2 Technical Data

APPENDIX E

SAMPLE

SOLICITATION CLAUSE

In the preparation of a response to this solicitation:

(a) The offeror shall extend the preliminary Contract Work Breakdown Structure (CWBS) contained in the solicitation as low as necessary to identify and structure the work effort to successfully achieve the end objective(s) of the contract scope of work. The preparation of a CWBS is described in RDD/PMS-6, Work Breakdown Structure Guide. The offeror shall develop the lower levels of the preliminary CWBS in a manner that will assure compatibility with his organization and management system.

(b) The offeror shall submit the CWBS in the format of a WBS Dictionary, as required by RDD/PMS-6. Changes proposed by the offeror to the preliminary CWBS included in the solicitation package shall be identified appropriately. The offeror shall provide information and assistance as requested by the Source Evaluation Board for evaluation of the CWBS submitted.

(c) The CWBS proposed by the offeror will be evaluated prior to contract award. Upon approval of the CWBS, the WBS Dictionary will be revised to list and define the approved CWBS elements. Subsequent changes to specified project controlled CWBS elements will require prior written approval of the Contracting Officer.

APPENDIX F

SAMPLE

CONTRACT CLAUSE

(a) In the performance of the work under this contract, the Contractor shall establish, maintain, and use the Contract Work Breakdown Structure (CWBS) approved by the Contracting Officer. The approved CWBS in the WBS Dictionary format, as required by RDD/PMS-6, Work Breakdown Structure Guide, shall be maintained and used by the Contractor in the performance of the contract work.

(b) If the Contractor proposes any changes to the project controlled CWBS elements identified in the approved WBS Dictionary which require prior approval, they shall be submitted to the Contracting Officer in WBS Dictionary format with supporting justification. The Contracting Officer shall advise the Contractor in writing of his approval or disapproval of such changes.

(c) The specified lower level CWBS elements that do not require prior approval for revision may be changed by the Contractor. After such changes are made, the Contractor will submit appropriate revisions to the WBS Dictionary to the Contracting Officer.

(d) The Reporting format by CWBS elements will be as directed by the Contracting Officer.

(e) Deviations from the approved CWBS discovered during contract performance evaluation conducted by the Government shall be corrected as directed by the Contracting Officer.

APPENDIX G

RDD/PMS-6 DID RDD 6-1

DATA ITEM DESCRIPTION	APPROVAL DATE March 30, 1976

1. Title

WORK BREAKDOWN STRUCTURE DICTIONARY

References

RDD/PMS-1	PPG #26
RDD/PMS-2	PPG #27
RDD/PMS-3	ERDA Handbook
RDD/PMS-4	0805.3 Part 1
RDD/PMS-5	
RDD/PMS-6	MIL-STD-881A

2. Description/Purpose

The Work Breakdown Structure (WBS) establishes the framework for reporting project cost, schedule, and technical performance. It provides a consistent and visible framework that facilitates uniform planning, assignment of responsibilities, and reporting of status. The WBS Dictionary is used to document this framework for the project and supporting contracts, as applicable. It consists of two parts. Part I is the Index, and Part II is the Element Definitions.

The WBS technique is used on projects/contracts with PMS requirements and for non-PMS projects/contracts when there is a need for defining and monitoring the work effort in a systematic manner.

3. Preparation Instructions

A. Part I, Index. The WBS Index contains the information in the attached format. The Index lists the preliminary WBS elements extended to the lowest level needed in accordance with RDD/PMS-6. Complete only applicable blocks. Specific project requirements may be added as needed.

Header:

Block 1. Enter project title and name of contractor
Block 2. Enter applicable contract number
Block 3. Enter date of preparation

Columns:

4. Line Number. Enter sequential numbers to identify each entry.

5. WBS Elements. Enter the WBS element title and an "x" to reflect the level, e.g., Level 1 is the contract. Level 2, 3, etc., are successively lower indentures of the contract WBS. Enter an asterisk (*) before the title of each element to be reported and under project control. Enter a parenthetic (s/c) following each subcontracted element title.

6. Contractor WBS Code. Enter the code devised by the contractor for internal identification of the WBS element.

7. Budget and Reporting Classification (B&RC). Enter the appropriate B&RC.

8. Phase Designator. Enter the appropriate designator from the table below to identify the project phase of the contract:

R	=	Research	D	=	Demonstration
Dv	=	Development	O	=	Operation
C	=	Construction	P	=	Production

9. Other. Add columns as required to cross reference the WBS element to other pertinent documents. For example, columns may be added for System Design Description Number, Configuration Item Number, Statement of Work Number, etc., and the applicable reference entered.

B. Part II, Element Definitions. Part II describes the WBS elements contained in the Index and their relationship to design and funding documents. The general format for Part II is in accordance with the attached format. Complete only applicable blocks. Specific project requirements may be added as needed.

Block 1. Enter the WBS element code from Column 6 Part I, element title, and contractor.

Block 2. Enter the Index Line Number.

Block 3. Enter the identifier of the current revision and reference the authorizing document.

Block 4. Enter date of preparation.

Block 5. Enter the identifier and short title of previously approved changes to the WBS element.

Block 6. Enter the System Design Description Number and title or other appropriate system specification identification pertaining to the WBS element.

Block 7. Enter the funding sources and appropriate identifier (e.g., number or title, or both) of the funding document associated with the WBS element.

Block 8. Cost Content - Describe the type of organizational entities and/or elements of costs charged to the WBS element (e.g., Construction Labor, Engineering Labor, Electrical Cable, Vendor Tooling, Subcontracted Effort, Computer Operation, Travel, Printing, etc.).

Technical Content - Describe, if any, the technical content (e.g., heat transport system), the components included (e.g., instrumentation and controls), their relationships to each other (e.g., operating temperatures and pressures), and how they support other WBS elements (e.g., reactor core).

Work Statement - Describe the functional activity or service necessary to make the product or to accomplish the work objectives of the WBS element (e.g., planning, designing, fabricating, constructing, integrating, testing, etc.).

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