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7. Abstract

This Systems Engineering Working Plan (SEWP) describes how the Westinghouse Hanford Company (WHC) Tank Waste Remediation System (TWRS) will implement the systems engineering policy and guidance in the RL TWRS Systems Engineering Management Plan (SEMP) dated March 1994.

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ABBREVIATIONS AND ACRONYM LIST

A/E	Architect and Engineer
ADR	As-built Design Review
ALARA	As Low as Reasonably Achievable
BSD	Baseline System Description
CCB	Configuration Control Boards
CFR	Code of Federal Regulations
CM	Configuration Management
D&D	Decontamination and Decommissioning
D&DR	Decontamination and Decommissioning Review
DDR	Detailed Design Review
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy, Headquarters
DRD	Design Requirements Document
DRR	Design Requirements Review
DT&E	Development Test and Evaluation
ECP	Engineering Change Proposal
ERC	Environmental Restoration Contractor
F&R	Functions and Requirements
F&OR	Functions and Operational Requirements
HAZOP	Hazard and Operability
ICD	Interface Control Document
ICWG	Interface Control Working Group
IDEF	Integrated Computer-Aided Manufacturing Definition
LCC	Life-Cycle Cost
MIP	Management Integrating Procedure
NEPA	National Environmental Policy Act
OT&E	Operational Test and Evaluation
P&ID	Piping and Instrumentation Diagram
PICD	Programmatic Interface Control Document
PMP	Program Management Plan
QA	Quality Assurance
R&D	Research and Development
RAM	Reliability, Availability, and Maintainability
RL	U.S. Department of Energy, Richland Operations Office
RM	Risk Management
RMACS	Requirements Management and Assured Compliance System
SAR	Safety Analysis Report
SE	Systems Engineering
SEML	Systems Engineering Master Logic
SEMP	Systems Engineering Management Plan
SEWP	Systems Engineering Working Plan
SRR	System Requirements Review
T&E	Test and Evaluation
TEP	Test and Evaluation Plan
TPM	Technical Performance Measurement

ABBREVIATIONS AND ACRONYM LIST (cont)

TRR	Technical Requirements Review
TRS	Technical Requirement Specification
TWRS	Tank Waste Remediation System
VE	Value Engineering
WBS	Work Breakdown Structure
WHC	Westinghouse Hanford Company

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this Systems Engineering (SE) Working Plan (SEWP) is to describe how the Westinghouse Hanford Company (WHC) Tank Waste Remediation System (TWRS) will implement the SE policy and guidance provided in the *Tank Waste Remediation System (TWRS) Systems Engineering Management Plan (SEMP)* (RL 1993b, Annex 2).

1.2 SCOPE AND APPLICABILITY

The SEWP is an internal WHC document that is subordinate to the U.S. Department of Energy (DOE), Richland Operations Office (RL) TWRS Program SEMP. The SEWP expands on the topics in the TWRS Program SEMP. The SEWP presents the TWRS approach and plans to implement the SEMP. Sections 2.0 through 4.0 cover how the SE process and management will be performed to develop a technical baseline within TWRS. Section 5.0 covers the plans and schedules to implement the SE process and management within TWRS. Detailed information contained in the TWRS Program SEMP is not repeated in this document.

This SEWP and the SE discipline defined within apply to the TWRS Program and new and ongoing TWRS projects or activities, including new facilities and safety. The SE process will be applied to the existing Tank Farm operations where the RL TWRS Program Office management determines the process appropriate and where value will be added to existing Tank Farm systems and operations.

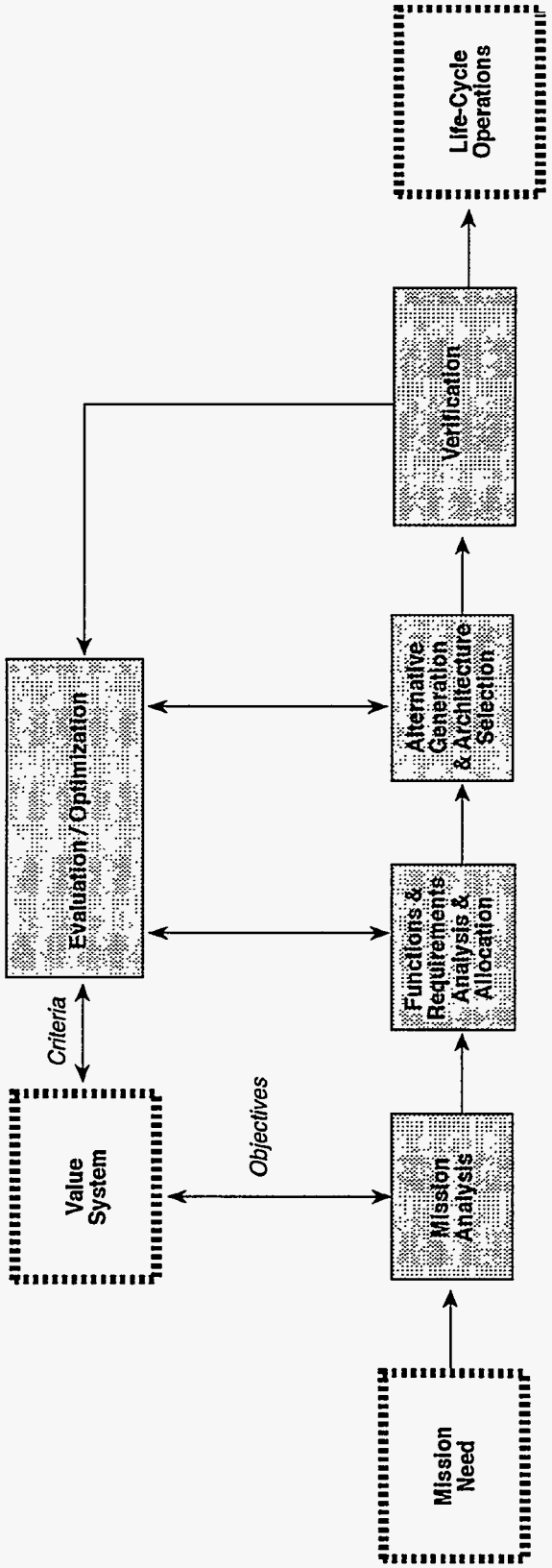
1.3 SYSTEMS ENGINEERING PROCESS OVERVIEW

WHC TWRS Program will use a SE process to develop the technical baseline. The process will advance the baseline from a general description of the system to a technical engineering specification for the Architect/Engineer (A/E) to design the system. The process will be used again during operations and for decommissioning and decontamination (D&D). SE management techniques will control the process throughout the life-cycle of the system.

The SE process that will be used by WHC TWRS Program is shown in Figure 1-1. The core process consists of Mission Analysis, Function and Requirements (F&R) Analysis and Allocation, Alternative Generation and Architecture Selection, Evaluation and Optimization, and Verification. The Value System is incorporated within the core process. The accomplishments of each step are:

- Mission Analysis - describes what needs to be done to get the desired end state.
- F&R Analysis and Allocation - describes what the system does, how well the system needs to perform, and relates the how well to the description.
- Alternative Generation and Architecture Selection - produces design concepts that can accomplish the F&R and produces a preferred design concept.

Figure 1-1. The TWRS Program Systems Engineering Process.



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- Evaluation and Optimization - assesses requirements, functions, and design concepts to support choosing a preferred, optimal design concept.

- Value System - provides input from the public and other stakeholders, which will be incorporated and tracked in the SE process.

- Verification - shows how well the system is progressing and conforming with the functions, requirements, and specifications.

The SE process is iterative and is used to produce solutions for the technical baseline.

The technical baseline evolves through seven phases over the life-cycle of the system. The baseline phases are:

- Functional Requirements - a program level description of what the system does and how well the system needs to perform.

- Technical Requirements - a program level description of design concept selected to accomplish the TWRS Program Mission. The description includes system level requirements traceability.

- Design Requirements - a project/program element level design description that includes project specification to be given to the A/E and requirements traceability.

- Design Configuration - the A/E package that starts as a conceptual design and finishes as a build-to design.

- As-built Configuration - the A/E and vendor as-built packages to be used by operations.

- Operational - the operations package that reflects the current system configuration. The package reflects all changes and updates on the system since A/E turnover.

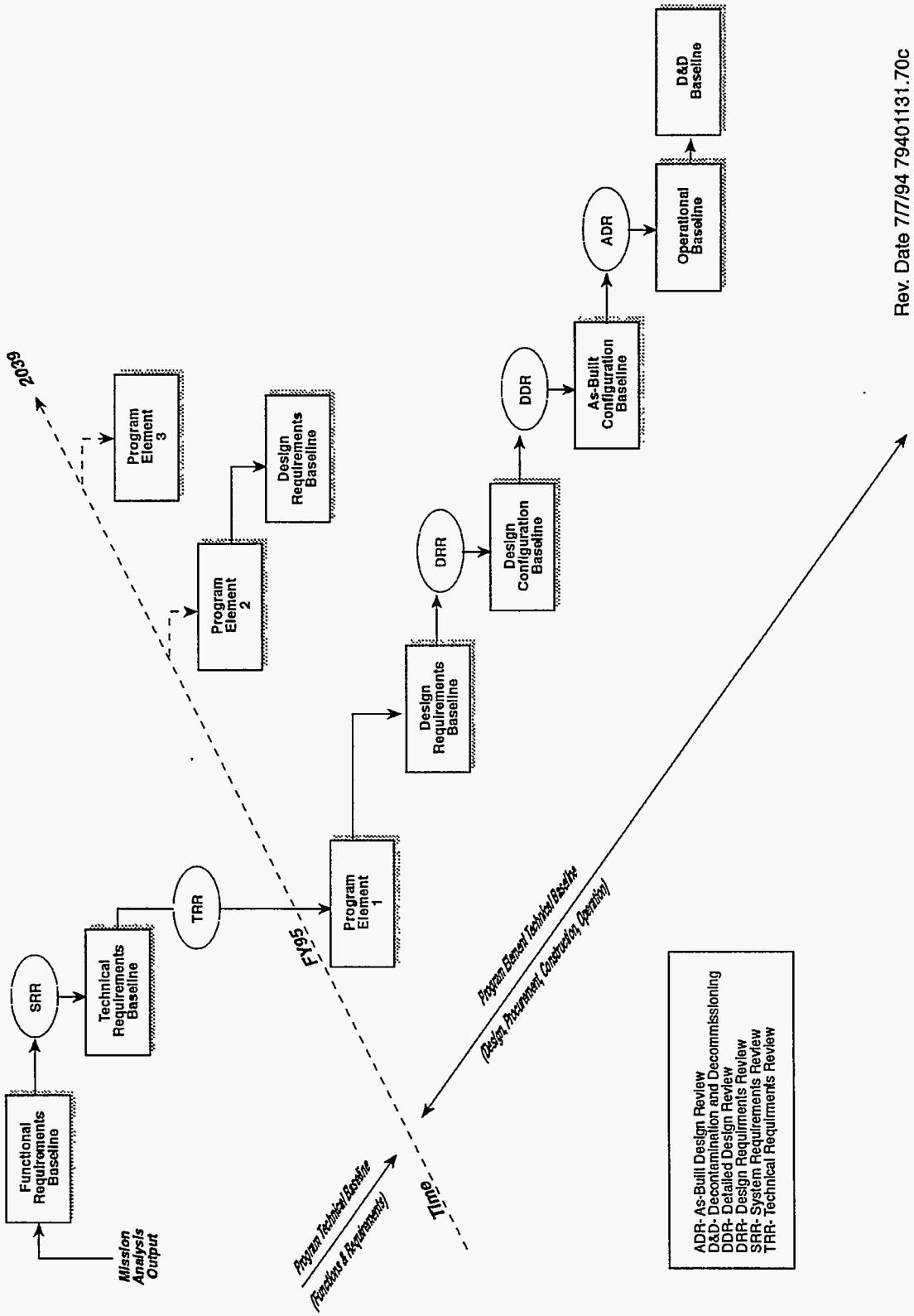
- D&D - the operations and D&D package that gives the systems configuration at the end of operations, the locations of hazardous areas, and the characteristics, form, and quantity of the remaining residual waste and hazards in the system.

Generally, the progression from one baseline phase to another occurs only after successfully completing technical baseline reviews. Figure 1-2 shows the sequence of the baseline evolution and technical baseline reviews.

SE management techniques are used to plan and control the process. The techniques consist of configuration management, SE schedules, work breakdown structures, risk management, technical performance measurements, test and evaluation, and quality assurance. The SE management techniques are used throughout the life-cycle of the system.

Throughout the systems life-cycle, teams using the SE process work together to develop the technical baseline. The teams include specialist from specialty and engineering disciplines. Examples of specialty disciplines are regulatory compliance, safety, value engineering, operations, D&D, and training.

Figure 1-2. TWRS Program Technical Baseline Phases and Reviews for the TWRS Program.



2.0 SYSTEMS ENGINEERING PROCESS

The SE policies and process being used in the TWRS Program are outlined in the TWRS Program SEMP. Figure 2-1 shows the TWRS SE process in detail. The process starts with mission analysis and iterates through F&R analysis and allocation, alternative generation and architecture selection, and evaluation and optimization. The process includes verification to provide test and analysis data during requirement, concept, and design development. Verification also provides a bottoms-up requirement compliance validation.

The SE process is used to develop a preferred system configuration and related performance parameters that fulfill the mission needs. The SE process promotes generating alternative solutions in order to obtain a robust system. The end product of the process is documentation describing the preferred system and required performance.

The process will be used throughout the life-cycle of the system. At the program level, the process will be used to develop an architecture concept that is related to the functions and requirements. The projects will use the SE process to develop the conceptual design based on the architecture concept. The SE process can be used for system modifications. The SE process will be used to determine the best approach to D&D. Each step of the TWRS SE process is discussed in the following sections.

2.1 MISSION ANALYSIS

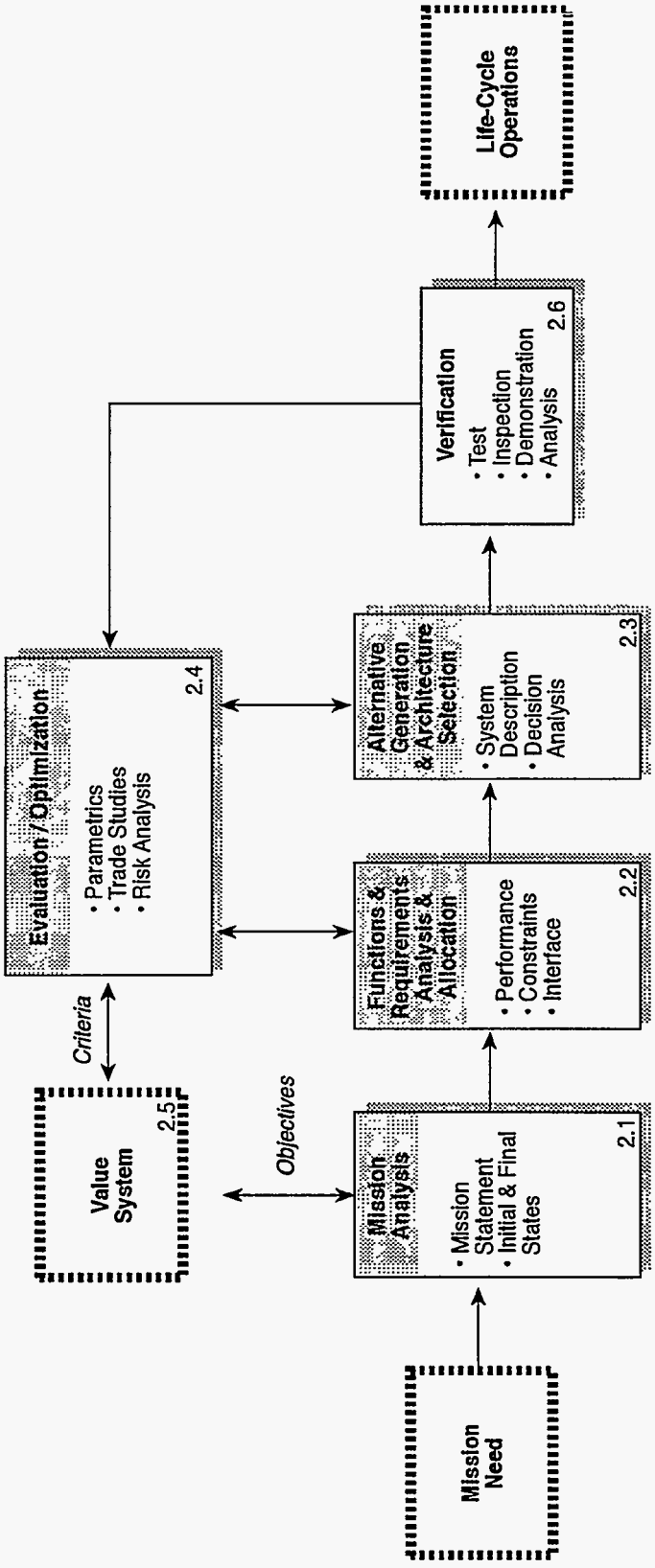
Mission analysis translates mission needs and objectives from the mission statement and other inputs, such as the value system, into mission requirements. Mission analysis provides the fundamental basis for all technical work. Mission analysis establishes and defines the scope of the problem, including initial and final states, requirements, and primary interfaces. The mission or problem to be solved must be traceable to a higher level function and requirements. Mission analysis results are documented in a Mission Analysis Report.

Mission analysis forms the basis for the next step in the SE process, which is F&R analysis and allocation. A detailed description of the mission analysis process and instructions on producing a Mission Analysis report are contained in the TWRS SE Mission Analysis Desk Instruction (WHC-IP-1098). Results of the TWRS Program Mission Analysis are documented in the TWRS Mission Analysis Report (Baynes et al. 1993).

2.2 FUNCTIONS AND REQUIREMENTS ANALYSIS AND ALLOCATION

F&R analysis and allocation transforms the mission analysis results into functions and requirements. F&R analysis and allocation systematically decomposes complex systems into simpler related parts. The result is a framework of functions, constrained by applicable requirements, to satisfy the mission.

Figure 2-1. The TWRS Systems Engineering Process (Detailed).



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The functional analysis portion of F&R analysis and allocation identifies and defines the logical activities that when performed together are equal to the parent function. The output of the functional analysis is a completely defined framework of functions that accomplishes the input parent function. TWRS Program SE is using Integrated Computer-Aided Manufacturing Definition (IDEF), a process diagraming tool, to produce and maintain the programmatic F&R flow diagrams.

Requirements analysis consists of three basic activities: requirements identification, requirements development, and requirement allocation. The activity identifies requirements, including performance requirements, constraints, derived requirements, interface requirements, and architectural requirements. After identification, the requirements are developed and allocated to the applicable functions, interfaces, and/or architectures. All information associated with functional analysis and requirements analysis will be entered into the Requirements Management and Assured Compliance System (RMACS). RMACS, which is being developed, will be the primary SE tool used to track requirement traceability and analyze the impact of functional and requirement changes. RMACS will aid in requirement traceability as discussed in Section 3.1.1.4.3.

The F&R analysis and allocation process provides the starting point for alternative generation and architecture selection. Results of the TWRS Program F&R analysis are contained in the TWRS F&R Document (RL 1993a).

Each project will perform its own F&R analysis. The Projects F&R analysis will be referred to as the Functions and Operational Requirements (F&OR) analysis. The requirements from the F&OR must be traceable to the program requirements. The TWRS SE F&R Desk Instruction (WHC-IP-1099) gives guidance on how to do the F&R process.

2.3 ALTERNATIVE GENERATION AND ARCHITECTURE SELECTION

Alternative generation and architecture selection is the iterative development of design solutions through synthesis and integration. The alternative design solutions are evaluated at each iteration. The resulting design solution reflects the optimal combination of requirements.

During alternative generation and architecture selection, alternative solutions that meet the requirements are candidates for trade studies and modeling. The trade studies and modeling support the decision analysis process. Modeling should contain parametric values (assumed and real). The risk related to the parametric value will be evaluated. Steps for reviewing derived data from models and simulations are given in the TWRS SE Data Review and Acceptance Desk Instruction (WHC-IP-1110).

Decision analysis will be applied during alternative generation and architecture selection to evaluate design architectures by determining the relative value of their cost and performance versus the selection criteria. This process results in a preferred design selection, which is explicitly justified and documented in a decision analysis report. The leading alternative architecture is selected for further definition. The Tank Waste Decision Analysis Report (Johnson et al. 1993) shows an example of the decision analysis process applied to TWRS.

The design architecture, in the form of selected engineering data, requirements, and specifications, becomes the technical baseline, which is then formalized through the technical baseline

review and configuration management process. The design architecture will start as a high-level concept at the program level and mature into greater detail at the project level.

To focus the design efforts, a baseline system description (BSD) document is produced. The BSD is a program level document. The BSD document provides a simple, top-level technical description of the TWRS Program (Section 3.1.1.3) and becomes part of the technical baseline. The BSD will mature as the architecture matures. Then the BSD will reflect project design efforts contained in the Project Design Concept document. The Project Design Concept is a project level BSD (Section 3.1.1.3).

Two TWRS SE desk instructions provide details of the alternative generation and architecture selection process. TWRS SE Alternative Solution Development Desk Instruction (WHC-IP-1100) describes the alternative solution architecture selection process. The TWRS SE Trade Study/Decision Analysis Desk Instruction (WHC-IP-1101) describes the trade study and decision analysis processes.

2.4 EVALUATION AND OPTIMIZATION

Evaluation and optimization provides the main feedback mechanism for the SE process and facilitates the development of a balanced, optimized design architecture. Thus, evaluation and optimization activities are performed throughout the SE process. Tradeoffs are conducted among the following: (1) requirements, (2) engineering designs, (3) project schedule and budget, (4) life-cycle costs, and (5) other significant factors. The value system criteria developed with the mission analysis are iteratively quantified and refined as indicted by the double-headed arrow in Figure 2-1. Typically, safety, system performance, and cost are major considerations in selecting an optimum design architecture.

The evaluation and optimization step ensures that no single characteristic dominates the design. Evaluation and optimization feeds "reality" back into the F&R analysis, which leads to a balanced architecture and technical baseline. Stakeholder values will be integrated in this step.

2.5 VALUE SYSTEM

The public and stakeholders integration with the TWRS SE process occurs with the Value System. The Value System is input from the general public and other stakeholders. This input, in the form of values, will be incorporated and tracked in the SE process. The values will be transformed to constraints, criteria, and measures of success, effectiveness, and performance. The input will be incorporated in each step of the SE process -- mission analysis, F&R analysis and allocation, alternative generation and architecture selection, evaluation and optimization, and verification.

Stakeholders and the general public will be part of the TWRS decision process. TWRS will actively seek stakeholders and the general public participation. TWRS is writing a formal public involvement plan. A decision-making process incorporating public and stakeholder involvement is also being written. (Johnson 1994)

2.6 VERIFICATION

Verification includes the planning, execution, and documentation of activities required to (1) demonstrate early concept viability, and (2) show requirement compliance for the detailed design. Test and Evaluation (T&E), described in Section 3.1.2, and reviews, described in Section 3.1.1.2, control the verification activities throughout the WHC TWRS Program.

The specific T&E method to be used for requirements compliance verification shall be considered as the requirements and design concepts are developed to ensure that requirements are measurable. T&E compliance verification methods include analysis, testing, inspection, and demonstration. The selection of the verification method depends on numerous factors including but not limited to cost, credibility, and schedule constraints. A graded system will be developed to aid in choosing the appropriate method.

The technical baseline reviews will also be used to evaluate how well the system definition meets the requirements.

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3.0 TECHNICAL MANAGEMENT

This section describes the technical planning and control activities required to manage the SE process and the overall organizational structure, responsibility, and authority for the TWRS Program. Section 3.1 provides the details of how and when technical planning and control activities will be conducted. Section 3.2 describes the technical management interface relationships and responsibilities necessary to carry out the program.

3.1 TECHNICAL PLANNING AND CONTROL

This section describes the evolution of the technical baseline and the related technical planning and control activities for the TWRS Program. To ensure that the technical and SE activities meet the overall needs of the TWRS Program, an integrated technical and management approach to plan and guide these activities is being implemented.

3.1.1 Technical Baseline, Reviews, and Documentation

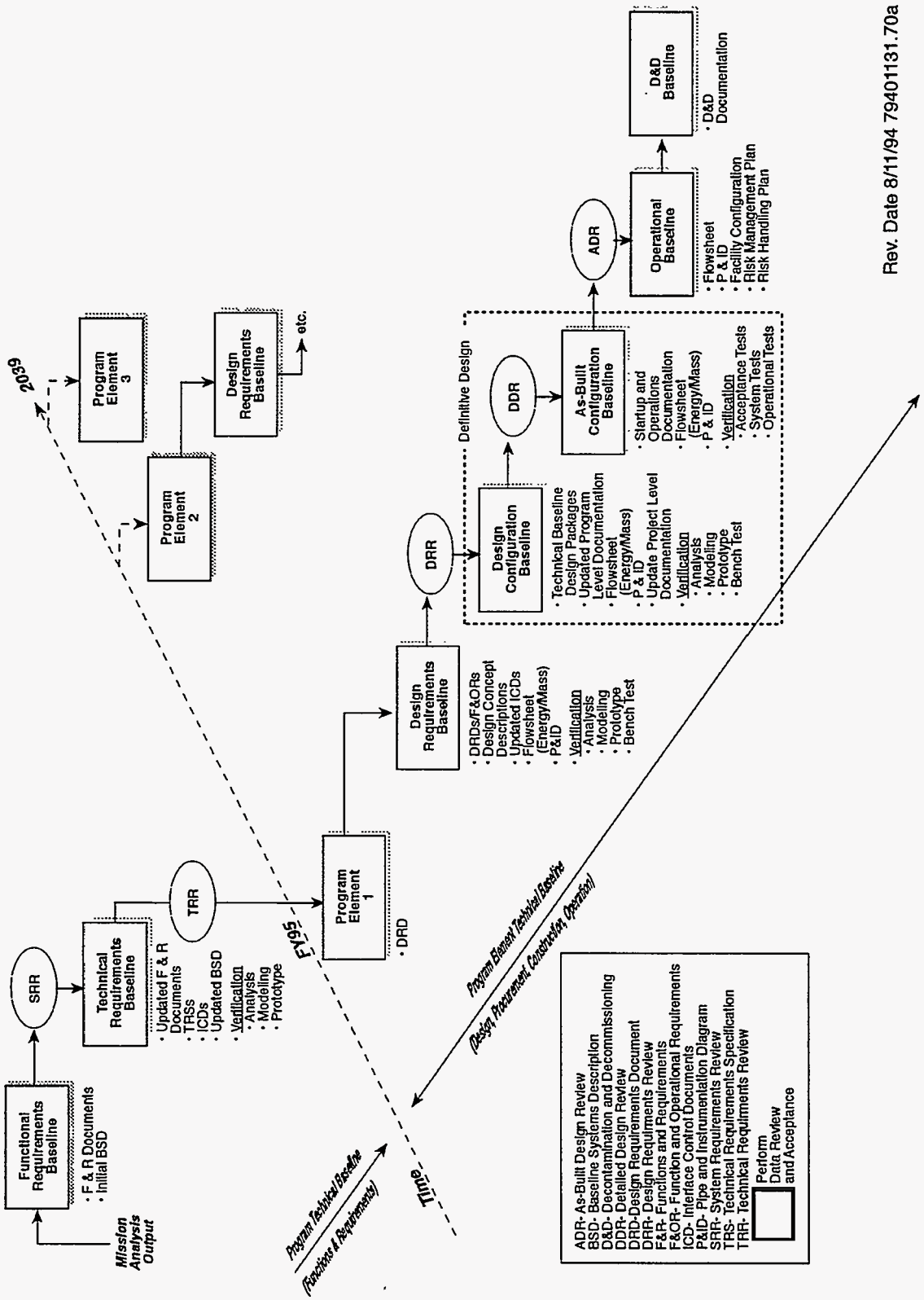
The TWRS Program SEMP shows the relationship between the technical baseline, reviews, and documentation. This section of the SEWP describes the three concepts in more detail and describes how the technical baseline is managed.

3.1.1.1 Technical Baseline. The technical baseline is the reference set of technical data. The technical baseline consists of technical documents which contain all technical requirements required to satisfy the mission needs. These requirements include program and project specifications, design configurations, operations requirements, and D&D requirements. The technical baseline will be controlled by WHC TWRS Program management at the system level using configuration management procedures as described in the TWRS Program Configuration Management Plan (RL 1993b, Annex 4). All documents in the baseline, including those related to structures, systems, and components important to safety and waste isolation, will be prepared, developed and controlled, according to the applicable procedures, throughout the TWRS Program life-cycle.

Over the program life-cycle, the WHC TWRS Program technical baseline will evolve through seven phases each referred to as a baseline. The baselines are: (1) Functional Requirements, (2) Technical Requirements, (3) Design Requirements, (4) Design Configuration, (5) As-built Configuration, (6) Operational, and (7) D&D. This baseline evolution is slightly different from the baseline evolution in the TWRS SEMP. The WHC TWRS Program baseline incorporates an operational baseline while the SEMP does not. Figure 3-1 shows the evolution of the WHC TWRS Program technical baseline, the contents of the baseline at each phase, and the related technical baseline reviews. The following paragraphs discuss the seven baselines phases in more detail.

3.1.1.1.1 Functional Requirements Baseline. Mission needs and objectives are developed into system and subsystem level functions to form the Functional Requirements Baseline. This baseline describes the strategic approach for the program and the top level functional and architectural features.

Figure 3-1. The TWRS Technical Baseline, Products, and Review Flow.



The Functional Requirements Baseline consists of the initial BSD and the program level F&R analysis and allocation database as documented in the TWRS F&R Document (RL 1993a). The initial BSD describes the initial conditions at TWRS and presents the conceptual baseline system architectures.

The Functional Requirements Baseline is approved through the System Requirements Review (SRR) (Section 3.1.1.2.1). After approval, this baseline provides the bases for the TWRS Program level architectural concept.

3.1.1.1.2 Technical Requirements Baseline. The Technical Requirements Baseline represents the technical requirements and system architecture chosen to accomplish the TWRS Program mission.

The Technical Requirements Baseline consists of the following: (1) updated program level F&R; (2) TWRS Program Technical Requirement Specifications (TRS) (i.e., Manage Tank Waste TRS, Process Waste TRS, and Manage System Generated Waste TRS); (3) Interface Control Documents (ICD); and (4) the updated program level BSD.

The Technical Requirements Baseline is approved through the Technical Requirements Review (TRR) (Section 3.1.1.2.2). After approval, this baseline provides the basis for project/program element identification, control, and design.

3.1.1.1.3 Design Requirements Baseline. The Design Requirements Baseline documents progress towards a conceptual design that fulfills the projects mission. This baseline expands on technical requirements allocated to each project, delineates more detailed requirements, and adds constraints that reflect design architecture decisions. The Design Requirements Baseline will give a well-defined scope along with specific cost and schedule.

The Design Requirements Baseline consists of updates of the Technical Requirements Baseline documentation, the Design Requirements Documents (DRD) plus the following project level documentation: (1) the Functions and Operational Requirements (F&OR); (2) Project Design Concepts; (3) project level ICDs; (4) Design Specifications; (5) Energy/mass flowsheets; and (6) Pipe and Instrumentation Diagrams (P&ID).

The Design Requirements Baseline is approved through the Design Requirements Review (DRR) (Section 3.1.1.2.3). After approval, this baseline becomes the controlling technical baseline between the WHC project/program element and the A/E.

3.1.1.1.4 Design Configuration Baseline. The Design Configuration Baseline shows the progress of the A/E in refining the design and developing the "build-to" design package. The technical baseline includes requirements that reflect design decisions.

The Design Configuration Baseline includes a detailed "build-to" design package and updates to the WHC program and project/program element TRSs, BSD, DRD, ICDs, F&Rs, F&ORs, P&ID and energy/mass flow sheets. The "build-to" design packages will provide the detailed design description necessary for procurement, fabrication, assembly, construction, installation, and testing of the facilities and equipment. The "build-to" design packages will include: (1) specifications and drawings, (2) quality assurance provisions, (3) test and inspection requirements, and (4) other applicable design documentation. Design documentation under technical baseline control will demonstrate requirements traceability to requirements contained in the DRD and tracked using the RMACS.

The Design Configuration Baseline is approved through the Detailed Design Review (DDR) (Section 3.1.1.2.4). After approval, the technical baseline becomes the basis for construction.

3.1.1.1.5 As-Built Configuration Baseline. This baseline documents the completion of construction. The As-Built Configuration Baseline contains updates to the previous baseline documentation plus the Construction, Test, and Turnover Packages, and the Operations and Maintenance packages that document the actual configuration of each project.

The As-Built Configuration Baseline is approved through the As-Built Design Review (ADR) (Section 3.1.1.2.5). This baseline is the technical basis for start-up, operations, maintenance, and upgrades.

3.1.1.1.6 Operational Baseline. This baseline documents the current configuration of the operational system. The technical baseline documents will be updated throughout the operational life of the system to reflect the actual TWRS operational configuration. The Operational Baseline contains the most recent energy/mass flow sheets, P&IDs, and system configuration.

The baseline continually changes throughout the operational lifetime of the operating system. Reviews for upgrades and selected maintenance will be held to approve changes to the system and the baseline. This baseline is the technical basis for the operating system and for the D&D Baseline at the end of operations.

3.1.1.1.7 Decontamination and Decommissioning Baseline. This baseline provides the basis for starting safe shutdown and D&D of facilities. The D&D Baseline consists of D&D related F&R, ICDs, and BSD, and a D&D package. The SE (Section 2.0) process will be used to develop the D&D related F&R, ICDs, and BSD. A D&D mission analysis will support the effort. The D&D package includes: (1) the existing physical configuration of the system; (2) the existing equipment types and usage; (3) a description of the exact location and hazard level of any waste or contaminated components that might require decontamination, (4) and any other data needed for planning the D&D of the system or facility. The baseline will be developed by the TWRS SE organization with Engineering and Operations support.

The D&D Baseline is approved through the Decontamination and Decommissioning Review (D&DR) (Section 3.1.1.2.6). This baseline then becomes the technical basis for the D&D of the facility.

Once the boundary between D&D and the activities of the Environmental Restoration Contractor (ERC) is defined, there will be another technical baseline that will be the basis for turning over activities to the ERC. This SEWP will be modified once the boundary is defined.

3.1.1.2 Technical Reviews. Technical reviews are conducted to assess the development of the technical baseline. These reviews are conducted according to DOE Order 4700.1, *Project Management System*, and are expanded to ensure proper development, establishment, and control of the TWRS Program technical baseline. Reviews are used to verify conformance with system requirements at the WHC TWRS Program level and with design requirements or specifications at the WHC TWRS Project level. Technical reviews provide data for DOE-Headquarters (HQ) and RL program reviews. Additional guidance on technical baseline reviews will be written (Section 5.2).

There are six technical baseline reviews. These reviews are the System Requirements Review (SRR), the Technical Requirements Review (TRR), the Design Requirements Review (DRR), the Detailed Design Review (DDR), the As-built Design Review (ADR), and the Decontamination and

Decommissioning Review (D&DR). These reviews are related to the progress of the technical baseline. Figure 3-1 shows the relationship between the reviews and the technical baseline.

Each review must be successfully completed before starting the next baseline phase. For example, successful completion of the TRR is required before the Technical Requirements Baseline can be used as the input data to the Design Requirements Baseline. The Program and projects may elect to have interim reviews.

The organizers and participants of the technical baseline reviews will vary from review to review. For example, the SRR will be organized by the WHC TWRS SE organization while the DDR will be organized by the Project. Program stakeholders will participate in reviews, as required, to ensure the consistency and technical adequacy of the evolving TWRS technical baseline. RL participation will depend on the baseline being approved.

The following sections describe the six technical baseline reviews and other related reviews. The objective of each review and the organizers of the review will be discussed.

3.1.1.2.1 System Requirements Review. This program level review is conducted to evaluate progress in defining TWRS Program system F&R and the architectural concept to satisfy mission needs. WHC TWRS SE organization will organize the review, ensuring RL TWRS Office participation.

After successful completion of the SRR, the Functional Requirements Baseline documents will be submitted to DOE for approval and placed under configuration control.

3.1.1.2.2 Technical Requirements Review. TRR is the focal point of the program level review of system requirements. It is conducted to; (1) evaluate the system requirements for adequacy and risk; (2) ensure a mutual understanding among TWRS Program and Projects participants of the TWRS Program system requirements and the corresponding design system architecture, and (3) assess the SE process that produced the system requirements.

The WHC TWRS SE organization organizes and conducts the TRR. RL TWRS Program office participation will be solicited. However, RL TWRS Program Office may choose not to review portions of the Technical Requirements Baseline. The program level TRS and ICDs are presented at the TRR. Also at the TRR, each functional area presents a design concept for review and verification of conformance with the system level requirements. Thus, the TRR validates the TWRS TRS and designs concepts.

After successful completion of the TRR, the TRS is submitted to the RL TWRS Program Manager for approval. The WHC TWRS Program will place the documents under configuration control.

3.1.1.2.3 Design Requirements Review. A DRR is held for each project to demonstrate readiness for proceeding to the A/E design development. DRR is conducted to; (1) verify project requirements conform with system requirements; (2) verify project design concepts conform with system concepts; (3) approve design specifications; (4) evaluate the technical adequacy and risk resolution of the selected design; (5) establish the existence and compatibility of the physical and functional interfaces among facilities, hardware, software, personnel, and procedures; and (6) assess progress to determine project readiness to successfully meet DOE reviews.

For each project, the responsible WHC Project organization organizes and conducts the DRR. RL TWRS Program Office will participate in selected reviews. The project level design requirements documents, associated interface control documents, and functions and operational requirements and their design basis are presented at the DRR. The DRR can be used for design verification purposes if it meets requirements of applicable quality assurance procedures.

After successful completion of the DRR, the design requirements will be submitted to the WHC Project manager and when required to the RL TWRS Office for approval. The documents are also brought under configuration control.

3.1.1.2.4 Detailed Design Review. A DDR is held for each project to demonstrate readiness to start procurement, construction, manufacturing, and coding of projects for verification. DDR is conducted to; (1) verify design conformance with the design requirements; (2) approve the design specifications updates; (3) evaluate the adequacy of the detailed design; (4) assess design producibility, constructability, testability, inspectability, and risk areas; (5) assess design readiness to proceed with procurement and construction; and (6) assess progress to determine project readiness to successfully meet DOE review.

The Project will organize and conduct the review ensuring the participation of the appropriate WHC organizations. RL TWRS Program Office will participate in selected reviews. The detailed "build-to" design packages (Section 3.1.1.1.4) are presented at the DDR. The DDR can be used for design verification purposes if it meets requirements of applicable quality assurance procedures.

After successful completion of the DDR, the "build-to" design packages are submitted to the WHC project manager for approval and configuration management. The A/E will approve the "build-to" packages for procurement and construction.

3.1.1.2.5 As-Built Design Review. An ADR is held following completion of facility construction. This review is conducted to; (1) compare the as-built configuration with the detail design configuration; (2) assess start up; and (3) allow for the orderly pre-operational testing and turnover of the facility to the WHC facility operations.

The Project along with the A/E will organize and conduct the ADR. The organizers will ensure participation by the WHC Program Office and RL TWRS Program Office. The Construction, Test, and Turnover Packages and the Operations and Maintenance Packages are presented at the ADR. The as-built system will be reviewed against the technical baseline to support the DOE review milestones and to permit facility operation approval.

Currently, DOE Order 4700.1, *Project Management System*, requires an operational readiness review. This will require inspection and acceptance testing. The pre-operational test results, ADR, and as-built configuration baseline will support this review.

After successful completion of the ADR, the as-built configuration will be submitted to the Project manager for acceptance and configuration control. The RL Program Office will also approve for start-up and operation.

3.1.1.2.6 Decontamination and Decommissioning Review. A D&DR is held to ensure that the D&D activities can be performed safely and to ensure that all necessary permits properly reflect the baseline.

The WHC SE organization will organize and conduct the D&DR. The WHC SE organization will ensure the participation of all responsible parties including the D&D organization. The D&D baseline documentation (Section 3.1.1.1.7) and the updated operational baseline configuration are presented at the D&DR.

After successful completion of the D&DR, the D&D baseline configuration will be submitted for approval and configuration control. The approval will authorize proceeding with the D&D.

The boundary between D&D and the ERC has not been defined. After this boundary is defined, this section will be modified to describe the review to proceed with the ERC work.

3.1.1.2.7 Other Reviews. In addition to the six technical baseline reviews, other reviews may be conducted separately to assess progress in the development of the technical baseline. These reviews (1) verify that design features conformance with the design requirements pertinent to the permit application and safety analysis report; (2) evaluate the adequacy of the detailed design of the structure, systems, and components important to safety; (3) review and approve the design specifications that describe the design; and (4) assess progress to determine project readiness to successfully meet DOE reviews.

TWRS facilities must show that they meet relevant regulatory, permitting, and safety requirements. Reviews related to regulatory and safety documentation needed for the Facility (e.g., Preliminary Safety Analysis Report) or for permitting will be required. The regulatory and safety groups will be consulted for the timing and requirements for these required reviews.

In-Process Reviews or Milestone Reviews are other reviews that may be conducted periodically during the design process. These reviews are held at the program or project manager's discretion. These reviews will determine the status of technical progress, cost, schedule, or attainment of specific program or project objectives. Normally such reviews are scheduled at some predetermined milestone or design completion point.

3.1.1.3 Technical Documentation. WHC TWRS will use technical documentation to integrate, control, record, and communicate the requirements, designs, modifications, and associated information. Throughout the SE process, there is a hierarchy of technical documentation related to the baselines. Figure 3-2 shows the SE technical documents hierarchy through the Design Configuration Baseline. The figure also shows that the technical documentation is one part of the TWRS Program SE documentation hierarchy. The following paragraphs expand on the SE technical documentation.

The top-level baseline design documents are the Program F&R and the BSD. The WHC TWRS Program top-level requirements are contained in the TWRS F&R (RL 1993a). The WHC TWRS Program BSD gives the program conceptual design. Associated with these baseline documents are the program level mission analysis report, trade study reports, the decision analysis reports, and a programmatic level operation support (logistics) plan.

The next level of baseline design documents are the ICDs and the TRS. These ICDs will be used to capture the external and program interfaces (Section 3.1.1.4.2). There will be three TRS documents; one each on Manage Waste, Process Waste, and Manage System Generated Waste. Table 3-1 lists the program level technical documents and the associated content descriptions.

Figure 3-2. Systems Engineering Document Hierarchy.

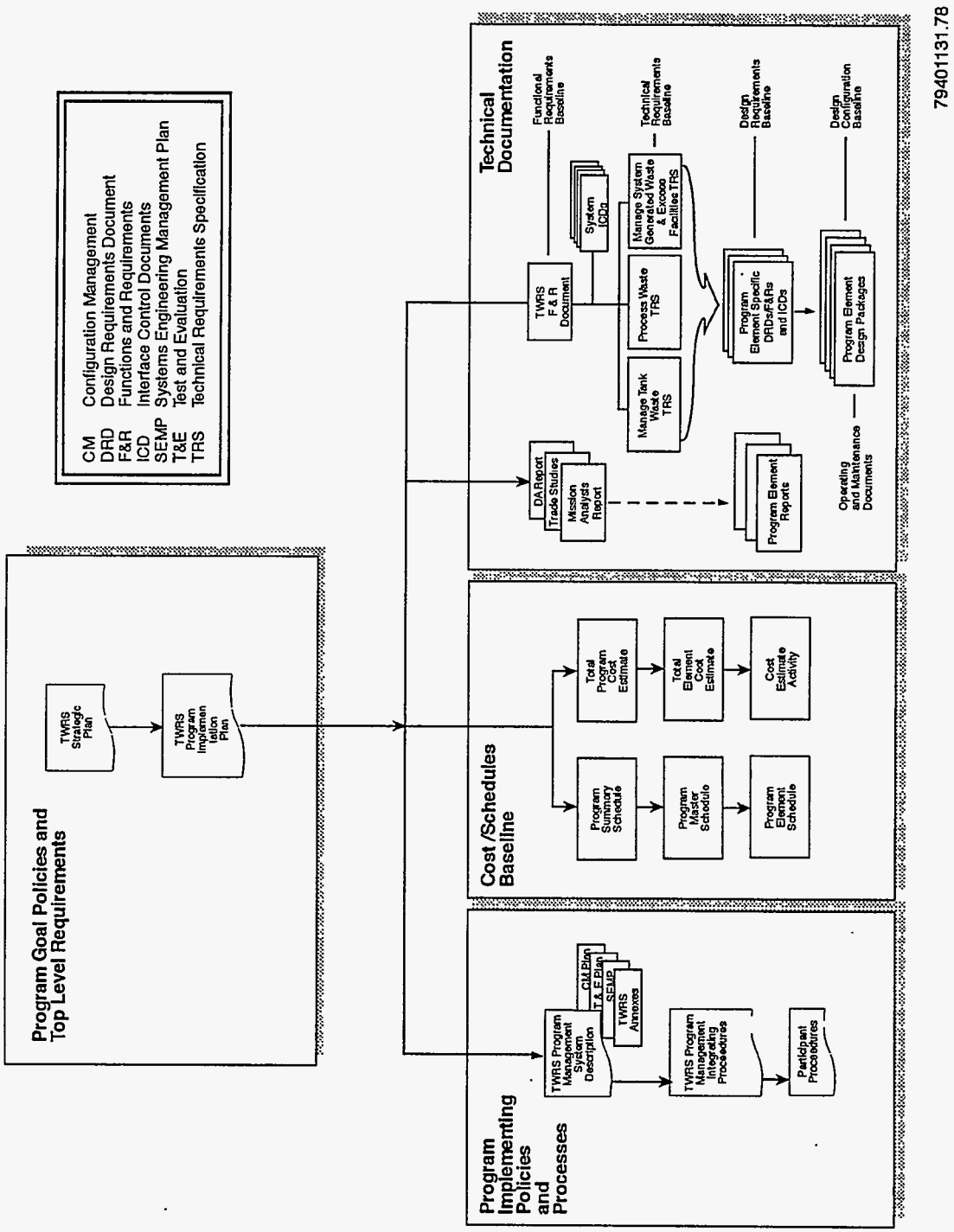


Table 3-1. Systems Engineering Technical Documents -- Program Documents.

Program Document	Document Description
Mission Analysis Report	Documents the mission analysis process that translates mission needs and objectives from the mission or problem statement and other top-level documents into mission requirements.
TWRS F&R Document	Documents the results of the F&R analysis and allocation process that transforms the mission analysis results into a set of executable functions properly constrained by both derived and imposed requirements. Includes functions analysis down to level 4, preliminary alternative architecture considerations, requirements identification and assignment.
Baseline Systems Description (BSD)	Contains summary of initial state of the program and illustrations and narrative for visualizing architecture concepts. The BSD is used by all team members working on the program as a communication tool at briefings, for cost estimates and studies.
Interface Control Document (ICD)	Depicts physical and functional interface engineering requirements between projects and programs or projects and the environment.
Technical Requirements Specification (TRS)	Contains the F&R analysis and allocation process starting at level 4 and continuing until missions of the projects and program elements are defined. Includes functions analysis, preliminary alternative architecture considerations, requirements identification and assignment.
Trade Study Reports	Documents the comparison (trades) of the strengths and weaknesses of alternative approaches or attributes.
Decision Analysis Report	Documents the decision analysis process that evaluates design solutions by determining the relative value of their cost and performance versus the selected criteria. The Decision Analysis Report explicitly justifies and documents the top level system architecture.
Design Requirements Documents (DRD)	Contains information -- ICDs, F&Rs, requirements allocated to specifications -- pertaining to a specific project. Describes the essential technical requirements for designing, constructing, operating, and maintaining the system. Includes the verification requirements for determining if the requirements have been met. Will be used by the project as a starting point for the design process.
Program Operational Support (Logistics) Report	Describes the desired logistics program for the program level concept architecture.

The WHC Project related design documentation consist of the next level of baseline documentation. For each project, the program level will generate a DRD. Based on the DRD, the project will produce the rest of the baseline documentation. This documentation consists of the F&OR, the project ICDs, the project concept, the design specifications, the energy/mass flowsheets, and the P&IDs. Associated with these baseline documents are the project mission analysis report (only for projects when the DRD is not available), technical development report, the logistics plan, and project reports. Examples of project reports are project alternative solution reports, trade study reports, and decision analysis reports. Table 3-2 lists the project technical documents and the associated content descriptions.

The last level of baseline documents related to the system design consist of the "Build-to" Project Design Packages. These packages will be developed by the A/E. Projects will determine the contents of the design packages.

3.1.1.4 Technical Baseline Management. The configuration of the TWRS Program technical baseline will be identified, approved, and controlled to ensure it is properly developed to support the TWRS Program. Configuration management, technical interface control, and requirements and interface traceability are three methods to be used to manage the technical baseline.

3.1.1.4.1 Configuration Management. Configuration Management (CM) maintains and controls changes to the technical baseline and supporting documents. These controls and changes include the ICDs that have been placed under configuration management.

A formal WHC TWRS CM plan will be developed. The plan will establish CM policy, assign responsibilities for CM implementation, and ensure establishment of and adherence to CM procedures for technical baseline identification, management, change control, document control, status accounting, and verification. The CM plan will follow the policy and guidance given in the RL TWRS Configuration Management Plan (RL 1993b, Annex 4).

3.1.1.4.2 Technical Interface Control. The TWRS technical interfaces are classified as external, program, or project interfaces. External interfaces are interfaces that exist between a TWRS Program element (program, project, or activity) and the external environment. Program interfaces exist between program-to-project or project-to-project. Project interfaces are those interfaces within a specific project.

System level interfaces are identified and described in the TWRS Program F&R Document. Lower-level interface requirements will be defined in the appropriate project level DRD, F&OR, or interface documentation. After the interface has been documented by a specification, the control process starts by creating a Programmatic Interface Control Document (PICD), which identifies the interface and the responsible participants. The PICDs will be developed and further defined using drawings in an ICD to eliminate any uncertainty on how the two program elements interact. These documents formally link and control the interface requirements. The external and program interface activities will be managed and controlled by the WHC TWRS SE organization. Internal (project) interface activities will be managed and controlled by the TWRS Project Management.

The TWRS SE organization will establish an interface control process coordinated by a team of representatives from the program and projects. The team, commonly referred to as an Interface Control Working Group (ICWG), will manage the external and program interfaces by providing traceability, coordination, and documentation of interface definitions using ICDs. Internal ICDs

Table 3-2. Systems Engineering Technical Documents -- Project Documents.

Project Document	Document Description
Project Mission Analysis	Produced only when the DRD is not available to the project. Documents the mission analysis process for the project. Gives the project mission objectives and establishes a link to the Program Mission.
Functions and Operational Requirements (F&OR) Document	Documents the F&OR analysis, the allocation process, and the concept architecture performed by the project. The F&OR analysis continues until design specification can be written for the A/E. Operational requirements are addressed. Document ensures that project scope is well understood and consistent with the DRD.
Project ICDs	Depicts physical and functional interface engineering requirements within a project.
Project Design Concept	A project level BSD. Contains summary on initial state and contains illustration and narrative for visualizing architecture concept.
Project Design Specification	Specification based on the F&OR and traceable to the program level specifications in the DRD.
Energy/mass flow sheets	Mass and energy flow sheets describing clearly to the A/E or design group what the process must do.
Piping and Instrumentation Diagram (P&ID)	Diagram showing piping and instrumentation requirements.
Technology Development Report	Summarizes emerging or innovative technologies used in design concept. Addresses technical adequacy of the technology. Summarizes associated risk assessment and test and evaluation plan. Co-written with R&D contractor or vendor of the technology being used. (Support Document. Only written if using emerging or innovative technologies.)
Project Logistics Plan	Describes the desired logistics program for supporting the project architecture. The plan addresses system availability, maintenance planning, supply support, technical data requirements, computer resources support, manpower, training support requirements, and packaging, handling, storage, and transportation requirements.
Project Reports	Project decides on which reports it needs. Examples of project reports are Alternative Solution Reports, Trade Study Reports, or Decision Analysis Reports. These reports document project level work related to choosing the project design solution.

for project interfaces are coordinated within a project by the project representative to the ICWG. A detailed description of technical interface control is contained in the TWRS SE Interface Control Desk Instruction (WHC-IP-1105).

3.1.1.4.3 Traceability. Requirement and interface traceability are critical aspects of managing the technical baseline. Traceability identifies the source of the requirement and tracks the requirement propagation through the system. When traceability is maintained, requirement changes at any level can be reviewed for the impact to the total system. Traceability will be provided between the requirements, specifications, and design packages.

TWRS Program requirement traceability will be performed using a computer automated RMACS. The RMACS automated database system will be the tool for supporting requirements traceability. As requirement relationships are established, they will be entered into the database.

Interface traceability ensures completeness of interface definition and facilitates evaluation of potential modifications or system upgrades. Interface traceability minimizes the discovery of functional or physical interface problems late in the design program. Interface traceability includes both functional (e.g., data exchange between functions) and physical (e.g., necessary fit between components) interfaces. Before detailed designs are prepared, only functional interfaces can be described explicitly unless the interface is with existing hardware in which case the physical interface can also be described.

3.1.2 Test and Evaluation

T&E will be implemented to; (1) reduce technical and program risk; (2) verify design and product conformance with requirements and specifications; (3) support technology and design development; (4) provide continuing estimates of operational performance; and (5) ensure that program objectives are achieved. TWRS Program T&E will be a life-cycle activity that includes both sequential and concurrent tests involving hardware, software, personnel, procedures, and facilities.

The T&E efforts will be closely integrated with the TWRS Program milestones to provide critical information regarding; (1) technology development, (2) technical baseline progress, (3) system design verification, (4) requirements conformance, (5) system operability/ maintainability, and (6) other TWRS Program needs.

The T&E program will be used for requirements verification throughout design and construction. Requirements verification starts at the lowest level of design to ensure conformance with each requirement. It continues through procurement, fabrication and startup and turnover for operations. Verification is accomplished through analysis, test, demonstration, and inspection.

T&E program consists of both development test and evaluation (DT&E) and operational test and evaluation (OT&E). Although the primary goal for each is the same (i.e., verification of TWRS Program requirements), the specific approach and activities in each phase are different. DT&E emphasizes technology development (research) and design development (prototype) testing. Program and project level activities and involvement dominate this phase. The Research and Development (R&D) Contractor or the vendor is also involved if there is emerging or innovative technologies being developed. DT&E supports the following: (1) early technical baseline development, (2) requirements development and allocation, (3) technology verification, and (4) prototype design performance. Initial DT&E efforts will be supported by analytical techniques (mathematical models and simulations) and

physical testing. Testing helps to define, develop, and select performance parameters and requirements as the design evolves. DT&E culminates during the final design phase.

OT&E is conducted on operational equipment and includes procurement acceptance, installation acceptance, pre-operational testing, and operational (turnover and startup) testing. In this phase, Projects, Operations, Engineering, A/E, and vendor activities predominate. OT&E will be conducted to determine the performance and suitability of the integrated TWRS Program and its elements to meet the TWRS Program mission. Performance assessment and technical performance measurement efforts continue during OT&E to verify that test results meet specified requirements.

A WHC TWRS Test and Evaluation Plan (TEP) will be developed and implemented to guide and direct the management of TWRS T&E activities. The TEP is the basic planning and integrating document for TWRS Program T&E activities. The TEP is the basis for other T&E planning documents including TWRS Project T&E plans. General guidance for the TEP is given in the Program Management System Description (RL 1993b, Annex 5). A detailed description for developing a TEP is contained in the TWRS SE Test and Evaluation Plan Desk Instruction (WHC-IP-1102).

The WHC TWRS Program TEP will be prepared by the WHC TWRS SE organization. The TEP will:

- Summarize the objectives, responsibilities, logic, resources, and schedules for planned T&E
- Describe the system level tests to be performed, test rationale, relationships to other tests in the integrated sequence, and the contribution each makes to verification of the system
- Describe the evaluation process to be followed to ensure performance compliance and verification of the TWRS Program
- Outline each participant's role in the T&E effort.

The initial TEP will be prepared for the TRR to support DT&E. The TEP will be updated and formally reviewed at each of the technical milestones and technical baseline reviews. At a minimum, the TEP will be updated semi-annually. Because the TWRS Program currently includes an ongoing testing effort, the initial TEP must adequately address integration and alignment of the total test program.

T&E documentation (Test Plans and Reports) will address the following information to support conformance verification; (1) test requirements, (2) acceptance criteria, (3) test scope, (4) test procedures, (5) test schedules, (6) estimated cost, (7) test data, and (8) test results. T&E plans and reports must be developed, approved, controlled, and maintained according to applicable DOE orders and procedures.

3.1.3 Systems Engineering Management Techniques

The WHC TWRS Program is responsible for managing the TWRS technical communication and information flow. A significant amount of technical information exchange will be required for proper program execution at all levels of management. The ability to provide and receive technical information in a timely manner is paramount to maintaining effective progress. The SE management

techniques that will be used for technical communications are management documentation, SE schedules, work breakdown structures, risk management, decision management, and technical performance measurements. The following sections discuss these techniques.

3.1.3.1 Management Documentation. A hierarchy of SE management documents will provide management policies and processes. The RL TWRS Program SEMP is the top level TWRS Program SE management document. The WHC TWRS SEWP is the top level WHC TWRS SE management document. Additional SEMPs may be required at the project level depending on the specific scope, nature, and complexity of the activity. As a minimum, a Project SEMP shall identify the following:

- The approach for implementing SE within the Project consistent with program guidance and the TWRS Program SEMP
- The organizational structure and responsibilities for implementing the Project SE effort, including the responsibilities of the Project office and its contractors
- The approach to risk management, trade studies, and technical performance measurements
- The documents that constitute the Project technical baseline
- The Program and Project reviews to be conducted to ensure adherence to the technical baseline. This will include the scope, frequency, and organizational responsibilities for participation and presentation
- The Project documentation to be developed and maintained, including organizational responsibility for development, review, approval, and the contents of such documents
- The Project SE milestones and events by using logic diagrams and schedules.

Figure 3-2 shows the hierarchy of the DOE management documentation. The figure show the connection between the DOE Program policies and requirements and the implementing policies and processes. Table 3-3 lists the RL, WHC Program, and WHC Project management documents for TWRS and includes content descriptions.

3.1.3.2 Systems Engineering Schedules. All TWRS schedules will be developed according to Section 1.2 (Scheduling) of WHC-CM-2-5, *Management Control System.* In addition, all TWRS project schedules will be developed according to TWRS-PIP-2.1 (Master Schedule Development or Revision) of RL-TWRS-93-01 (Tank Waste Remediation System Projects Integrating Procedures Manual). All TWRS WBS elements, including SE activities, will have schedules developed that define the task activities.

SE schedules define the engineering and technical activities performed at the program and project level. They provide management with a tool to evaluate progress against planned events and milestones. Lower-level program and project SE schedules will be integrated into higher-level program or project schedules. Program SE schedules integrate the overall SE effort by including program requirements and architecture development as well as SE and technical activities for ongoing and new projects. Project schedules will define the SE activities used to create the project requirements and architecture. Integrating the TWRS Program and Project SE schedules provides management with a complete description of SE and technical tasks.

Table 3-3. TWRS Systems Engineering Management Documentation. (2 sheets)

Document	General Content Description
DOE Program Documentation	
TWRS Program Implementation Plan	Summarizes the TWRS Program, including the Program mission and objectives, risk management, management approach, roles and responsibilities, and other essential aspects of the Program. Is an agreement between USDOE Acquisition Executive, USDOE Office of Hanford Programs and RL regarding the execution of the TWRS Program.
Program Management System Description (PMSD)	Defines the policy and processes the TWRS Program will use to plan and control the program baseline, execute and control program work, and evaluate and report program performance. Contains annexes that give RL policy and guidance for policy and framework which integrates all TWRS Program aspects. Annexes include specific management techniques used for SE -- SEMP, Configuration Management Plan, TEP, Total Quality Management Plan, and Environmental Compliance Management Plan.
Systems Engineering Management Plan (SEMP)	Defines the RL policies and guidance for the application of systems engineering throughout the TWRS Program for a fully integrated TWRS engineering effort. (Annex 2 of PMSD)
WHC Program Documentation	
Systems Engineering Working Plan (SEWP)	Gives the specific SE processes, SE planning and control methods, SE products, and organizational responsibilities required to implement the SE policy and guidance provided in the TWRS Program SEMP.
TWRS Risk Management (RM) Program Plan	Describes the WHC TWRS process and tasks for planning and managing public and occupational health and safety risks, environmental risks, and programmatic risks. The plan includes an implementation schedule.
TWRS Test and Evaluation (T&E) Program Plan	Implements the policy and guidance provided in the TWRS PMSD Annex on Test and Evaluation. Gives the program level plan for test and evaluation. Identifies necessary test and evaluation activities, necessary requirements verification activities, outlines each organizations T&E role in the program. Identifies required major test facilities and resources. Includes contingency planning to verify the correction of deficiencies for completion, acceptance, and qualification testing.

Table 3-3. TWRS Systems Engineering Management Documentation. (2 sheets)

Document	General Content Description
WHC Program Documentation (Cont.)	
TWRS Configuration Management (CM) Program Plan	Establishes CM policy, assigns responsibilities for CM implementation, and ensures requirements are established and followed for technical baseline identification, management, change control, document control, status accounting, and verification.
Systems Engineering Schedule	Provides a calendar-driven schedule used to manage SE activities. Works with milestone description sheets and SEMLs to integrate the programmatic and working levels.
Project Documentation	
Project Plans	Determined by specific project.
Project Systems Engineering Management Plan (P-SEMP)	Optional document. Defines the Project's policies and process for SE within the project. (Section 3.1.3.1)
Project Test and Evaluation Plan	Gives the T&E program for the project. Identifies required facilities and resources. Includes contingency planning to verify the correction of deficiencies for completion, acceptance, and qualification testing.
Project Risk Management Plan	Describes the risks associated with the project concept design. Gives the project process and tasks for planning and managing public and occupational risks, environmental risks, and programmatic risks. The plan includes an implementation schedule.
Project Systems Engineering Schedule	Provides a calendar-driven schedule used to manage project level SE activities. Works with project milestone description sheets and SEMLs.

A TWRS Systems Engineering Master Logic (SEML) shall also be developed for the program. SEMLs identify the products required to complete activities and milestone events. They also identify the entry and exit criteria required to obtain approval of the activities and events. The benefits of SEMLs are; (1) help plan, integrate, and monitor major engineering and technical activities; (2) provide management with a tool to evaluate technical progress, events, and milestones; and (3) provide overall visibility into SE and technical tasks. SEMLs will be updated and maintained to provide timely support to technical and program management reviews and decisions. Project SEMLs will be integrated into the TWRS Program SEML. Details on producing a SEML will be given in a TWRS SE Master Logic Desk Instruction.

3.1.3.3 Work Breakdown Structure. The RL Site Management System requires that TWRS Program activities be organized around a Program Work Breakdown Structure. The SE process will be used to identify and define new design concepts that satisfy the TWRS Program functions. These alternative design concepts represent eventual physical products or components of the TWRS Program. As these new products are derived by the SE process, the Program Work Breakdown Structure and associated Work Breakdown Structure Element Dictionary will be appropriately expanded to include these future products.

3.1.3.4 Risk Management. Risk is the probability of an undesirable event occurring and the significance of that occurrence. For the TWRS Program, these undesirable events and consequences will relate mainly to; (1) public and occupational health and safety risks, (2) environmental risks (ecological damage), and (3) programmatic risks. However, other risks such as regulatory compliance risk and security risks will be evaluated.

TWRS will use risk management (RM) to identify, assess, analyze, and handle risk associated with TWRS activities. The TWRS Program RM Plan will identify the processes used in managing risk during the program. A Risk Watch List, a risk-based priority list, will be produced from the RM activities. The TWRS SE Risk Management Desk Instruction (WHC-IP-1103) describes the risk management process and outlines the contents of a RM plan. The TWRS SE organization is responsible for maintaining the RM plan and the activities to assess program risk factors.

RM will be part of the baseline development starting with the Functional Baseline and continuing for the life-cycle of the system. RM also integrates with established SE management techniques. For example, RM can identify items for test and evaluation (Section 3.1.2) and emphasize certain technical performance measurements (Section 3.1.3.6).

3.1.3.5 Decision Management. The WHC TWRS Program level decisions on requirements pertaining to the environment, the public, or workers will involve the general public and stakeholders. The decision process will follow the methodology given in the WHC document "Tank Waste Remediation System Program Decisions and Risk Assessment" (Johnson 1994). The decisions made will be documented in a decision report and kept under configuration control. These decisions will be reflected in requirements and related architecture selection and specifications.

Other program and project level technical decisions are the primary responsibility of the manager. The manager may employ a multidisciplinary team to identify, control, and resolve technical issues affecting cost, schedule, or technical baseline of multiple projects. Decision making will be a key part of technical baseline reviews. Management will use SE to ensure project decisions are implemented, documented, tracked and are consistent with program policy and direction. Many of the technical decisions will be documented in decision analysis reports.

3.1.3.6 Technical Performance Measurements. TWRS SE organization will use Technical Performance Measurements (TPMs) to:

- Gain insight into the maturity of the engineering design
- Identify key parameters for the T&E program
- Provide inputs into overall program, decision, and risk management.

These parameters are compared to predicted values or are used on a relative basis for comparison of alternatives. TPMs are tracked as a function of time once the system architecture has been selected. From that point, deviations of the actual parameters from the estimated (or design "goal") values provide management with an estimated maturity of, and the associated risk in, the TWRS Program.

TPMs should be selected from requirements that are critical to the mission objectives, environment, or safety. They will be identified during the requirements development process. The parameters selected for tracking should be key indicators and forecasters of technical success. They are derived primarily from technical uncertainty assessments and system sensitivity (parametric) studies. These parameters will be analyzed to help determine what should be verified along with when and how verification should be accomplished.

The WHC TWRS Program SE organization will be responsible for updating, maintaining, and tracking the TPMs on the TPM list. The WHC TWRS Program Manager, or designee, is responsible for approving the initial TPM list and any additions or deletions to the list. Some parameters will be tracked throughout the program. Others will be tracked only during specific program phases or to identify and resolve specific risk issues. TPMs will be input to T&E as test candidates for data collection. As the T&E program progresses, test results will be reviewed, evaluated, and compared to the parameter limits. Trend analyses will be conducted to determine performance achievements (verification) and deviations (corrective action initiation). When performance exceeds specifications, opportunities for requirement or resources reallocation will be examined. A detailed description of TPM is contained in the TWRS SE Technical Performance Measurements Desk Instruction (WHC-IP-1106).

3.1.4 Quality Assurance

The TWRS Quality Assurance Program as outlined in Annex 6 of the TWRS Program Management System Description (RL 1993b) will govern technical and SE Quality Assurance activities.

3.2 ORGANIZATION, RESPONSIBILITY, AND AUTHORITY

The TWRS Program organizational responsibility and authority, are defined in the TWRS Program Implementation Plan (RL 1994) and the TWRS SEMP (RL 1993b, Annex 2). This section discusses additional rolls and responsibilities that are not addressed in the two documents.

3.2.1 U.S. Department of Energy - Richland Operations Office

The responsibility and authority for formulating the TWRS Program SE program has been delegated to RL by HQ. The RL TWRS Program Office has assigned the Office of Tank Waste, Retrieval, Treatment, and Immobilization as the oversight authority to monitor, assess, and ensure the adequacy of the TWRS Program SE activities. It will review and approve top-level program requirements and system descriptions as part of the SE process through established technical planning and control activities. It will identify, review, and approve project-level design requirements baselines for selected critical projects. It will also review and approve change requests to selected critical health, safety, and environmental requirements, regulatory requirements, selected performance requirements, and TWRS Program system-level interface requirements. It will ensure that TWRS Program SE goals, objectives, and priorities are clear and reflected in the products produced by the Maintenance and Operations (M&O) contractor.

RL has primary responsibility for ensuring participants, involved internally and externally with the TWRS Program, establish and maintain appropriate lines of communication. External technical communications will include: (1) technical committees, (2) government agencies, (3) national laboratories, and (4) other participants in the TWRS Program. As required, the TWRS participants will provide technical support and interact with these participants.

3.2.2 Maintenance and Operations Contractor

As the Design Authority, the M&O contractor has primary responsibility and authority for executing the TWRS Program. The execution of the TWRS program will include implementing the SE activities outlined in this document and in the TWRS Program SEMP. The M&O contractor will also identify the TWRS Program technology needs.

The TWRS Program Office has assigned TWRS Program Integration and Control, TWRS Program Strategic Planning and SE organization the responsibility to direct and review TWRS Program technical activities and products using the SE process and technical management techniques. Appendix A gives the TWRS SE responsibilities matrix for the SE tasks, documentation, reviews, and management given in this SEWP.

3.2.3 Architect/Engineer Contractors

As the Design Agents, the A/E contractors design, construct, or purchase the TWRS Program facilities and systems or modify these facilities and systems according to specified requirements and direction from the Design Authority (M&O contractor). The M&O Project manager is the design authority for all Major Acquisition Systems and Major Projects. The A/E contractors will ensure, through use of the SE process and established technical planning and control activities, that TWRS Program designs and acquired products comply with established specification and criteria. They will ensure compliance and support SE verification activities for TWRS Program facilities and operations.

3.2.4 Research and Development Contractor

The research and development contractor has the responsibility for TWRS Program technology development. The M&O contractor identifies the TWRS Program technology development needs. The results from these activities will be integrated into the ongoing SE process through the technical planning and control activities. The research and development contractor will closely support the TWRS Program technical planning and requirements development through these activities.

3.2.5 Environmental Restoration Contractor

The responsibilities of the ERC are being established. This section will be revised when the TWRS related ERC responsibilities are established.

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4.0 REGULATORY AND ENGINEERING SPECIALTIES

Individuals in the regulatory, health and safety, and specialty disciplines will participate in the development of the technical baseline. These specialists participate throughout the SE process starting with function and requirements analysis and allocation.

There are many types of engineering and non-engineering specialist who can participate in the baseline development. However, the TWRS Program SEMP identifies 13 specialty disciplines. The 13 specialties are:

- D&D Engineering
- Environmental Engineering
- Facility/Systems Commissioning and Startup
- Human Factors Engineering
- Integrated Logistics Support
- Producibility and Constructability
- Reliability, Availability, and Maintainability
- Safeguards and Security
- Safety and Operability
- Standardization, Materials, and Processes
- Systems Life-Cycle Cost
- Training
- Value Engineering.

The TWRS program is not limited to using the above specialists. The following sections discuss the involvement of the regulatory, health and safety, and the 13 specialty disciplines within the TWRS program.

4.1 REGULATORY COMPLIANCE INTEGRATION

Regulatory support personnel will begin their involvement with the technical baseline requirements definition and alternatives development. This early integration into the SE process provides an evolutionary development of inputs and outputs based on compliance criteria. Regulatory support and TWRS personnel must continuously interface during the entire acquisition process for successful implementation of the TWRS Program.

In general, the role of regulatory compliance will continue over the life of the TWRS Program. It will start on receipt of program strategy from which the bounds of applicable regulatory requirements can be established. A complete set of compliance constraints and the associated compliance approach will be produced for integration into the program. Later efforts will concentrate on obtaining the necessary regulatory approvals for operating the TWRS, maintaining those approvals, and confirming the compliance status of the TWRS Program. Regulatory integration will continue throughout the TWRS life-cycle.

To ensure that the TWRS Program and technical baseline meets regulatory requirements, the following activities will be implemented.

- Identify regulations applicable to the TWRS Program and its technical baseline
- Develop criteria and strategies along with associated technical requirements for regulatory compliance
- Integrate permits, approvals, and other prerequisites with the SE process for construction, operation, and deactivation of the TWRS Program
- Determine the acceptability of technical regulatory compliance activities and SE verification process against applicable regulations
- Prepare regulatory documents supported by the SE and technical baseline processes

4.1.1 Regulatory Compliance

The TWRS Program will be designed to operate in compliance with applicable laws and regulations. The system will be constructed, operated, and decontaminated and decommissioned to applicable environmental laws and regulations. The SE process will be used to ensure the technical baseline complies with applicable laws and regulations to support the compliance and permitting process.

The regulatory compliance verification effort will ensure that regulatory requirements are traceable and achieved. This effort follows the policies and guidance contained in the RL Environmental Compliance Management Plan (RL 1993b, Annex 7). The SE process will be used to support the regulatory compliance program.

The regulatory compliance program will facilitate coordination with the regulatory agencies to ensure complete permit applications which result in the permit to construct and operate the TWRS Program. The permit process will be according to the framework established by the NEPA/regulatory permitting plan. A detailed description of environmental regulatory compliance and its integration into the SE process is contained in the TWRS SE Environmental Regulatory Integration Desk Instruction (WHC-IP-1107).

As part of compliance verification, regulatory TPMs will be utilized to show compliance with restrictions on emissions imposed by Federal and state limitations and the facility permit. Test and evaluation will evaluate the TWRS performance. These evaluations provide the quantitative components of the TPMs.

4.1.2 Permitting

Permitting is the cumulative process of activities to ensure that the Federal and state permit requirements are met resulting in the issuance of a permit. This includes demonstration of compliance with regulatory requirements, including NEPA and Washington State Environmental Policy Act requirements.

To accomplish the objectives of the permitting process successfully, permitting will be integrated with the SE process. Regulatory requirements must be analyzed and identified for incorporation in the technical baseline. Later compliance with these constraints and requirements must be verified and demonstrated in the permit application.

Development of the permitting documentation is fully integrated with the SE process, including coordination of the permitting and SE milestones. Particular emphasis will be placed on the safety engineering program to ensure that safety is built into the design and that the TWRS Program safety and hazards analysis effort responds to the needs of the Safety Analysis Report. The TWRS SE Environmental Regulatory Integration Desk Instruction (WHC-IP-1107) contains more details on integrating permitting within the SE process.

4.2 HEALTH AND SAFETY

Health and safety personnel will participate with TWRS personnel throughout the life-cycle of the system. Health and safety will be integrated with the systems engineering process. These specialist can identify health and safety requirements, identify health and safety issues related to architectures, and aid in health and safety risk assessment and mitigation. The TWRS Program will address public health and safety and occupational health and safety.

4.2.1 Public Health and Safety

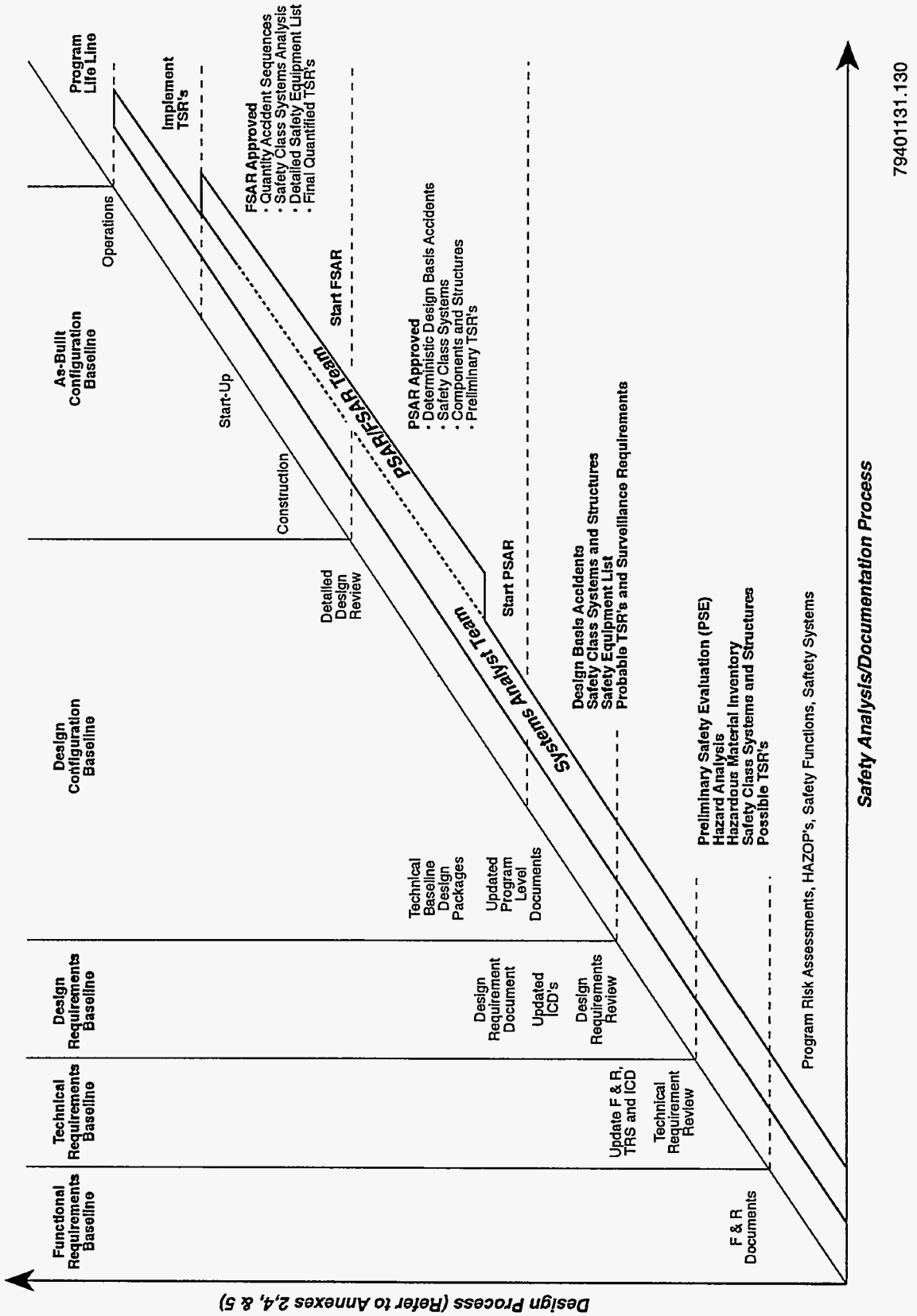
Public health and safety requirements will be included as an integral part of the TWRS Program technical baseline. These requirements may be public values or from Environmental Protection Agency guidelines or other public health and safety regulations. Propose architectures will be evaluated for public health and safety hazards and exposure scenarios during operation and after D&D when the area may be given to the public. Personnel at the Hanford Environmental Health Foundation (HEHF) are available to support health issues.

4.2.2 Occupational Health and Safety

Occupational health and safety requirements will be included as an integral part of the TWRS Program technical baseline. These requirements may be employee values or concerns or from occupational health and safety regulations such as Occupational Safety and Health Administration. Propose architectures will be evaluated for occupational health and safety hazards and exposure scenarios throughout the systems life cycle. Personnel at the HEHF are available to support health issues.

The TWRS Program safety program will ensure that system safety is integrated into all phases of the SE process. Figure 4-1 shows how safety integrates with the technical baseline. The M&O contractor establishes and manages the safety program. The safety program will interface with the regulatory compliance program which addresses compliance with environmental, nuclear, safety, and health regulations. This interface will ensure that safety aspects are addressed, particularly the provision for engineering support for the preparation of safety documentation such as the Safety Analysis Report (SAR). Industrial and radiation safety requirements and standards will often require special interpretation and guidance by the Safety discipline. These standards will be identified, analyzed, and allocated during the F&R process.

Figure 4-1. Safety and Design Engineering Interface.



The TWRS safety program will include the Hazard and Operability (HAZOP) process to identify potential hazards and provide operability requirements that will be incorporated into the SE process. Potential hazards will be systematically identified, potential consequences analyzed, and reasonable efforts taken to ensure that the hazards are eliminated, controlled, or mitigated. Identification of hazards related to these requirements will be documented for design verification and safety reporting.

Minimizing exposure to hazardous, toxic, and radioactive materials will be a primary goal of the TWRS safety program. This will be achieved using the As Low As Reasonably Achievable (ALARA) program. The ALARA program will establish requirements and evaluate designs to ensure that exposure to hazardous, toxic, and radioactive materials is minimized throughout the TWRS Program. ALARA requirements will be established during the F&R analysis and allocation process. Designs will be evaluated against these requirements during alternative generation and architecture development. Because TWRS Program will process mixed waste that contains toxic chemicals, safety requirements will be developed and designs evaluated for safe operation.

4.3 ENGINEERING SPECIALTIES

Specialty disciplines, including engineering specialties, must be integrated throughout the TWRS Program life-cycle. Engineering specialties and other specialty disciplines required for the TWRS Program include, but are not limited to, the 13 areas described below.

4.3.1 Decontamination and Decommissioning

The D&D specialists ensure that shutdown and D&D requirements for TWRS Program facilities are identified and addressed during the SE process. D&D requirements will be developed throughout the evolution of the technical baseline and embedded in the baseline. D&D requirements will be developed, deactivation guidelines will be written, and advice on D&D requirements implementation will be given to the TWRS designers.

4.3.2 Environmental Engineering

Environmental engineers ensure that the system is designed to meet environmental constraints and verify that environmental monitoring systems are properly designed, installed, and operated during the life-cycle. Environmental requirements will be identified and allocated to the program elements/projects during all phases of the SE process. These requirements are based on applicable Federal and state regulations, standards, and Statutes, along with DOE directives and environmental compliance documentation. Environmental engineers will verify that environmental requirements are properly interpreted and embedded in the technical baseline.

4.3.3 Facility and System Commissioning and Startup

Facility and System Commissioning and Startup specialists identify early in the design process design requirements that enable facility commissioning and startup to be efficiently accomplished. These specialists will be included in the SE process throughout the development of the technical baseline. The goal is to incorporate design features that could reduce the cost and schedule of the commissioning phase of a facility.

4.3.4 Human Factors Engineering

Human Factors Engineers ensure that designs are compatible with the capabilities and limitations of the personnel who will operate, maintain, transport, supply, control, and dispose of the system. Human factors engineering will be applied during development and design of the TWRS Program and its projects. Where human interfaces occur within the physical system, the interfaces will be appropriately engineered. Special attention will be given to those requirements and design attributes affecting the safety of personnel who operate and maintain the system. Additionally, special attention will be given to the potential for the system to release radioactive or toxic materials to the environment through human error or through a poorly designed human-equipment interface.

4.3.5 Integrated Logistics Support

Operational servicing personnel will provide the logistics support for the system. They will review the evolving design for logistics requirements and will address logistics support issues. Examples of logistics support issues are: (1) parts warehousing space, (2) component handling/ storage requirements, and (3) spare part levels.

The logistics support personnel will participate in preparing the Logistics plan, which describes the desired logistics program for the architecture. The plan addresses availability of the system, maintenance planning, facilities needed, supply support, support equipment, technical data requirements, computer resources support, manpower, training support requirements, and packaging, handling, storage, and transportation requirements. The Operational Servicing model will be used to support the logistics planning.

4.3.6 Producibility and Constructability

The Producibility and Constructability specialists consider equipment production, fabrication, facility construction, facility startup testing, and operational requirements. The technical baseline will be reviewed for compliance to these requirements on an ongoing basis. Cost trade studies will be performed where other design requirements conflict with producibility and constructability requirements. Fabrication and construction disciplines will use the technical baseline as the basis for planning efforts. The design approach can significantly impact the ability to construct, test, and operate equipment or facilities. Therefore, producibility and constructability requirements will be established, along with design guidelines, at the start of the SE process. These requirements will be given consideration throughout the technical baseline development and SE process.

4.3.7 Reliability, Availability, and Maintainability

The reliability, availability, and maintainability (RAM) specialists provide RAM inputs into development of the F&R and the F&OR. As part of the requirements development and design process, RAM requirements are developed and assigned to the designs. Examples of RAM requirements are; (1) mean time between failures, (2) mean time to replace, (3) availability, (4) corrective maintenance times, and (5) preventive maintenance. The RAM data will be collected from appropriate sources to monitor the status of the system. When RAM system requirements are not met, these specialist will recommend corrective action. RAM requirements are developed and designs are evaluated against these requirements throughout the SE process.

4.3.8 Safeguards and Security

Safeguards and Security personnel identify safeguard and security issues and develop safeguards and security plans throughout the TWRS program. Safeguard and security issues will be identified and defined during the programmatic F&R analysis and allocation stage. These issues affecting the development of the technical baseline will become requirements. In addition to identifying requirements, safeguards and security personnel will provide inputs regarding methods for verifying design conformance.

Safeguards and security planning will be incorporated into all phases of the systems engineering process. The planning will be developed to establish and maintain adequate safeguard requirements, including physical security, to protect nuclear materials and program facilities. The TWRS Program safeguards and security planning will describe the safeguards and security programs that need to be defined, documented, and implemented.

4.3.9 Safety and Operability

See Section 4.2.2 Occupational Safety and Health.

4.3.10 Standardization, Materials, and Processes

The Standardization, Materials, and Processes specialists emphasize reducing the variety of parts, variability in processes, and associated documents used with items. This discipline ensures that Hanford Site design standards are used to the greatest extent possible in the design of all elements of the TWRS Program. Hanford Site design standards will be used in the TWRS Program design as appropriate. Standard equipment, materials, and processes will be incorporated into the design where these standards exist and can be used. This discipline will be incorporated into all phases of the SE process.

4.3.11 System Life-Cycle Cost

System Life-Cycle Cost (LCC) analyses develop the requisite cost information to support decisions on alternatives, people, product, process solutions, and risk assessments. LCC is the total of the direct, indirect, recurring, nonrecurring, and related costs incurred or estimated to be incurred during the anticipated life span of the system. The life span consists of design development, production, construction, operation, maintenance, support, and final disposition. System LCC analyses will be performed and maintained by the M&O contractor according to applicable DOE directives. Early design evaluations will include system trade studies that establish a desirable balance among performance, reliability, supportability, schedule, cost, and other significant attributes while complying with safety, regulatory, and permitting requirements. The TWRS Program LCC analysis will be performed on a continuing basis as the program evolves and will be established specifically at each technical baseline review. The TWRS SE Life-Cycle Cost Desk Instruction (WHC-IP-1104) describes the development of a LCC Program.

4.3.12 Training

The training discipline provides requirements into the SE process by performing a training analysis. This analysis determines the number of personnel and skills required to operate and maintain the facilities and equipment in the TWRS Program. The analysis also identifies the training and training equipment required to support the program. Training tasks are identified through analysis of the personnel tasks, which are derived during the F&R analysis and allocation step of the SE process. After training tasks have been identified, further analysis determines student task requirements, instructor requirements, and trainer requirements. Instructor requirements are further analyzed to determine the instructor training requirements for the program. After all requirements have been determined, they are compared with current training resources to determine additional resources that may be needed to train personnel. Training analysis is conducted during F&R analysis and allocation and training requirements are given consideration throughout the development of the technical baseline.

4.3.13 Value Engineering

System Value Engineering (VE) studies will assist in development of design configurations or alternative designs to achieve the optimum design configuration and value based on LCC (Section 4.3.11) and other value criteria. VE study results must be consistent with satisfying constraints and requirements for the following; (1) constructability, (2) quality of performance, (3) reliability, (4) availability, (5) productivity operability, and (6) safety. VE studies will be incorporated into all phases of the SE process.

5.0 AIDS TO IMPLEMENTATION

To aid in implementing SE within the TWRS organization, the WHC TWRS SE organization will provide guidance on the SE process and management techniques given in Sections 2 through 4. Primary guidance products will be desk instructions, training, computer tools, and management documents such as the SEMP, this SEWP, and Project SEMPs. The following sections contain brief descriptions of the implementation tasks that are in progress or are being planned. Appendix B gives the schedules for the implementation tasks.

5.1 SYSTEMS ENGINEERING PROCESS IMPLEMENTATION

Desk instructions, training, and computer tools will be used to implement the SE process within the WHC TWRS organization. The TWRS SE desk instructions describe the specific actions required to perform different activities in the SE process. These desk instructions cover the SE process and some of the SE technical management techniques. Table 5-1 lists the SE desk instructions being written and references the applicable sections of the SEWP.

Table 5-1. Systems Engineering Desk Instructions.

Desk Instruction	Applicable SEWP Section
Mission Analysis	2.1
Functions and Requirements Analysis and Allocation	2.2
Alternative Solution Development	2.3
Trade Study/Decision Analysis	2.3
Data Review and Acceptance	2.3
Specifications	3.1.1.1, 3.1.1.2, 3.1.1.3
Interface Control	3.1.1.4.2
Test and Evaluation Plan (TEP)	3.1.2
Systems Engineering Master Logic (SEML)	3.1.3.2
Risk Management	3.1.3.4
Technical Performance Measurement (TPM)	3.1.3.6
Environmental Regulatory Integration	4.1.1, 4.1.2
Life-Cycle Cost Analysis	4.3.11

All the desk instructions except for the Systems Engineering Master Logic (SEML) and Specification Desk Instructions are in draft form. The first five desk instructions listed in Table 5-1 plus the Interface Control and Risk Management Desk Instructions will be released by September 30,

1994. Rest of the desk instructions except for the SEML and Specification Desk Instructions will be release early FY95. Work begins on the SEML Desk Instructions in November 1994. Work on the Specifications Desk Instruction will start in February 1995. Additional desk instructions will be written as needed. Appendix B contains the schedule for the desk instructions.

Training on the SE process and management has started with general courses and a mentor program. A 5-day workshop course and a 2-day SE overview course are available. Both courses are for the general SE process and are not TWRS specific. The mentoring program consists of an expert in SE aiding a project in the TWRS SE process.

The training effort will expand. Training will include training on the desk instructions and on the SEWP. Training will expand to cover the SE computer tools when they become available. Appendix B gives the training schedule.

5.2 TECHNICAL BASELINES, REVIEWS, AND DOCUMENTATION IMPLEMENTATION

The TWRS SE organization will provide guidance on the program and projects technical baseline reviews. The guidance will contain entry and exit criteria for the reviews and the format of the reviews. A change control policy will be implemented to track open actions and issues. Appendix B contains the program and project reviews guidance schedules.

Guidance will be provided for baseline related documentation. Some of the Desk Instructions contain guidance for producing some of the technical documents. The WHC TWRS SE organization will identify where additional guidance is needed to produce documents identified in the SEWP. The best method for guidance; e.g., Desk Instructions, tools, or training, will be determined. Appendix B contains the detailed schedule for additional technical baseline documentaion guidance.

The WHC TWRS SE organization will assess if the TWRS Projects, Engineering, and Operations will need special oriented guidance for applying the SE process within their respective organizations. Some guidance has been conducted for specific projects. The evaluation of specific guidance is schedule to start in FY95. Appendix B contains the detailed schedule for organizational guidance.

5.3 TECHNICAL BASELINE MANAGEMENT IMPLEMENTATION

Technical baseline management consists of traceability, configuration management, and technical interface control. The implementation of each aspect is discussed in the following subsections.

5.3.1 Traceability Implementation

The RMACS is being developed for TWRS program requirement and compliance traceability. The goal for RMACS is to provide a well integrated, easy to use, computer based system that will facilitate efficient requirements and compliance management for the TWRS program. RMACS development has started and will continue over the next three to seven years. Appendix B contains the schedule for RMACS implementation.

5.3.2 Configuration Management Implementation

A TWRS wide CM plan will be developed by the WHC configuration management organization for the TWRS program. TWRS SE will review and approve the plan, which will address the TWRS CM organization, responsibilities, establishment and procedures for Configuration Control Boards (CCB), processing of Engineering Change Proposals (ECP) and relationships with the Interface Control Process. The program CM plan will cover all of TWRS throughout the life cycle. The ICWG will be an integral subordinate part of the CM organization.

5.3.3 Technical Interface Control Implementation

TWRS SE has started the technical interface control process. The process has begun with the draft Interface Control Desk Instruction used as guidance. Proposed modifications will be incorporated before the release of the Desk Instruction on September 30, 1994. PICDs have been drafted and are planned for presentation as an element of the Technical Requirements Baseline. The PICDs will be reviewed and approved by the TWRS ICWG. A charter for the ICWG is in draft; this document will detail membership, responsibilities and authority of the ICWG.

The interface control plan is in two phases: (1) ICD development and (2) Interface management and control. Establishment of the ICWG will bridge both phases. The ICWG is scheduled to be formed in October 1994. Then monthly ICWG meetings will be held.

5.4 TEST AND EVALUATION IMPLEMENTATION

T&E will be implemented throughout the WHC TWRS program. A Desk Instruction on producing T&E plans will be released early FY95. Work has started on identifying all TWRS testing and evaluation that is being planned. Bench tests are also being verified. However, most of the implementation will be done in FY95. Appendix B contains the detailed scheduled for test and evaluation.

5.5 SYSTEMS ENGINEERING MANAGEMENT TECHNIQUES IMPLEMENTATION

The SE management techniques consist of management documentation, SE schedules, work breakdown structures, risk management, decision management, and technical performance measurements. The implementation of each element is discussed in the following paragraphs.

5.5.1 Management Documentation Implementation

Guidance will be provided for management related documentation. Some of the desk instructions contain guidance for producing some of the management documents such as the Test and Evaluation Plan and the Risk Management Plan. The WHC TWRS SE organization will identify where additional guidance is needed to produce management documents identified in the SEWP. This identification process will coincide with the process identified for technical baseline documentation (Section 5.2).

5.5.2 Systems Engineering Schedules Implementation

Most of the SE scheduling will use established guidelines. All TWRS schedules will be developed according to Section 1.2 (Scheduling) of WHC-CM-2-5, *Management Control System.* In addition, all TWRS project schedules will be developed according to TWRS-PIP-2.1 (Master Schedule Development or Revision) of RL-TWRS-93-01 (Tank Waste Remediation System Projects Integrating Procedures Manual).

SEMLs will be implemented to aid regular scheduling. The approach and details for constructing a SEML will be given in the SEML Desk Instruction. This desk instruction is part of the group of desk instructions discussed in Section 5.1.

5.5.3 Work Breakdown Structure Implementation

Work breakdown structures and the work breakdown structure dictionaries are already part of the planning system. The WHC TWRS SE organization will not provide extra guidance for making a work breakdown structure.

The WHC TWRS SE organization has produced a work breakdown structure for "providing TWRS Systems Engineering." The work breakdown structure is given in Figure 5-1. All schedules given in Appendix B are based on the TWRS SE work breakdown.

5.5.4 Risk Management Implementation

A risk management program for WHC TWRS organizations is being developed. By September 30, 1994, the TWRS Risk Management Desk Instruction and the TWRS Risk Management Plan will be released. The Risk Management Desk Instruction will explain the contents of a risk management plan and the risk management activities. The Risk Management program will continue in FY95 with initial risk assessment studies. In January 1995, the Risk Watch list will be developed. Appendix B contains the schedule for TWRS risk management.

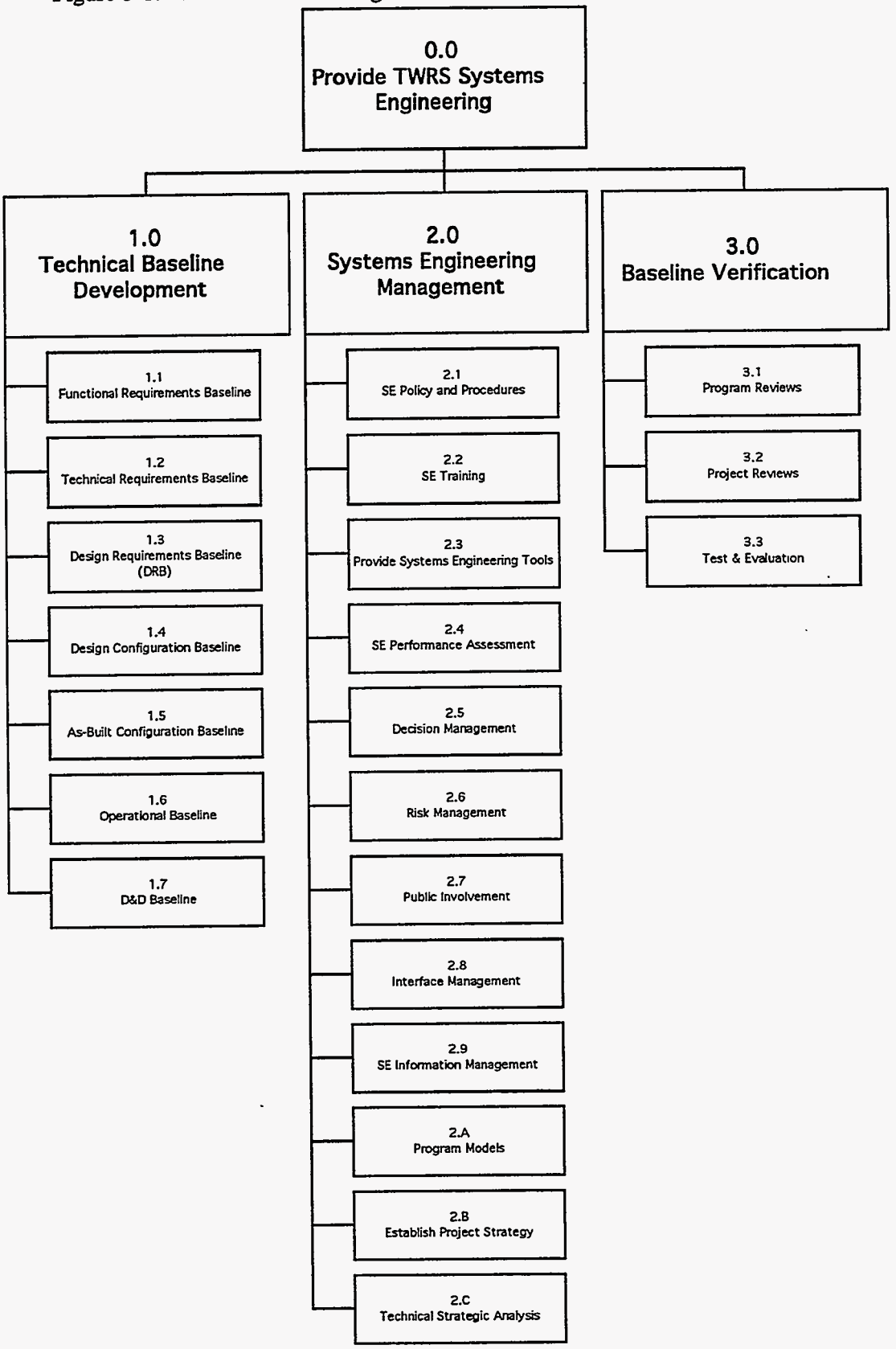
5.5.5 Decision Management Implementation

Implementing decision management has started. Guidance for incorporating public input in the decision-making process is being developed (Johnson 1994). Decision management policy will continue to be developed through next fiscal year. Throughout FY95, the decision methodology and guidance plan will be developed. Appendix B contains the detailed schedule for SE decision management.

5.5.6 Technical Performance Measurements Implementation

Technical Performance Measurements will be implemented by a Desk Instruction. This desk instruction is part of the group of Desk Instructions discussed in Section 5.1.

Figure 5-1. WHC TWRS SE Organization Work Breakdown Structure.



Rev. Date 7/7/94 79401131.

5.6 REGULATORY AND ENGINEERING SPECIALTIES IMPLEMENTATION

Two desk instructions are being written to implement two topics under Regulatory and Engineering Specialties. The Environmental Regulatory Integration Desk Instruction gives guidance on environmental regulatory and permitting involvement for the life-cycle of the system. The LCC Desk Instruction will give guidance on performing the cost analysis.

Other desk instructions, such as the F&R analysis and allocation, will contain reminders to have participants from the specialty disciplines.

Section 4 of this SEWP also contains direction about the Regulatory and Engineering Specialties and how they contribute to the SE process.

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APPENDIX A - SYSTEMS ENGINEERING PROCESS, PRODUCTS, AND MANAGEMENT RESPONSIBILITIES MATRIX

Many organizations will be involved with the technical baseline development. This SEWP gives the SE process, products, and management techniques that will be used to develop the technical baseline. Table A-1 gives the responsibility matrix for the SE processes, products, and management techniques discussed in the SEWP and the SEMP. The following is a key to the abbreviations used in Table A-1.

Organizations:

RL - US Department of Energy, Richland Field Office
TWRS Program Office
TWRS Program SE - TWRS Strategic Planning and Systems Engineering organization
TWRS Project - The Project Organizations Systems Engineering effort
TWRS Engineering
TWRS Operations
TWRS Bus. Mgmt. - TWRS Business Management
TWRS Tech. Dev. Prog. Office - TWRS Technical Development Program Office
A/E - Architect and Engineer

Responsibility Key:

A - Approval. Organization(s) that approve document, review, or task
I - Information. Organization(s) that receive the document for information only.
L - Lead Organization. Responsible for the activity.
P - Participant of baseline document.
R - Review. Organization(s) that review the activity.
S - Supporting Organizations. Works with lead organization to complete activity.

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
FUNCTIONAL REQUIREMENTS BASELINE DEVELOPMENT										
Activities										
Mission Analysis	SEMP 2.1, SEWP 2.1	S	S	L	S	S[1]	S		S	
F&R Analysis & Allocation	SEMP 2.2, 2.3, 3.1.1 SEWP 2.2	S	S	L	S	S	S		S	
Alternative Generation	SEMP 2.4 SEWP 2.3	S	S	L	S	S	S		S	
Architecture Selection	SEMP 2.4 SEWP 2.3	S	A	L	S	S	S		S	
Decision Analysis	SEMP 2.5, SEWP 2.3	S	A	L	S	S			S	
Required Analyses-Program Policy	SEMP 2.4 SEWP 2.4	S		L		S			S	
Value System Input	SEMP 3.1.7, Figure 2 SEWP 2.5	S	S	L		S	S		S	
Programmatic Risk Assessment	SEMP 3.1.6 SEWP 3.1.3.4	S	S	L		S				
Program Cost and Schedule Data	SEMP 3.1.4 SEWP 3.1.3.2		S	L	S	S	S		S	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
FUNCTIONAL REQUIREMENTS BASELINE DEVELOPMENT (Cont.)										
Documentation										
Mission Analysis Document	SEMP 2.1 SEWP 2.1, 3.1.1.3	A	R	L	I	R	I	I	I	
F&R Document	SEMP 3.1.1 SEWP 3.1.1.1.1, 3.1.1.3	A	R	L	R	R	R	I	R	
Baseline System Description	SEMP 3.1.1 SEWP 3.1.1.1.1, 3.1.1.3	I	R	L,A	I	R	I	I	I	
Required Analysis (Trade Studies) Document - Program Policy	SEMP 2.4 SEWP 2.3	R	R	L,A	I	R	I		R	
Programmatic Risk Management Plan	SEMP 3.1.6 SEWP 3.1.3.4	R	A	L	I	R	I	I	I	
Program Operational (Logistics) Support	SEMP Table 3-1 SEWP 3.1.1.3	I	R	L,A	I	R	R	I	R	
Review										
Systems Requirements Review	SEMP 3.1.1 SEWP 3.1.1.1.1, 3.1.1.2.1	A	P	L	P	P	P	I	P	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
TECHNICAL REQUIREMENTS BASELINE DEVELOPMENT										
Activities										
F&R Analysis & Allocation	SEMP 2.2, 2.3, 3.1.1 SEWP 2.2	S	S	L	S	S	S		S	
Alternative Generation	SEMP 2.4 SEWP 2.3	S	S	L	S	S	S		S	
Architecture Selection	SEMP 2.4 SEWP 2.3	S	A	L	S	S	S		S	
Decision Analysis	SEMP 2.5, SEWP 2.3	S	A	L	S	S			S	
Required Analyses (Trade Studies) - Program Policy	SEMP 2.4, SEWP 2.4	S		L		S			S	
Required Analyses (Trade Studies) - Technical	SEMP 2.4, SEWP 2.4	S		S		L			S	
Value System Input	SEMP 3.1.7, Figure 2 SEWP 2.5	S	S	L		S	S		S	
Programmatic Risk Assessment	SEMP 3.1.6 SEWP 3.1.3.4	S	S	L		S				
Program Cost and Schedule Data	SEMP 3.1.4 SEWP 3.1.3.2		S	L	S	S	S		S	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
TECHNICAL REQUIREMENTS BASELINE DEVELOPMENT (Cont.)										
Documentation										
Technical Requirements Specification (TRS)	SEMP 3.1.1 SEWP 3.1.1.1.2, 3.1.1.3	A	R	L	R	R	R	I	R	
Program Interface Control Documents (ICD)	SEMP 3.1.1 SEWP 3.1.1.1.2, 3.1.1.4.2	I	R	L,A	R	R	R	I	R	
Baseline System Description Update	SEMP Table 3-1 SEWP 3.1.1.1.2	I	R	L,A	I	R	I	I	I	
Required Analysis (Trade Studies) Document - Program Policy	SEMP 2.4 SEWP 2.3, 3.1.1.3	R	R	L,A	I	R	I		R	
Required Analysis Document (Trade Studies) - Technical	SEMP 2.4 SEWP 2.3, 3.1.1.3	R	R	R	I	L,A	I		R	
Program Test and Evaluation Plan	SEMP 3.1.9 SEWP 3.1.2	I	I	L,A	R	R	I		R	
Risk Watch List	SEMP 3.1.6 SEWP 3.1.3.4	I	R	L,A	R	R	R	R	R	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
TECHNICAL REQUIREMENTS BASELINE DEVELOPMENT (Cont.)										
Programmatic Risk Mgt. Plan Update	SEMP 3.1.6 SEWP 3.1.3.4	R	A	L	I	R	I	I	I	
Program Operational (Logistics) Support Update	SEMP Table 3-1 SEWP 3.1.1.3	I	R	L,A	I	R	R	I	R	
Review										
Technical Requirements Review	SEMP 3.1.1 SEWP 3.1.1.1.2, 3.1.1.2.2	A[2]	P	L	P	P	P	I	P	
DESIGN REQUIREMENTS BASELINE [3] DEVELOPMENT										
Activities										
Translate TRS into Project Specific Spec. Data for DRD	SEWP 3.1.1.1.3, 3.1.1.3	S	S	L	S	S			S	
Produce Technical Specifications for Rest of Design	Not mention in SEMP or SEWP. However, needed to proceed.			S	L	S	S			
Project Mission Analysis (on going projects only)	SEWP 3.1.1.3	S	S	S	L	S	S			

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DESIGN REQUIREMENTS BASELINE [3] DEVELOPMENT (Cont.)										
Function and Operational Requirements (F&OR) Analysis and Allocation	SEMP 2.2, 2.3, 3.1.1 SEWP 2.2, 3.1.1.1.3		S	S	L	S	S		S	
Alternative Generation & Evaluation	SEMP 2.4 SEWP 2.3		S	S	L	S	S		S	
Architecture Selection	SEMP 2.4 SEWP 2.3		S	S	L	S	S		S	
Decision Analysis	SEMP 2.5, SEWP 2.3	S	S	S	L	S	S		S	
Trade Studies	SEMP 2.4, SEWP 2.4		S	S	L	S	S		S	
Project Risk Analysis	SEMP 3.1.6, SEWP 3.1.3.4		S	S	L	S	S	S	S	
Safety & Regulatory Compliance Activities	SEMP 4.0 SEWP 4.1, 4.2			S	L[4]	S	S		S	
Produce Spec. for A/E	SEMP 3.1.1 SEWP 3.1.1.1.3, 3.1.1.3		S	S	L	S	S		S	
Project Cost and Schedule Data	SEMP 3.1.1, 3.1.4 SEWP 3.1.3.2		S	S	L	S	S	S	S	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DESIGN REQUIREMENTS BASELINE [3] DEVELOPMENT (Cont.)										
Program Cost and Schedule Data Update	SEMP 3.1.1, 3.1.4 SEWP 3.1.3.2		L	S	S	S	S		S	
Documentation										
Design Requirements Document	SEMP 3.1.1 SEWP 3.1.1.1.3, 3.1.1.3	A	R	L	R	R	I	I	I	I
Project SEMP (optional)	SEWP 3.1.3.1	I	I	R[5]	L,A	I	I		I	
Mission Analysis Document (when DRD is not available.)	SEWP 3.1.1.3		R	R[5]	L,A	I	I	I	I	
F&OR Document	SEMP 3.1.1 SEWP 3.1.1.1.3, 3.1.1.3	R	R	R[5]	L,A	R	R		I	
Project Design Concept	SEMP Table 3-1 SEWP 3.1.1.1.3, 3.1.1.3	I	R	R[5]	L,A	R	R		I	S
Project ICD	SEMP 3.1.1 SEWP 3.1.1.1.3, 3.1.1.3	I	R	R[5]	L,A	R	R		I	S
Energy/Mass flow Sheet	SEWP 3.1.1.1.3, 3.1.1.3			I	L,A	R	R		I	S

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DESIGN REQUIREMENTS BASELINE [3] DEVELOPMENT (Cont.)										
Piping and Instrumentation Diagram	SEWP 3.1.1.1.3, 3.1.1.3			I	L, A	R	R		I	S
Project Test and Evaluation Plan	SEMP 3.1.9 SEWP 3.1.2		I	R[5]	L,A	I	R		I	
Project Risk Management Plan	SEMP 3.1.6 SEWP 3.1.3.4		I	R[5]	L,A	I	R		I	
Project Risk Analysis Document	SEMP 3.1.6 SEWP 3.1.3.4		I	R[5]	L,A	I	R		R	
Safety Documentation	SEMP 4.0 SEWP 4.2		I	I	L[6],A	R	I		I	
Regulatory Compliance Documentation	SEMP 4.0 SEWP 4.1		I	I	L[7],A	R	I		I	
Project Operational Support (Logistics) Plan	SEMP Table 3-1 SEWP 3.1.1.3	I	R	R[5]	L,A	R	R		I	
Technology Development Report	SEMP 3.1.1, Table 3-1 SEWP 3.1.1.3	I	R	R[5]	A	R			L	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DESIGN REQUIREMENTS BASELINE [3] DEVELOPMENT (Cont.)										
Specification Document for A/E to design to	SEMP 3.1.1 SEWP 3.1.1.1.3, 3.1.1.3	I	R	R[5]	L,A	R	R	I	R	
Program Baseline Documentation Updated	SEWP 3.1.1.1.3	I	R	L,A	R	R	I	I	I	
Review										
Project Interim, Safety, and Regulatory Reviews	SEWP 3.1.1.2.7			S	L,A	S,P	S,P		S,P	
Design Requirements Review	SEMP 3.1.1 SEWP 3.1.1.1.3, 3.1.1.2.3	P[2], A	P	S,P	L	S	S		S	
DESIGN CONFIGURATION BASELINE DEVELOPMENT										
Activities										
Developing to-build design package	SEMP 3.1.1 SEWP 3.1.1.1.4		S	S	S	S	S		S	L
Project Interface Control	SEMP Table 3-1, 3.1.3 SEWP 3.1.1.1.4, 3.1.1.4.2		S	S	L	S	S			S

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DESIGN CONFIGURATION BASELINE DEVELOPMENT (Cont.)										
Program Interface Control	SEMP Table 3-1 SEWP 3.1.1.1.4, 3.1.1.4.2		S	L	S	S	S		S	
Safety & Regulatory Compliance Activities	SEMP 4.0 SEWP 4.1, 4.2			S	L[4]	S	S		S	S
Produce Procurement and Construction Specifications	SEMP 3.1.1 SEWP 3.1.1.1.4		S	S	S	S	S	S		L
Risk Management	SEMP 3.1.6 SEWP 3.1.3.4			S	L	S	S		S	S
Verification testing	SEMP 3.1.9 SEWP 3.1.2			S	L	S	S		S	S
Evaluation testing	SEMP 3.1.9 SEWP 3.1.2			S	L	S	S		S	S
Documentation										
Safety Analysis Reports	SEMP 4.0 SEWP 4.2	I	I	I	L[6], A	R	R	I	I	R

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DESIGN CONFIGURATION BASELINE DEVELOPMENT (Cont.)										
Regulatory and Permitting Reports	SEMP 4.0 SEWP 4.1	I	I	R	L[7], A	R	R	I	I	R
Project Baseline Documentation Updated	SEWP 3.1.1.1.4		R	R[5]	L, A	R	R	I	I	
Program Baseline Documentation Updated	SEWP 3.1.1.1.4	I	R	L,A	I	R	I	I	I	
Procurement and Construction Specifications Document	SEMP Table 3-1 SEWP 3.1.1.1.4	I	R	R[5]	R,A	R	R	I	I	L
"build-to" design Package	SEMP 3.1.1 SEWP 3.1.1.1.4	I	R	R[5]	R,A	R	R	I	I	
Reviews										
Project Interim, Safety, and Regulatory Reviews	SEWP 3.1.1.2.7			S	L,A	S,P	S,P		S	S,P
Detailed Design Review	SEMP 3.1.1 SEWP 3.1.1.1.4, 3.1.1.2.4	P[2], A	P	S,P	L	S	S		S	S,P

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
AS-BUILT CONFIGURATION BASELINE DEVELOPMENT										
Activities										
Project Interface Control	SEMP 3.1.3 SEWP 3.1.1.1.5, 3.1.1.4.2		S	S	L	S	S			
Program Interface Control	SEMP 3.1.3 SEWP 3.1.1.1.5, 3.1.1.4.2		S	L	S	S	S		S	S
Safety & Regulatory Compliance Activities	SEMP 4.0 SEWP 4.1, 4.2			S	L[4]	S	S		S	S
Risk Management Activities	SEMP 3.1.6 SEWP 3.1.3.4		S	S	L	S	S		S	S
Verification Tests	SEMP 3.1.9 SEWP 3.1.2			S	L	S	S		S	
Acceptance Tests	SEMP 3.1.9 SEWP 3.1.2			S	S	L	S		S	
System Tests	SEMP 3.1.9 SEWP 3.1.2			S	S	L	S		S	
Operational Tests	SEMP 3.1.9 SEWP 3.1.2				S	S	L		S	S

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineering	TWRS Operations	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
AS-BUILT CONFIGURATION BASELINE DEVELOPMENT (Cont.)										
Documentation										
Safety Analysis Reports	SEMP 4.0 SEWP 4.2	I	I	R	L[6], A		R	I	I	
Regulatory and Permitting Reports	SEMP 4.0 SEWP 4.1	I	I	R	L[7], A	R	R	I	I	R
Project Baseline Documentation Updated	SEWP 3.1.1.1.5		R	R[5]	L, A	R	R	I	I	
Program Baseline Documentation Updated	SEWP 3.1.1.1.5	I	R	L,A	I	R	I	I	I	
Construction, Test, & Turnover, Package	SEMP Table 3-1 SEWP 3.1.1.1.5	I	R	R[5]	R,A	R	R	I	I	L
Operations & Maintenance Package	SEMP Table 3-1 SEWP 3.1.1.1.5	I	R	R[5]	R,A	R	L	I		R
Reviews										
Project Interim, Safety, and Regulatory Reviews	SEWP 3.1.1.2.7			S	L,A	S,P	S,P			S,P

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
AS-BUILT CONFIGURATION BASELINE DEVELOPMENT (Cont.)										
As-Built Design Review	SEMP 3.1.1 SEWP 3.1.1.1.5, 3.1.1.2.5	P,A	P	S,P	L	S	S			S,P
Operational Readiness Review	SEMP Table 3-1 SEWP 3.1.1.2.5	A		S,P	S,P	S,P	L			S,P
OPERATIONAL BASELINE DEVELOPMENT										
Activities and Documentation										
Operational Risk Analysis	SEMP 3.1.6 SEWP 3.1.3.4		S	S	S	S	L	S		
Operational Risk Management Plan	SEMP 3.1.6 SEWP 3.1.3.4		I	R	I	R,A	L	I		
Operational Risk Handling Plan	SEMP 3.1.6 SEWP 3.1.3.4		I	R	I	R,A	L	I		
Operational Facility Configuration Updates	SEWP 3.1.1.1.6			I	I	S,R,A	L			
Program Baseline Documentation Updated	SEWP 3.1.1.1.6	I	R	L,A	I	R	I	I	I	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DECONTAMINATION AND DECOMMISSIONING BASELINE DEVELOPMENT										
Activities										
D&D Mission Analysis	SEWP 3.1.1.1.7	S	S	L	S	S	S			
D&D F&R Analysis and Allocation	SEWP 3.1.1.1.7	S	S	L[8]	S	S	S			
D&D Alternative Generation	SEWP 3.1.1.1.7	S	S	L[8]	S	S	S			
D&D Selection	SEWP 3.1.1.1.7	S	A	L[8]	S	S	S			
D&D Decision Analysis	SEWP 3.1.1.1.7	S	A	L[8]	S	S	S			
D&D Required Analyses (Trade Studies) - Program Policy	SEWP 3.1.1.1.7	S		L[8]		S	S			
D&D Required Analyses (Trade Studies) - Technical	SEWP 3.1.1.1.7	S		S		L[8]	S			
D&D Risk Assessment	SEMP 3.1.6 SEWP 3.1.3.4	S	S	L		S	S			

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DECONTAMINATION AND DECOMMISSIONING BASELINE DEVELOPMENT (Cont.)										
D&D Safety and Regulatory Compliance Activities	SEMP 4.0 SEWP 4.1, 4.2			S	S	L[4]	S			
Program D&D Cost and Schedule Data	SEMP 3.1.4 SEWP 3.1.3.2		S	L	S	S	S			
Documentation										
D&D Mission Analysis Report	SEWP 3.1.1.1.7	A	R	L	I	R	R	I		
D&D F&R Documentation	SEWP 3.1.1.1.7	A	R	L[8]	I	R	R	I		
D&D ICDs	SEWP 3.1.1.1.7	I	A	L		S	S			
D&D Baseline System Description	SEWP 3.1.1.1.7	I	R	L[8],A	I	R	R	I		
D&D Risk Management Plan	SEMP 3.1.6 SEWP 3.1.3.4	R	A	L	I	R	R	I		
Safety Analysis Reports	SEMP 4.0 SEWP 4.2	I	I	R	R	L[6], A	R	I	R	
Regulatory Reports	SEMP 4.0, 3.1.1 SEWP 4.1	I	I	R	R	L[7], A	R	I	R	R

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineer-ing	TWRS Operat-ions	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
DECONTAMINATION AND DECOMMISSIONING BASELINE DEVELOPMENT (Cont.)										
D&D Package Documentation	SEMP 3.1.1 SEWP 3.1.1.1.7	I	R	L[9],A	I	R	R	I		
Reviews										
Interim Safety and Regulatory Reviews	SEWP 3.1.1.2.7		P	L[8],A		S,P	S,P			
D&D Review	SEMP 3.1.1 SEWP 3.1.1.1.6, 3.1.1.2.6	P,A	P	L[8]		S,P	S,P			
Deactivation Readiness Review	SEMP Table 3-1 SEWP 3.1.1.2.7	P,A	P	L[8]		S,P	S,P			
SYSTEM ENGINEERING TECHNICAL MANAGEMENT [10]										
TWRS Configuration Management	SEMP 3.1.2 SEWP 3.1.1.4.1			S,R[11]		L[11]				
Technical Interface Control Working Group	SEMP 3.1.3 SEWP 3.1.1.4.2		S	L	S	S	S			
Requirements Traceability	SEMP 2.3, 2.7 SEWP 3.1.1.4.3		S	L	S	S	S		S	

Table A-1. TWRS Systems Engineering Activities Responsibility Matrix. (18 sheets)

ACTIVITY	TWRS SEMP/SEWP Section Reference	ORGANIZATION								
		RL	TWRS Programs Office	TWRS Program SE	TWRS Project	TWRS Engineering	TWRS Operations	TWRS Bus. Mgmt.	TWRS Tech. Dev. Prog. Office	A/E
SYSTEM ENGINEERING TECHNICAL MANAGEMENT [10] (Cont.)										
Scheduling -- SE Master Logic	SEMP 3.1.4 SEWP 3.1.3.2		L	S	S	S	S	S		
Scheduling - SE Activities	SEMP 3.1.4 SEWP 3.1.3.2		L	S	S	S	S	S		
Work Breakdown Structures	SEMP 3.1.5 SEWP 3.1.3.3		L	S	S	S	S	S		
Decision Management (Public Input)	SEMP 3.1.7 SEWP 3.1.3.5	A	L	S	S	S	S		S	
Technical Performance Measures Management	SEMP 3.1.8 SEWP 3.1.3.6	A	S	L	S	S	S		S	S

(1) Throughout matrix, engineering support includes specialty discipline integration including regulatory compliance, permitting, and health and safety. HEHF will support engineering with health issues.

(2) RL may chose to review select portions of the baseline.

(3) Programs hand over to Projects after Technical Requirements Review and Design Requirements Document completion. Projects become design authority.

(4) Appropriate Regulatory and Safety organizations will perform activity.

(5) Program SE will review and concur. Program SE will review for project SE continuity, terminology and methods.

(6) WHC Safety will write the reports.

(7) Appropriate Regulatory organizations will write reports.

(8) Also supported by D&D organization

(9) D&D specialist develop the D&D package.

(10) SE Technical Management performed throughout life-cycle of the system.

(11) L. S. Legowik organization will write and manage the CM effort. Program SE will review and concur.

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APPENDIX B - TWRS SYSTEMS ENGINEERING IMPLEMENTATION SCHEDULES

This appendix contains selected schedules from the TWRS SE organization WBS effort. The schedules in this appendix show the plans for implementing various SE processes and management techniques. The following tables are:

Table B-1. Desk Instructions Schedule

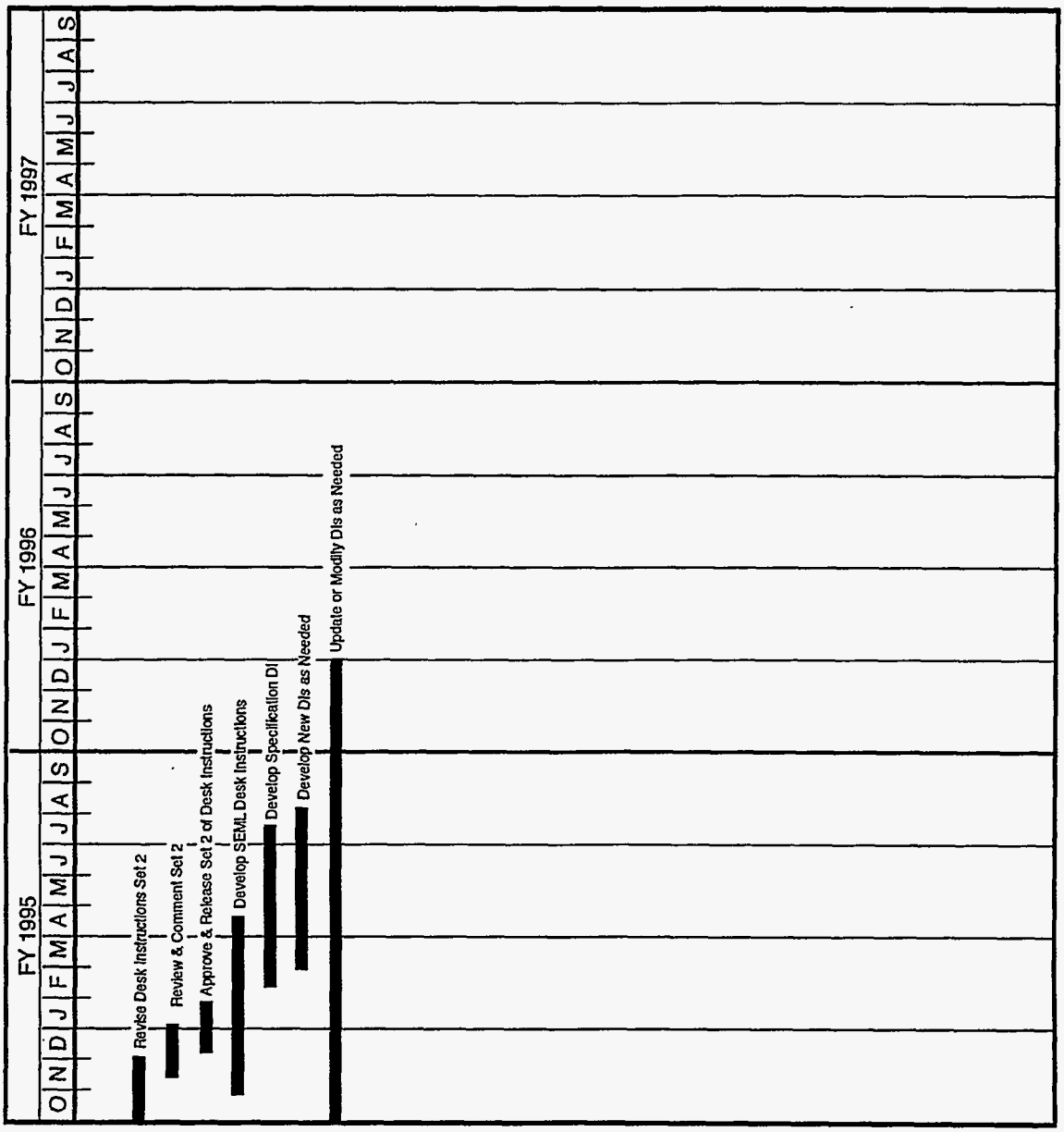

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Table B-2. Systems Engineering Training Schedule

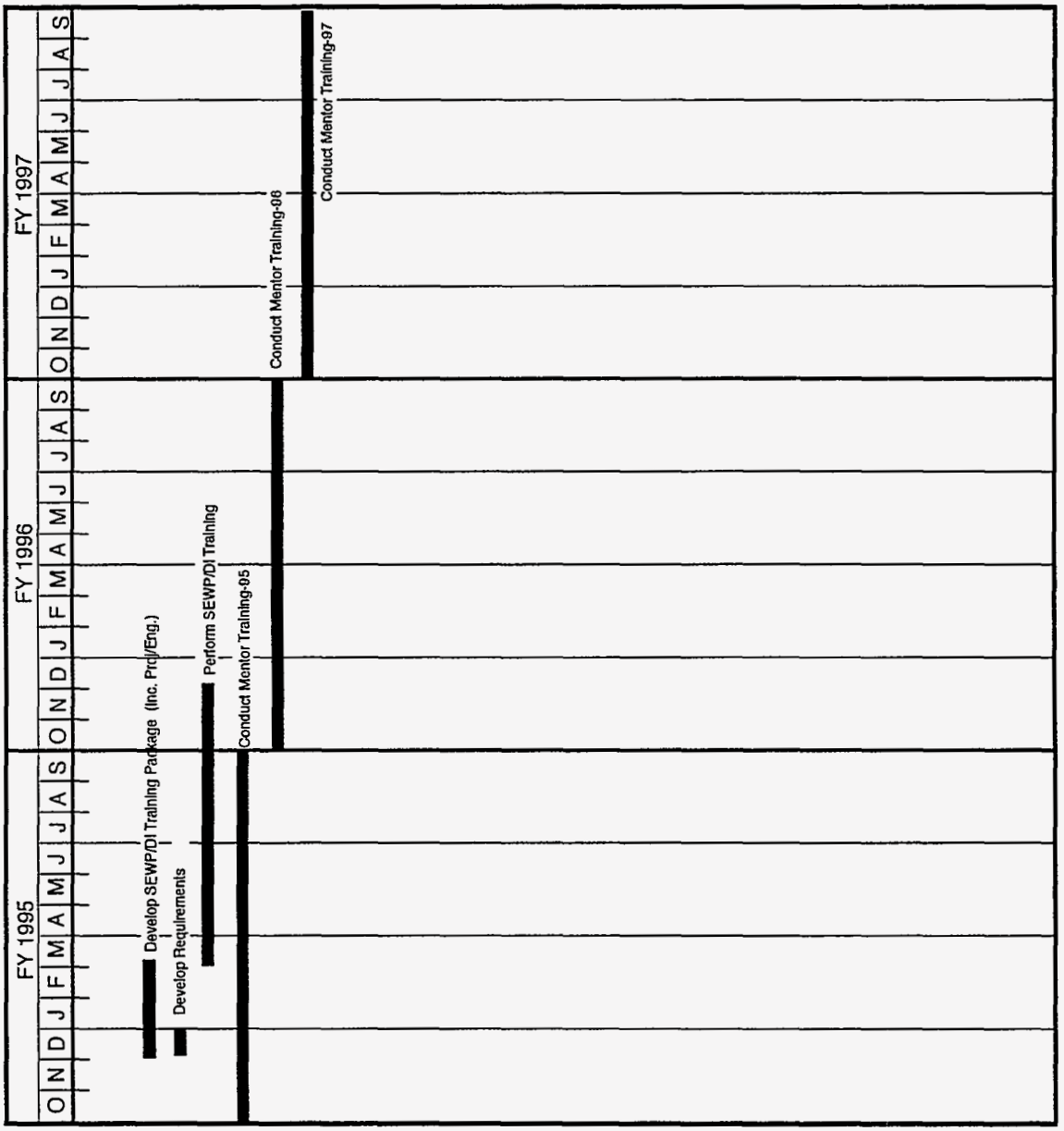

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Table B-3. SE Program & Project Reviews Guidance Schedule

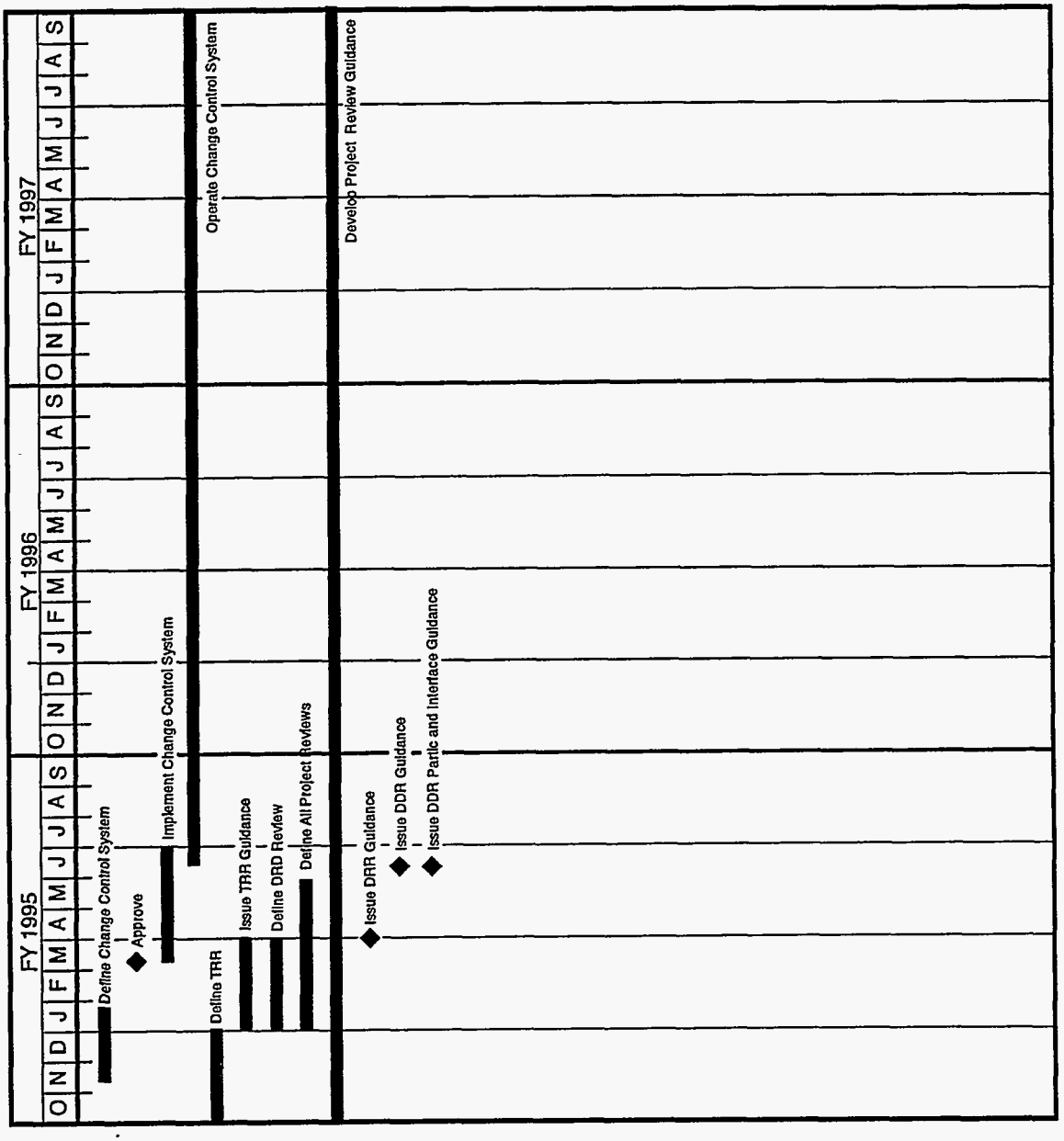

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Table B-4. Technical Baseline Document Guidance Schedule

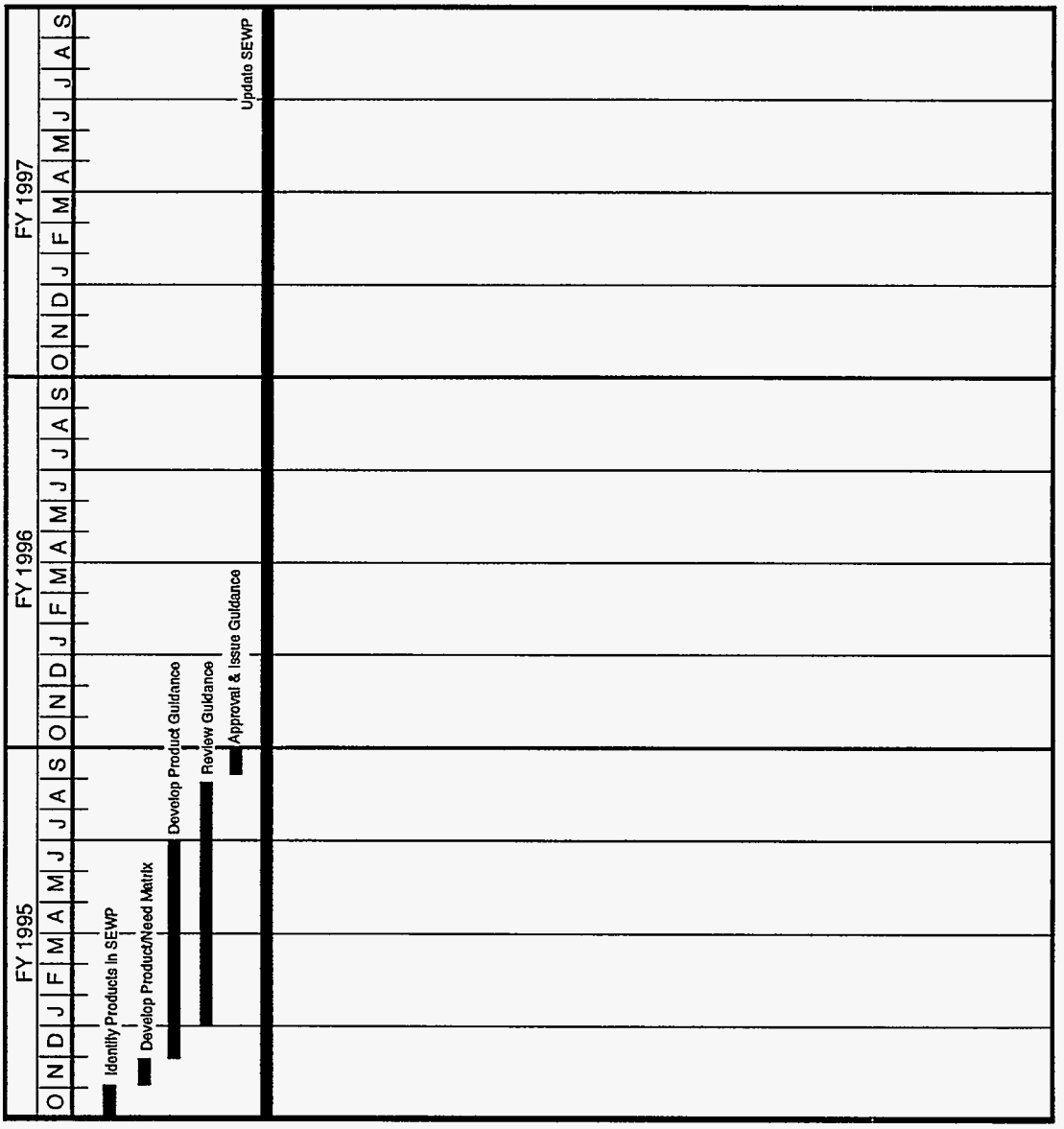

Table B-5. Organizational Guidance Schedule

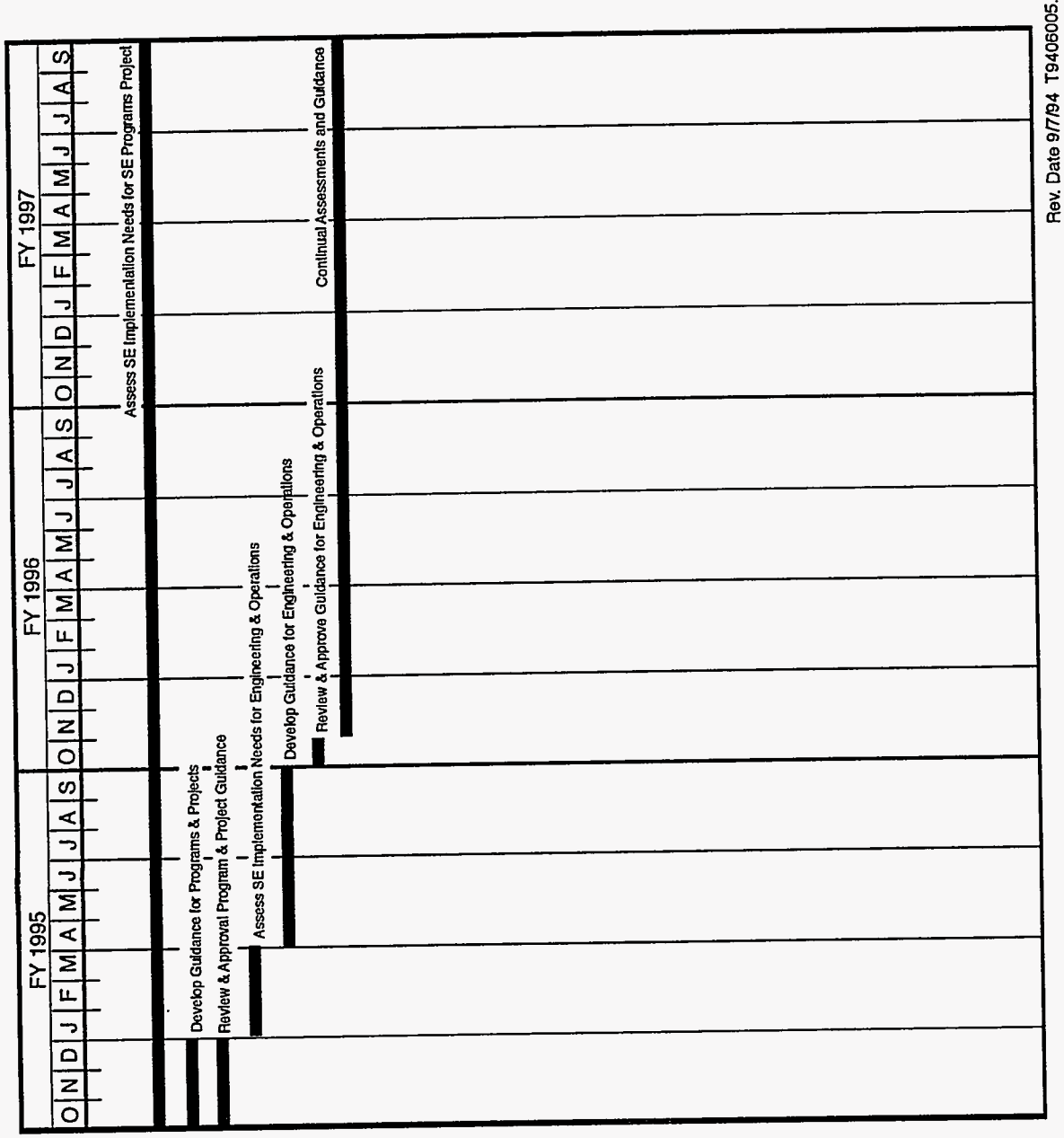

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Table B-6. RMACS Implementation Schedule

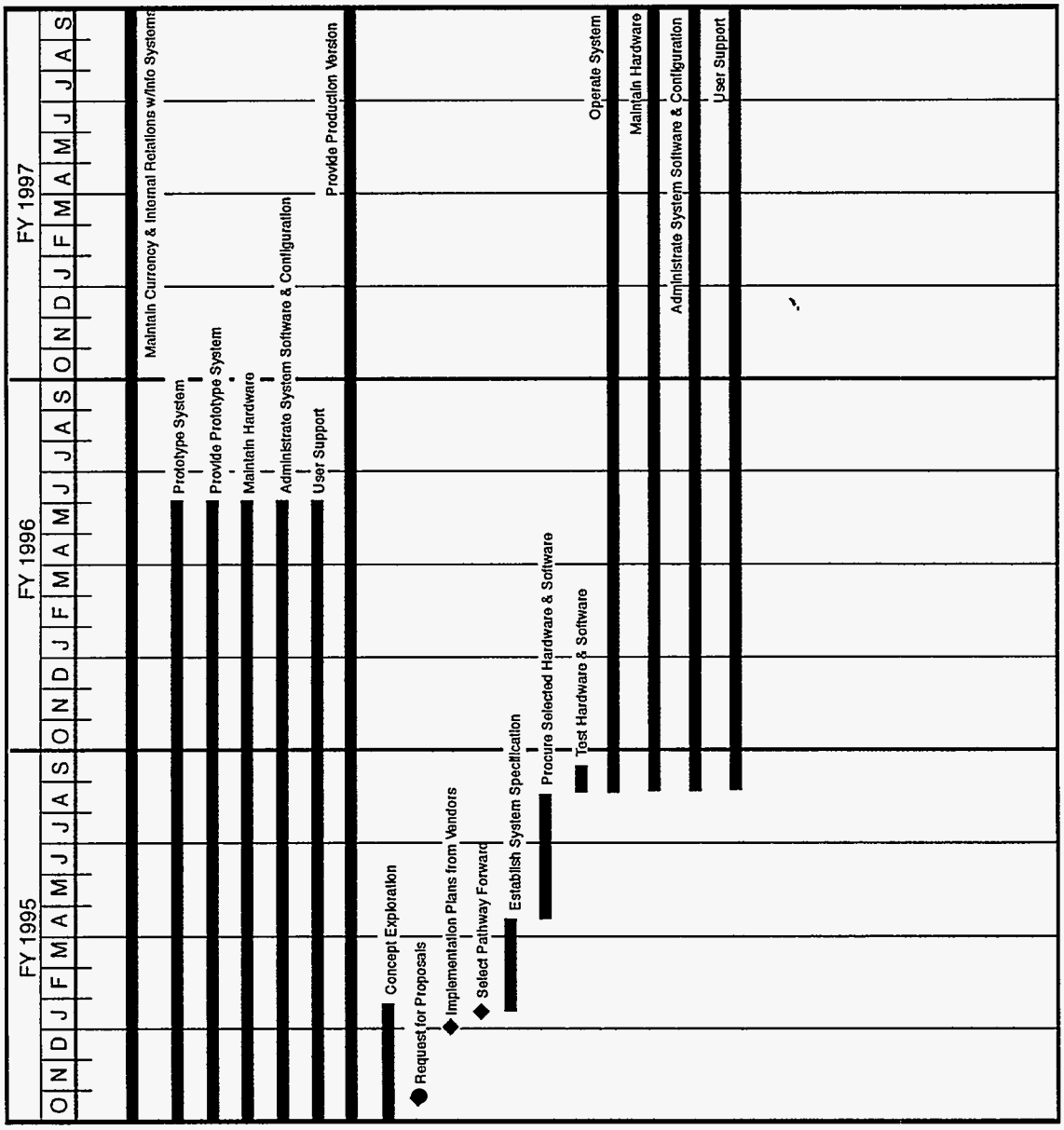

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Table B-7. Test & Evaluation Schedule

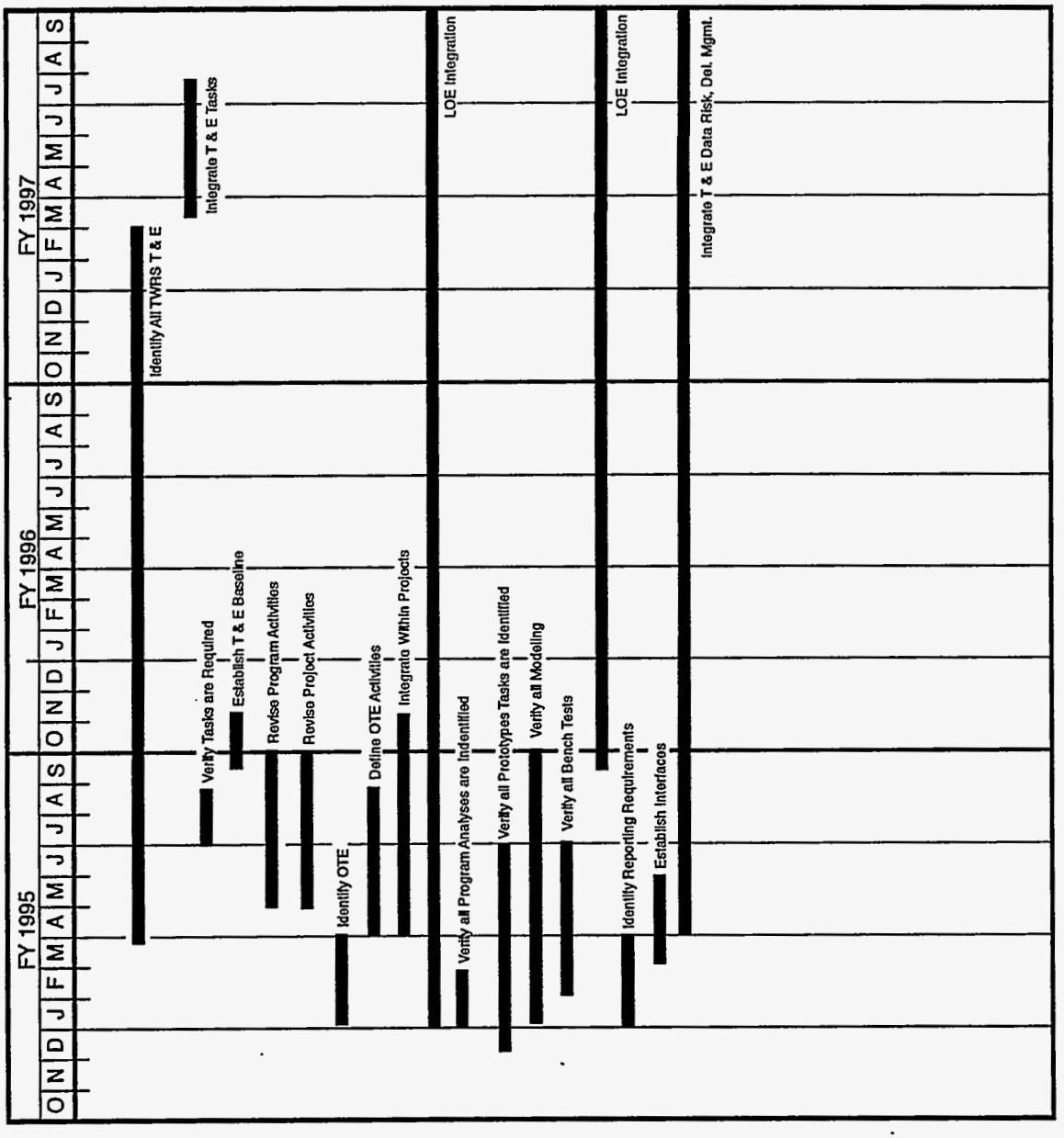

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Table B-8. Risk Management Schedule

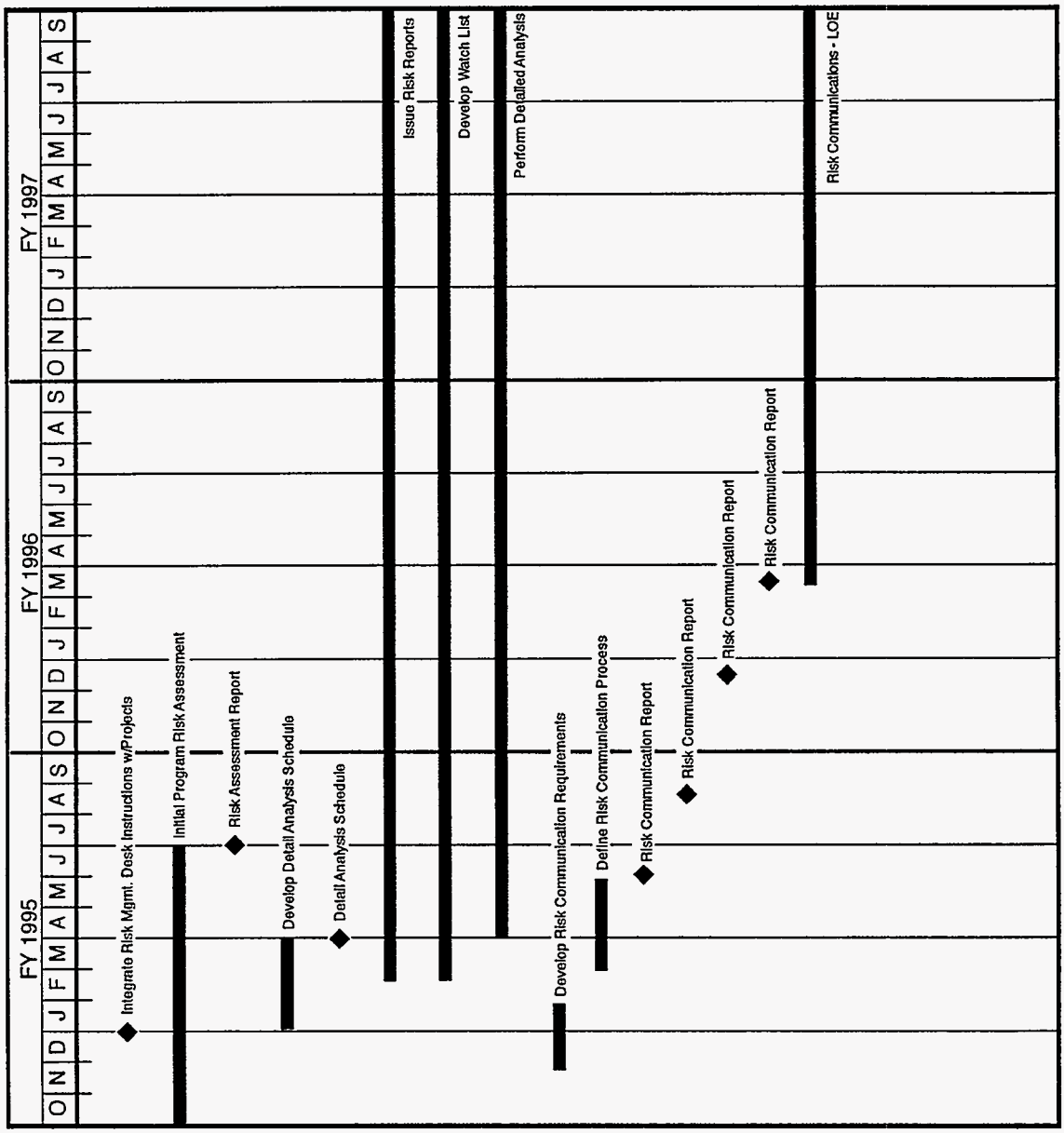

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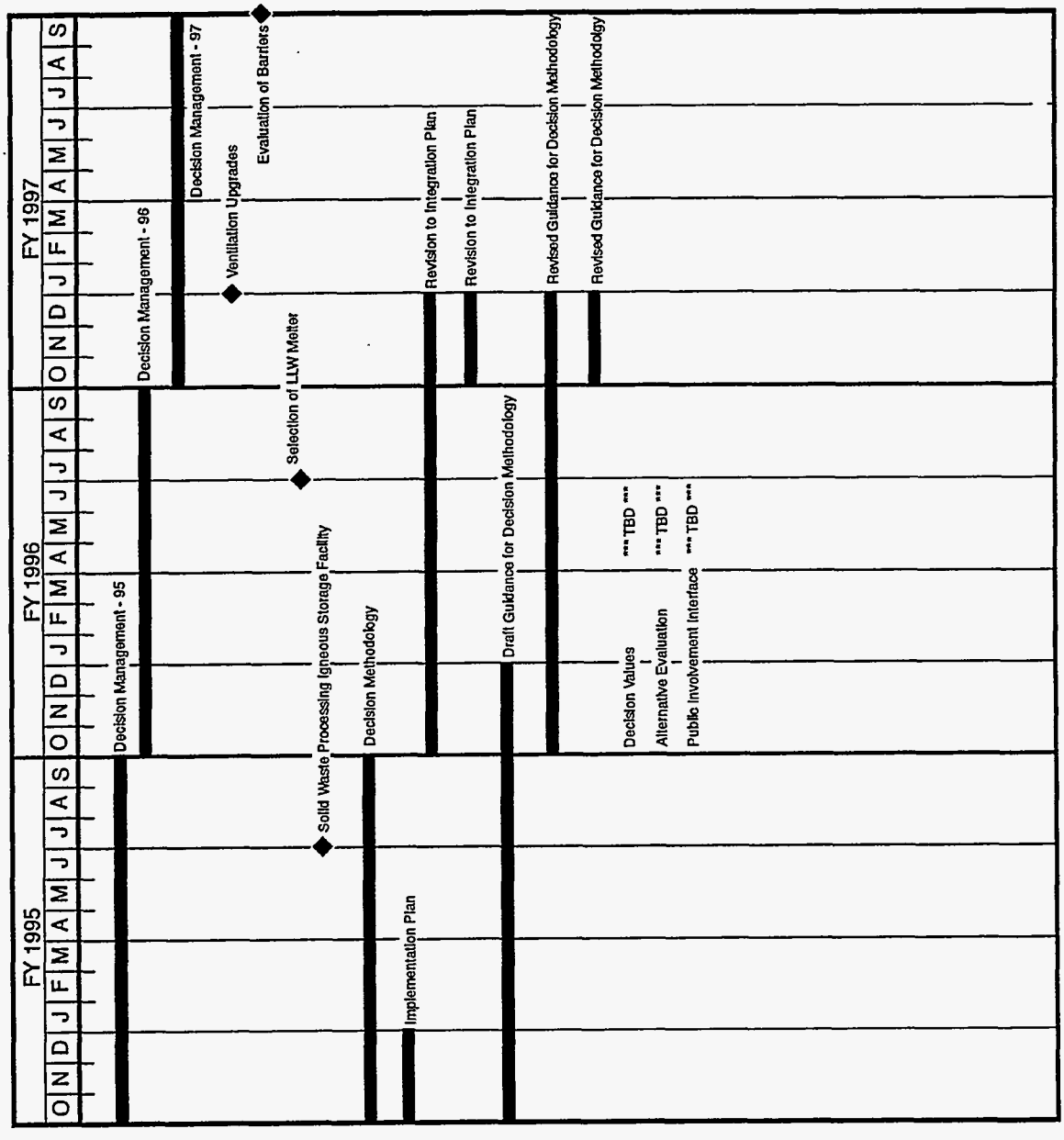
Table B-9. Decision Management Schedule



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GLOSSARY

Alternative solution	A candidate technical design strategy or approach that potentially satisfies the functions and requirements.
Architecture	(1) The selected design solution from the set of alternative solutions that best satisfies the F&R and is used for more detailed design activities. (2) That part of the physical system actually built, found, or selected to perform a function to the stated requirements.
As-Built Design	Constitutes the design of the as-built operational system. Confirmation of As-built condition ensures that the system is constructed according to the approved specifications and that the quality of materials and workmanship meets system requirements.
Baseline System Description (BSD)	A document that summarizes the initial state of the program and provides illustrations and narrative for visualizing architecture concepts. The BSD is used by all team members working on the program as a communication tool at briefings, for cost estimates, and for studies.
Baseline	
• Cost and Schedule baseline	Quantitative expressions of projected cost and schedule objectives/targets. This baseline serves as a base or standard for measuring of progress during the performance of an effort.
• Programmatic baseline	The documented scope, schedule, and cost by which the program will be executed, controlled, measured, and assessed.
• Technical baseline	The documented functions, requirements, and configuration from which the program will acquire an operational system. The technical baseline will be maintained under configuration control, and will be the basis for technical performance measurement.
Boundary	The border that establishes the interface for inputs and outputs of the system.
Configuration	The functional and/or physical characteristics of a set of controls, including hardware, firmware, software, or any other items as described in technical documentation and achieved in a product.

Constraint	Restrictions or limitation that must be met. Constraints are used to screen alternatives strategies and are always non-tradable by the designer (as opposed to requirements, which are tradable).
Decomposition	The process of breaking down a whole into its parts. Functions, environments, and systems each may be decomposed when proceeding from one level to the next.
Definitive Design	The design covering preliminary and detail designs.
Design Requirements	The "build to," "code to," and "buy to," requirements for products and "how to execute" requirements for processes. Design requirements are developed through synthesis of detailed design.
Design solution	Selected alternative approach or architecture that best satisfies the F&Rs.
Function	A specific action, activity, or process that achieves or supports the achievement of an objective (e.g., an operation that a system must perform to accomplish its mission).
Functional analysis	The first step of the "F&R analysis" systems engineering process at each level. This step identifies what the system does.
Functions and Requirements Analysis	The determination of specific characteristics based on analyses of customer needs, requirements, and objectives; missions; projected environments for people, products, and processes; constraints; and measures of effectiveness. F&R analysis assists the customers in defining and refining F&Rs for the life-cycle of the system.
Input	Anything that enters a function or system.
Interface	System boundary across which material, data, or energy passes.
Life-Cycle Costs	The sum total of the costs incurred, or estimated to be incurred, in the acquisition, operation and decommissioning of a system.
Milestone	An important or critical event that must occur in the development cycle in order to achieve the mission objectives.
Mission Statement	A declaration (usually written) of what is to be accomplished.
Output	Anything that leaves a function or system.

Physical Interface	The boundary at which physical systems interact, as in necessary to fit between architectures.
Physical System	The Tank Waste Remediation System (TWRS) consisting of the composition of the sites and facilities, systems, equipment, materials, information, activities, and personnel required to perform those activities necessary to manage waste remediation.
Process	A set of interrelated work activities characterized by a set of specific inputs, tasks, knowledge, and procedures that produce a set of specific outputs.
Product	The output or accomplishment of a process.
Program	An organized set of activities directed toward a common purpose or goal undertaken or proposed in support of an assigned mission area. A program may include one or more major system acquisitions or major projects, other projects, operations, or some combination thereof.
Program element	A unique effort that does not qualify as a project. A deliverable that will be directly managed by the M&O contractor for final design and construction.
Project	A unique major effort within a program that has a firmly scheduled beginning, intermediate, and ending date milestones. (sometimes called a program element)
Quality	The degree to which an item or process meets or exceeds the user's requirements and expectations.
Remediation	Action taken to safely store, maintain, treat, and dispose of tank waste.
Requirement	How well the system needs to perform a function. The extent to which a function must be executed, generally measured in terms of quantity, quality, coverage, timeliness or safety. Requirements include constraints, performance requirements and interface requirements.
Restoration	Return to the operating condition for which something was originally designed.

Risk	The probability of an undesirable event occurring and the significance or consequence of the occurrence. Risk can be related to health, safety, environment, technical, programmatic or other issues that may adversely impact the program or project.
Solution	A technical design strategy or approach that potentially satisfies the driving F&Rs.
Stakeholder	Any person or group that is potentially affected by actions at the Hanford Site.
Strategy	A plan or approach to accomplish the mission.
System	A combination of related functions or equipment integrated into a single activity.
Systems Engineering	The systematic approach used by management and engineering to transform technical objectives into an optimized, operational, physical system that achieves the mission. The iterative technical and management process applied throughout the system life-cycle that produces and maintains a well defined and documented system technical baseline.
Systems Engineering Management	Organizing and directing the tasks, activities, and performances related to the technical baseline work, defining the Systems Engineering process, ensuring that the process is followed, reviewing technical results, and making strategic technical decisions based on those results for the system under development.
Systems Engineering Management Plan (SEMP)	The document that defines the policies and guidance for the application of systems engineering for; a) a fully integrated TWRS Program engineering effort, (RL-SEMP) or b) a project effort (Project SEMP).
Tank Waste Remediation System (TWRS)	An integrated solution for carrying out the specific functions associated with remediating tank waste.
Tank Waste Remediation System Program	An integrated program for carrying out the specific functions associated with remediating tank waste at the Hanford Site.

Tank Waste Remediation System Program Mission Statement	To store, treat, and immobilize highly radioactive Hanford waste (current and future tank waste and the strontium and cesium capsules) in an environmentally sound, safe, and cost effective manner.
Technical Performance Measurement	An evaluation, preferably quantitative, that predicts the future performance of a physical system, subsystem, or component and compares that prediction to the required performance.
Trade study	(1) The process of comparing or trading the strengths and weaknesses of alternative approaches or attributes; (2) a feedback process for resolving inconsistencies between steps or levels; (3) the analysis of the ability of a design solution to meet its stated objectives as inputs are varied.
Uncertainty	Lack of technical, schedule, cost, or institutional information that could adversely impact the outcome or ability of a program to accomplish the mission.
Validation	The demonstration that a predictive model and its mathematical expression adequately reflect reality. Validation usually consists of comparing the results of the applied mathematical expression to measured results from the system being modeled (or from similar or identical systems), and showing that any differences were expected and/or within acceptable error.
Value System	The identification and definition of the public's and stakeholder's values -- their measures of success, effectiveness, and performance. These values includes constraints and criteria.
Verification	A process of planning and performing activities that will show compliance to constraints and technical design requirements. This process is performed at each level of the system architecture's development (i.e., from hardware item component all the way up to the system level). The method used to show compliance (test, inspection, demonstration, or analysis) is dependent on architecture complexity, engineering test data availability, and validated analytical methods availability or existence.

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