HNF-1751
Revision 0

0048562

TWRS Retrieval and Disposal Mission

Immobilized High-Level Waste Storage Plan

JAN 1998
RECEIVED
EDMC

Prepared for the U.S. Department of Energy
Assistance Secretary for Environmental Management

Fluor Daniel Hanford, Inc.
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC-0696-RL13200

Approved for Public Release; Further Dissemination Unlimited

HNF-1751
Revision 0

TWRS Retrieval and Disposal Mission

Immobilized High-Level Waste Storage Plan

Prepared by
R. B. Calmus
SGN Eurosys Services Corp.

Date Published
December 1997

Prepared for the U.S. Department of Energy
Assistance Secretary for Environmental Management

Fluor Daniel Hanford, Inc.
P.O. Box 1000
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC-0696-RL13200

Approved for Public Release; Further Dissemination Unlimited

RELEASE AUTHORIZATION

Document Number: HNF-1751, Revision 0

Document Title: TWRS Retrieval and Disposal Mission Immobilized High-Level Waste Disposal Storage Plan

This document, reviewed in accordance with DOE Order 1430.1D, "Scientific and Technical Information Management," and DOE G 1430.1D-1, "Guide to the Management of Scientific and Technical Information," does not contain classified or sensitive unclassified information and is:

APPROVED FOR PUBLIC RELEASE

V. L. Birkland 1/7/98

V. L. Birkland

Lockheed Martin Services, Inc.
Document Control/Information Clearance

Reviewed for Applied Technology, Business Sensitive, Classified, Copyrighted, Export Controlled, Patent, Personal/Private, Proprietary, Protected CRADA, Trademark, Unclassified Controlled Nuclear Information.

LEGAL DISCLAIMER. This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, not any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof. This report has been reproduced from the best available copy. Printed in the United States of America. Available to the U.S. Department of Energy and its contractors from the U.S. Department of Energy Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; Telephone: 423/576-8401.

Available to the public from the U.S. Department of Commerce National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; Telephone: 703/487-4650.

CONTENTS

1.0 PURPOSE 1

2.0 HANFORD SITE MISSION AND OBJECTIVES 2

3.0 MISSION AND OBJECTIVES OF THE IHLW STORAGE SUBPROJECT 4

4.0 SCOPE OF IHLW STORAGE SUBPROJECT 5
- 4.1 FACILITY DESCRIPTION 6
- 4.2 GENERAL CHARACTERISTICS OF TANK WASTE AND VITRIFICATION FEEDS TO BE PROCESSED 6
- 4.3 PROJECTED INVENTORIES FOR HLW PRODUCTS 8
- 4.4 TOP-LEVEL WORK BREAKDOWN STRUCTURE 11
- 4.5 INTERFACING ORGANIZATIONS 11

5.0 PROGRAM/PROJECT BACKGROUND 13
- 5.1 OPTIONS FOR GOVERNMENT AND COMMERCIAL ACTIVITIES AND CONCEPT SELECTION AND IMPLEMENTATION 14
- 5.2 EXISTING PHASE 1 INTERIM STORAGE FACILITY DESCRIPTION 15
- 5.3 ADDITIONAL CSB AND TRANSPORTATION SYSTEM FEATURES 17

6.0 LINE-ITEM PROJECT MANAGEMENT APPROACH 19

7.0 PROJECT-CONTROLLING MILESTONES AND CRITICAL ACTIVITIES SCHEDULE 20

8.0 PROJECT COST 23

9.0 PROGRAMMATIC RISK ASSESSMENT 25

10.0 PROJECT ORGANIZATION, ROLES, AND RESPONSIBILITIES 28

11.0 PROJECT MANAGEMENT AND CONTROL 30
- 11.1 PROJECT PLANNING 30
  - 11.1.1 Work Breakdown Structure 30
  - 11.1.2 Project Management Plans (Phase 1 and 2 IHLW Storage Line-Item Projects) 31
  - 11.1.3 System Engineering Management 31
  - 11.1.4 Configuration Management 38
  - 11.1.5 Project Files 38

CONTENTS (cont)

11.2 BASELINE MANAGEMENT AND CONTROL 39
11.2.1 Technical Baseline Control 39
11.2.2 Schedule Baseline Control 40
11.2.3 Cost Baseline 40
11.3 PERFORMANCE MEASUREMENT AND REPORTING 41
11.4 WORK AUTHORIZATION 41
11.5 FUNDS MANAGEMENT 41
11.6 CONTINGENCY MANAGEMENT 42
11.7 MEETINGS AND REVIEWS 42
11.8 PROJECT VALIDATIONS 42
11.9 CRITICAL DECISIONS 43
11.10 EXTERNAL INTERFACE CONTROL 43

12.0 ACQUISITION STRATEGY 44

13.0 QUALITY, SAFETY, AND ENVIRONMENTAL PROTECTION 45
13.1 QUALITY ASSURANCE 45
13.2 NUCLEAR SAFETY ACTIVITIES AND AUTHORIZATION BASIS PROCESS 46
13.2.1 Nuclear Safety Activities 46
13.2.2 Authorization Basis Documentation and Approval Process 47
13.2.3 Safety Activity Schedule 48
13.2.4 Safety References 50
13.3 ENVIRONMENTAL MANAGEMENT 51

14.0 TEST AND EVALUATION PLAN 54

15.0 REFERENCES 56

APPENDICES

A Cross-Check Matrix of Plan Elements
B Immobilized High-Level Waste Storage Subproject High-Level Waste Composition
C Tank Waste Remediation System Work Breakdown Structure Dictionary Level 5
D Division of Responsibility Matrix—Immobilized High-Level Waste Storage Subproject
E Immobilized High-Level Waste Storage Subproject Schedule

LIST OF FIGURES

1 Canister Storage Building 7
2 IHLW Storage Subproject 9
3 Canister Storage Building Configuration 16
4 Programmatic Risk Management Process 26
5 IHLW Storage Subproject Organizational Relationships 29
6 Subproject Work Breakdown Structure 32
7 A Typical Project Life Cycle with Associated Systems Engineering Docu 34
8 TWRS Systems Engineering Process 35
9 Systems Engineering Activities and Documentation, Project W-464 36
10 Systems Engineering Activities and Documentation, Phase 2 37

LIST OF TABLES

1 Phase 1 and 2 HLW Product Inventories 10
2 Top-Level Work Breakdown Structure for IHLW Storage Subproject 11
3 Tri-Party Agreement Milestones 20
4 Major Subproject Activities and Activity Durations 21
5 IHLW Storage Subproject Estimated Life-Cycle Costs 24
6. Safety-Related Activities. 49

TERMS

A-E	architect-engineer
CD	critical decision
CFR	*Code of Federal Regulations*
CSB	Canister Storage Building
CWBS	contractor work breakdown structures
DST	double-shell tanks
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy-Headquarters
DRD	design requirements document
Ecology	Washington State Department of Ecology
EM	DOE Office of Environmental Management
FFTF	Fast Flux Test Facility
FSAR	final safety analysis report
FY	fiscal year
HCA	hot conditioning annex
HLW	high-level waste
ICD	interface control document
IHLW	immobilized high-level waste
ILAW	immobilized low-activity waste
LAW	low-activity waste
MCO	multi-canisters overpacks
MHM	MCO handling machine
MOA	memorandum of agreement
MRM	management review meetings
MYWP	multi-year work plan
NEPA	*National Environmental Policy Act of 1969*
PHMC	Project Hanford Management Contractor
PMP	project management plans
PSE	preliminary safety evaluation
PUREX	Plutonium-Uranium Extraction (Plant)
QAPD	quality assurance program description
QAPP	quality assurance program plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
RW	DOE Office of Civilian Radioactive Waste Management
S&D	Storage and Disposal
SEMP	Systems Engineering Management Plan
SEPA	"State Environmental Policy Act of 1971"
SNF	Spent Nuclear Fuel
SSC	structures, systems and components
SST	single-shell tanks

TERMS (cont)

Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRIGA	Test Reactor and Isotope Production General Atomics
TWRS	Tank Waste Remediation System
USC	*United States Code*
WBS	work breakdown structure
WDD	Waste Disposal Division
WAC	*Washington Administrative Code*

This page intentionally left blank.

TWRS RETRIEVAL AND DISPOSAL MISSION IMMOBILIZED HIGH-LEVEL WASTE STORAGE PLAN

1.0 PURPOSE

This project plan has a twofold purpose. First, it provides a plan specific to the Hanford Tank Waste Remediation System (TWRS) Immobilized High-Level Waste (IHLW) Storage Subproject for the Washington State Department of Ecology (Ecology) that meets the requirements of *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-90-01 (Ecology et al. 1996) and is consistent with the project plan content guidelines found in Section 11.5 of the Tri-Party Agreement action plan (Ecology et al. 1996). Second, it provides an upper tier document that can be used as the basis for future subproject line-item construction management plans. The planning elements for the construction management plans are derived from applicable U.S. Department of Energy (DOE) planning guidance documents [DOE Orders 4700.1 (DOE 1992a) and 430.1 (DOE 1995). The format and content of this project plan are designed to accommodate the plan's dual purpose. A cross-check matrix is provided in Appendix A to explain where in the plan project planning elements required by Section 11.5 of the Tri-Party Agreement are addressed.

The TWRS Tank Waste Storage and Disposal Project is divided into four subprojects.

- The immobilized low-activity waste (ILAW) Storage and Disposal Subproject
- The IHLW Storage Subproject
- The Cesium/Strontium Capsule Disposal Subproject
- The IHLW Repository Interface Subproject.

This document discusses the project plan for the IHLW Storage Subproject. Updates to this document (i.e., scope, cost, and schedule) will be reflected in appropriate multi-year activity planning and subproject technical baseline documents. The project plan is supplemented by the information contained in the following:

- Appendix A–Cross Check Matrix of Plan Elements

- Appendix B–Immobilized High Level Waste Storage Subproject High-Level Waste Composition

- Appendix C–Tank Waste Remediation System Work Breakdown Structure Dictionary Level 5

- Appendix D–Division of Responsibility Matrix–Immobilized High-Level Waste Storage Subproject.

- Appendix E–Immobilized High-Level Waste Storage Subproject Schedule.

2.0 HANFORD SITE MISSION AND OBJECTIVES

The *Tank Waste Remediation System Mission Analysis* (Knutson 1995) states

> "The TWRS mission is to store, treat, and immobilize highly radioactive Hanford waste (current and future tank waste and the encapsulated cesium and strontium) in a safe, environmentally sound, and cost-effective manner (TWRS JMN [justification for mission need]).
>
> "The mission includes retrieval, pretreatment, immobilization, interim storage and disposal, and tank closure."

As part of this mission, the U.S. Department of Energy (DOE) has established the TWRS Office to manage all Hanford Site tank waste activities. The TWRS program has identified the need to store, treat, immobilize, and dispose of the highly radioactive Hanford Site tank waste and encapsulated cesium and strontium materials in an environmentally sound, safe, and cost-effective manner (Knutson 1995).

To support the environmental remediation and restoration effort at the Hanford Site, a two-phase approach was established to privatize the treatment and immobilization of the Site's low-activity and high-level waste currently stored in underground tanks. The request for proposals for the first phase of waste treatment and immobilization was issued in February 1996 (Wagoner 1996). Initial contracts with private contractor teams led by British Nuclear Fuels Ltd. (RL 1996a) and Lockheed-Martin Advanced Environmental Services (RL 1996b) were signed in September 1996. Phase 1 is a proof-of-concept and commercial demonstration effort with the following goals:

- To demonstrate the technical and business feasibility of using private facilities to treat Hanford Site waste
- Maintain radiological, nuclear, process, and occupational safety
- Maintain environmental protection and compliance, while reducing life-cycle costs and waste treatment times.

Production of IHLW and ILAW from Phase 1 is planned to begin in June 2002, and will treat approximately 6 percent (minimum order quantity) to 13 percent (maximum order quantity) of the waste (Wagoner 1996). Phase 1 production is expected to be completed in June 2007 for minimum order quantities or December 2011 for maximum order quantities. Phase 2 is a full-scale production effort that will begin after Phase 1 and treat and immobilize the bulk of the waste. Phase 2 production is expected to be completed in 2028.

DOE will supply the feed to the private contractors and will receive the high-level waste (HLW) and low-activity waste (LAW) products from the private treatment facilities during Phase 1. For Phase 2, retrieval and feed delivery, as well as waste treatment and immobilization, are planned to be conducted by private contractors.

DOE will pay the private contractors for each IHLW and ILAW package that meets the product specifications stated in the privatization contracts. Acceptance of immobilized waste will be based on private contractor activities to qualify, verify, document, and certify the product and DOE activities to audit, review, inspect, and evaluate the treatment and immobilization process and products. The acceptance process is expected to result in IHLW and ILAW product packages certified for eventual safe and environmentally compliant transport and disposal.

The TWRS Storage and Disposal (S&D) Project was established to provide storage and disposal functions as necessary for HLW and LAW products generated as part of the tank waste remediation privatization effort. The Project also will provide integration with federal disposal facilities. To accomplish its mission, the TWRS S&D Project is divided into four subprojects. These are the IHLW Storage Subproject, the ILAW S&D Subproject, the Cs/Sr Capsule Disposal Subproject, and the IHLW Repository Interface Subproject. This project plan addresses the IHLW Storage Subproject (Subproject).

3.0 MISSION AND OBJECTIVES OF THE IHLW STORAGE SUBPROJECT

The Subproject's mission is to receive certified HLW products produced by the private contractors, transport the products to an acceptable Hanford Site interim storage facility and store them safely and economically until they can be shipped to a permanent federal geologic repository or returned to privatization contractors for further processing.

The Subproject's primary objective is to provide onsite transportation systems and interim storage facilities for Phase 1 and 2 HLW products in accordance with the Subproject mission. This includes establishing two line-item projects. One will provide an onsite HLW product transportation system and retrofit the Hanford Site Canister Storage Building (CSB) to accommodate Phase 1 HLW products. The other will design and construct new facilities and onsite transportation equipment to accommodate Phase 2 HLW products.

Specific Subproject objectives common to the Phase 1 and 2 line-item projects are as follows:

- To provide transportation systems and retrofit or design Phase 1 and 2 interim storage facilities in accordance with established design requirements (Calmus 1996a), the DOE budgeting process, and federal, state, and local laws and regulations

- Obtain all necessary construction and operations permits and authorization bases and have HLW interim storage capability operational on a schedule consistent with private contractor production schedules and Tri-Party Agreement provisions.

- Develop and implement all necessary operational and equipment/facility decontamination and decommissioning plans for Subproject interim storage facilities and supporting systems

- Support environmental, safety, and health requirements through *National Environmental Policy Act of 1969* (NEPA) compliance and safety analyses

- Integrate with applicable Site Projects and other agencies to the extent necessary to maintain Subproject goals and objectives and established Subproject baseline planning and cost targets.

4.0 SCOPE OF IHLW STORAGE SUBPROJECT

To support its mission and objectives, the Subproject includes design and implementation of an onsite HLW transportation system and retrofit of the Hanford Site CSB to accommodate Phase 1 HLW products. In addition, the Subproject includes future design and construction of a new onsite transportation system and new facilities to accommodate Phase 2 HLW products.

Functions that form the basis for the IHLW storage requirements and design are as follows:

- Accept HLW products from the producer
- Transport the products to interim storage
- Isolate products
- Retrieve products from storage
- Support storage of products
- Deliver products for shipping or processing.

Further functional decomposition and specific design requirements are provided in the Subproject baseline design documents (LMHC 1996, Calmus 1996a).

This plan presents organizational and management approaches that will be used to control and execute the subproject. It also identifies the elements needed for subproject and line-item project management and includes subproject schedules and milestones. The cost and schedule information presented in this document are derived from the TWRS S&D Projects portion of the draft TWRS multi-year work plan (MYWP) as of December 1997. Future cost, scope, and schedule updates will be reflected in the MYWP and technical baseline documents.

Specifically, the project plan covers the following key elements:

- Mission and objectives
- Scope
- Definition and background
- Subproject and line-item construction project management and controls approach
- Schedules, outputs, and milestones
- Cost
- Risk assessment and mitigation approach
- Responsible organizations and interfacing organizations or projects
- Acquisition strategy
- Approach to quality, safety, environmental protection [i.e., NEPA, *Resource Conservation and Recovery Act of 1976* (RCRA)], systems engineering and test and evaluation.

A primary objective of the TWRS S&D Project is to evaluate and select the path forward for disposal of the $^{137}Cs/^{90}Sr$ capsules located at the Hanford Site by the end of fiscal year

(FY) 1997 (Cesium/Strontium Capsule Disposal Subproject) and, if appropriate, implement the selected option. Recently, Numatec Hanford Company submitted a recommended approach to DOE (Numatec 1997). DOE subsequently concurred with the recommendation (Taylor 1997) to blend the $^{137}Cs/^{90}Sr$ capsules into the Phase 2 IHLW vitrification plant feed. Therefore, $^{137}Cs/^{90}Sr$ capsules are not included in any facet of the Phase 1 Subproject. The decision to add the $^{137}Cs/^{90}Sr$ capsules to the Phase 2 HLW vitrification plant feed does not significantly affect current IHLW Storage Subproject Phase 2 planning or cost estimates.

4.1 FACILITY DESCRIPTION

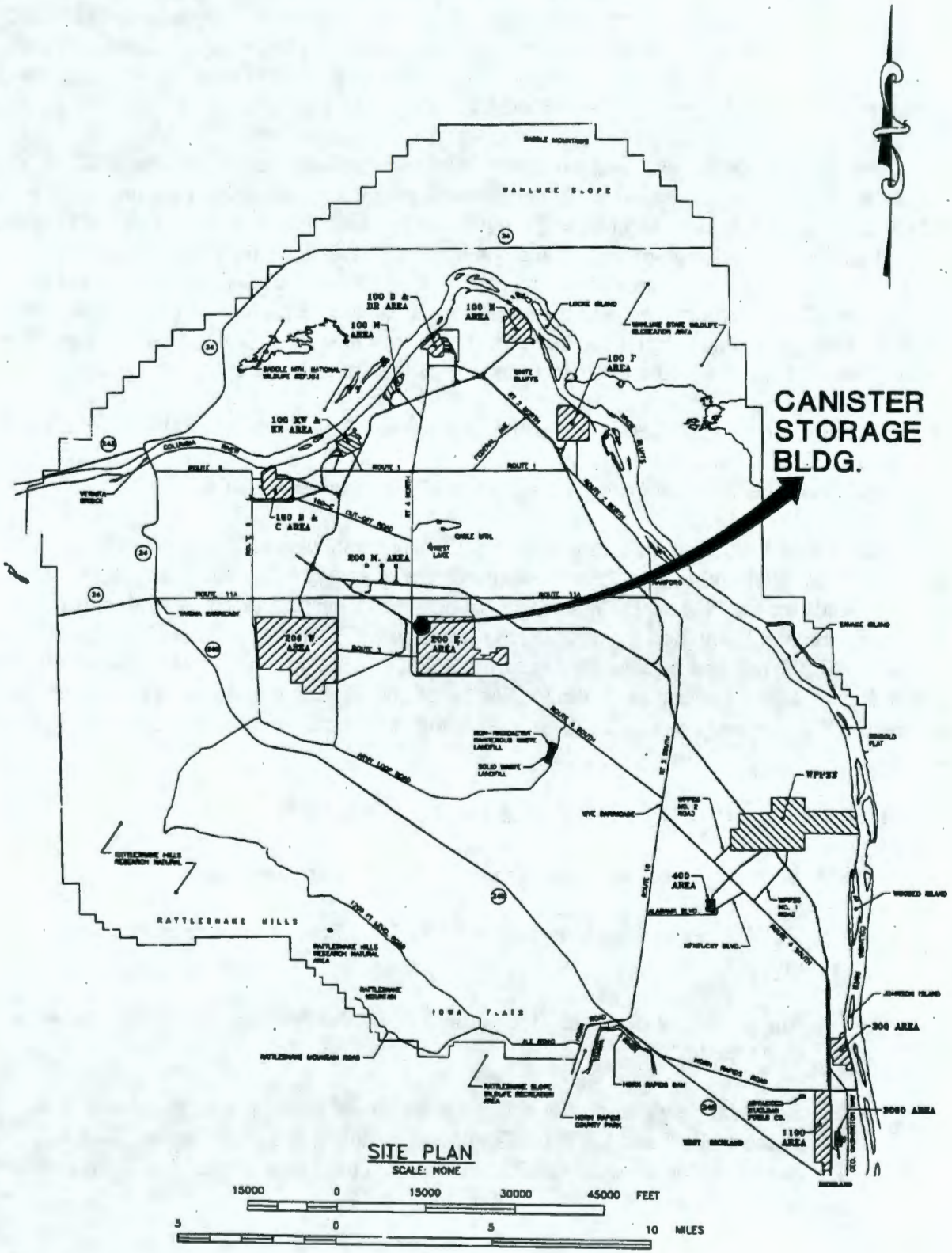
The CSB is located in the Hanford Site 200 East Area (Building 212H) and is currently being constructed as part of the Spent Nuclear Fuel (SNF) Line-Item Project (Project W-379). The CSB location relative to the Hanford Site is shown in Figure 1. After the SNF CSB construction is finished, the IHLW Storage Line-Item Project (Project W-464), intends to outfit the CSB by installing new features (systems, structures, and components) to enable receipt and storage of Phase 1 solidified HLW. The SNF Project will use Vault 1 for interim storage of SNF; Project W-464 will retrofit Vaults 2 and 3 for interim storage of HLW. Project W-464 also includes a system for transporting solidified HLW canisters from the privatized demonstration plants to the CSB. Conceptual design of the CSB retrofit and transportation system is being performed in FY 1997 and early FY 1998 to determine the baseline cost estimate to support Project validation in mid-FY 1998. Phase 1 solidified HLW interim storage capability is required by June 2002, to coincide with the scheduled start of solidified HLW product generation from the privatized demonstration facility.

The available CSB storage capacity (Vaults 2 and 3) is insufficient for interim storage of any Phase 2-generated HLW canisters and no existing Hanford Site facilities exist to handle the bulk of Phase 2 HLW canisters. An evaluation will be performed by FY 2005 to select the most viable method to interim store Phase 2 HLW products. The established planning basis includes providing additional phased Phase 2 interim storage capability by constructing modular facilities similar to the Canister Storage Building as needed.

4.2 GENERAL CHARACTERISTICS OF TANK WASTE AND VITRIFICATION FEEDS TO BE PROCESSED

Hanford Site radioactive tank waste was produced primarily from reprocessing irradiated fuel from plutonium production reactors. The Hanford Site tank waste is stored in 149 single-shell tanks (SST) containing approximately 136,800 m^3 (36 Mgal) of salt cake, sludge, and residual liquid with an activity level of approximately 460 x 10^{16} Bq (125 MCi) and 28 double-shell tanks (DST) containing 80,000 m^3 (21 Mgal) of liquid, salt, and sludge with an activity level of approximately 310 x 10^{16} Bq (85 MCi). In addition to the waste stored in the tanks, approximately 1,900 6.7 cm-diameter by 52 cm-long cesium/strontium capsules containing approximately 600 x 10^{16} Bq (160 MCi) will be processed. More detailed information of tank waste characteristics can be found in *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740 (Kupfer et al. 1997).

Figure 1. Canister Storage Building.



The overall logic for HLW treatment, vitrification, and storage of Hanford Site tank waste is shown in Figure 2. Retrieval and pretreatment operations will prepare the DST and SST waste for vitrification. Waste will be retrieved from most tanks in a manner that separates soluble and insoluble material (sludge). Soluble salts and supernate solutions will be staged for pretreatment as LAW vitrification feed. Retrieved sludge will be consolidated in DSTs for in-tank pretreatment and staged to HLW vitrification (Phases 1 and 2).

Pretreatment of Hanford Site tank waste is intended to minimize the volume of HLW chemicals to be vitrified and separate radionuclides to meet the regulatory criteria imposed on the LAW vitrified glass product. Cesium, and possibly other radionuclides, will be removed from the LAW stream by ion-exchange processes and combined with the HLW tank fraction (washed solids resulting from HLW pretreatment processes). Cesium removed during Phase 1 of the privatization effort in accordance with the privatization contract requirements (RL 1996a, 1996b) will require interim storage until it can be processed in the Phase 2 HLW vitrification plant. The cesium "product" is to be further defined as a result of the Phase 1 conceptual design effort.

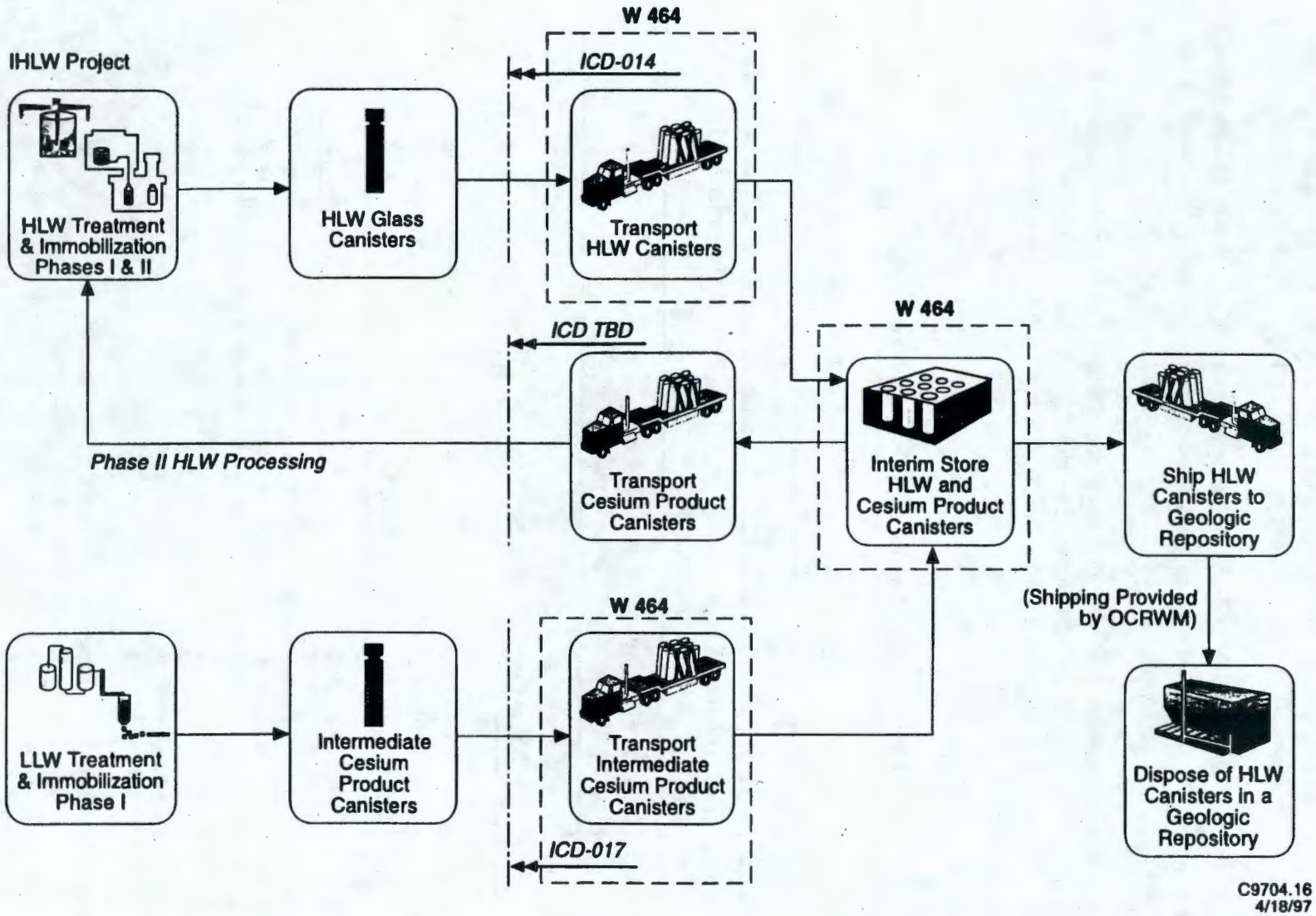
Existing encapsulated cesium and strontium waste will be blended into the Phase 2 HLW feed stream and incorporated into the Phase 2 IHLW product or packaged for disposal in the permanent federal geologic repository (Claghorn 1997, Wodrich et al. 1995).

The Phase 1 vitrification demonstration plant will immobilize only approximately 3 percent (minimum order quantity) to 5 percent (maximum order quantity) of the HLW inventory. The candidate feeds for the Phase 1 HLW vitrification demonstration include HLW sludge from the Plutonium-Uranium Extraction Plant (PUREX) stored in DSTs 241-AZ-101 (101-AZ) and 241-AZ-102 (102AZ), and high-heat sludge from SST 241-C-106 (106-C). The Phase 1 HLW (IHLW and separated cesium) feed composition range and maximum radionuclide composition for selected Phase 1 feed components is defined in the privatization contracts (RL 1996a, 1996b).

4.3 PROJECTED INVENTORIES FOR HLW PRODUCTS

The Phase 1 Subproject scope covers the following waste categories:

- IHLW produced primarily during Phase 1 vitrification plant operation (glass product)
- Radioactive cesium separated during Phase 1 LAW vitrification plant operation (separated cesium)
- Secondary high-level radioactive and high-level mixed waste produced during Phase 1 HLW and LAW vitrification plant operations (non-routine HLW). Secondary or non-routine HLW is expected to consist primarily of refractory and solidified glass from failed melters.



2. IHLW Storage Subproject.

The Subproject Phase 2 scope covers the following waste categories:

- Immobilized HLW produced during Phase 2 HLW vitrification plant operation
- Secondary HLW produced during Phase 2 HLW vitrification plant operation.

Separated cesium from the Phase 1 effort will be incorporated into the Phase 2 glass and will be included as part of the Immobilized HLW product; no separated cesium product will be generated during Phase 2.

The current planning baseline is to process the cesium/strontium capsules into the Phase 2 glass. Therefore, the capsules will be included as part of the Phase 2 immobilized HLW product inventory. Table 1 provides summary inventories. Appendix B provides a summary discussion and a basis of inventory estimates.

Table 1. Phase 1 and 2 HLW Product Inventories.

HLW Product	Canister Size	Estimated Number of Canisters
	Phase 1	
IHLW	Glass volume: 1.05 m^3 OD: 4.5[1] m long x 0.61 m diameter	Min order:[1] 316 Max order[1] 600
Cesium	Volume of cesium product: 0.084 m^3 OD: 1.37 m long x 0.70 m diameter	153
Non-routine	Product volume: 1.05 m^3 OD: 4.5[1] m long x 0.61 m diameter	32
	Phase 2	
IHLW	Glass volume: 1.05 m^3 OD: 4.5 m long x 0.61 m diameter	11,842
Non-routine	Same as Phase 2 IHLW	TBD

[1]IHLW Storage Subproject was directed in September 1997[a] to rebaseline using the 3.0-m long by 0.61-m dia. IHLW canister with a 4.5 m long by 0.61 m dia. canister expected to reduce permanent disposal costs.
[1]Minimum and maximum order quantities of waste to be processed are identified in the Phase 1 privatization contracts

IHLW = immobilized high-level waste
TBD = to be determined

[a]Ashley, D. J., 1997, Subcontract Number 80232764-9-K001; *Tank Waste Remediation System High-Level Waste Canister*, Correspondence Number FDH-9758282A, memo to L. E. Hall, Lockheed Martin Hanford Company, dated September 15, 1997, Fluor Daniel Hanford Company, Richland, Washington.

4.4 TOP-LEVEL WORK BREAKDOWN STRUCTURE

The top-level work breakdown structure (WBS) established for planning, execution, and control of the Subproject work is shown in Table 2. A detailed WBS is provided in Chapter 11, Program Management Control. More detailed schedule and cost information about the WBS is provided in Chapters 7 and 8, respectively. A description of the top-level WBS activities is provided in Appendix C.

Table 2. Top-Level Work Breakdown Structure for IHLW Storage Subproject.

WBS Code	Activity Title
1.1.3.4.02	IHLW [Immobilized High-Level Waste] Storage (Phase 1 and 2)
1.1.3.4.02.01	Project Management and Administration (Phase 1 and 2)
1.1.3.4.02.02	System Definition (Phase 1 and 2)
1.1.3.4.02.03	Immobilized High-Level Waste (IHLW) (Project W-464) (Phase 1)
1.1.2.4.02.04	Operations (Phase 1 and 2)
1.1.2.4.02.05	Future Projects (Line Item Project) (Phase 2 - Interim Storage Facility Design and Construction)
1.1.2.4.02.06	Facility Decontamination and Decommissioning (D&D)

4.5 INTERFACING ORGANIZATIONS

The IHLW Storage Subproject's primary external interfaces will be the privatization contractors, the SNF Project, and the federal and state agencies responsible for regulatory oversite and permitting (e.g., Ecology).

The functional elements of the transport system and interim storage facility (e.g., receipt of product from vendor, transport cask) depend on the HLW products received from the privatization contractors. An interface process has been established to define responsibilities and resolve issues. This interface will be conducted in accordance with interface control documents (ICD) specific to each HLW Product. The final ICDs are to be issued by the privatization contractors in January 1998. External interface control is covered in Chapter 11. Use of the CSB depends on the eventual use of the SNF Project W-379-designed CSB facility. A memorandum

of agreement (MOA) (Hansen 1996) between the SNF Project and IHLW Storage Subproject has been established to reserve CSB vaults 2 and 3 for storing Phase 1 HLW products. The IHLW Storage Subproject continually interacts with the SNF Project to assess impacts to the Subproject's baseline MYWP. The interface with the applicable regulatory and environmental agencies is covered in Chapter 13.

5.0 PROGRAM/PROJECT BACKGROUND

DOE's primary goal is to immobilize all HLW tank waste and disposition cesium/strontium capsules on the Hanford Site by 2028 (Ecology et al. 1996).

As part of the TWRS Program, DOE has embarked on a course to acquire Hanford Site tank waste treatment and immobilization services from commercial suppliers. These will be privately developed, financed, constructed, owned, operated, decontaminated (RL 1996a, 1996b). The successful bidders (i.e., vendor or team of vendors awarded a contract) are to be paid for the immobilized Hanford Site tank waste (product) that they have produced, thereby recouping their investment. This plan uses a two-phased approach. Phase 1 is proof-of-principle and commercial demonstration-scale efforts and Phase 2 is a full-scale production effort. The referenced contracts (RL 1996a and 1996b) describes the privatization process for both Phases. Contracted work is for the conceptual design, detailed design, construction, and operation of the Phase 1 facility. The contract consists of two distinct phases: Phase 1a for conceptual design and Phase 1b for the detailed design, construction, and operation. A separate contract will be prepared for Phase 2 work.

The primary purpose of Phase 1 is to demonstrate the technical and business viability of using privatized facilities to treat and immobilize Hanford Site LAW and HLW. This is to be accomplished using demonstration facilities (i.e., low-capacity immobilization plants) based on the successful bidder's design. Subproject planning assumes that two LAW demonstration vitrification plants and one HLW demonstration vitrification plant will be constructed during Phase 1. In addition, it is assumed that one LAW and one HLW production facility (i.e., high-capacity immobilization plants) will be designed, constructed, and operated during Phase II. These production facilities are assumed to provide sufficient capacity to immobilize the remaining Hanford Site tank waste by 2028.

In accordance with the solicitation of Phase 1, services, transportation, interim storage, and disposal of various products from the demonstration plants are to be provided by the DOE. The Phase 1 products requiring interim storage in the CSB include IHLW or vitrified HLW, separated cesium from the LAW vitrification plant feed, and non-routine HLW (i.e., failed glass contact equipment). The Phase 2 HLW product is canisters of IHLW containing the contents of the cesium canisters generated in Phase 1 and the contents of the cesium/strontium capsules. The Subproject has established a construction project, Project W-464, to provide the capability to interim store the solidified Phase 1 HLW products until they can be transferred to a federal geologic repository for disposal (IHLW and non-routine HLW) or processed further (cesium canisters incorporated into Phase 2 IHLW product).

5.1 OPTIONS FOR GOVERNMENT AND COMMERCIAL ACTIVITIES AND CONCEPT SELECTION AND IMPLEMENTATION

A FY 1996 task (Activity No. S2W02000) (WHC 1995) was established to define the system, functions, and requirements for solidified HLW interim storage specific to the HLW privatization mission. Existing and new Hanford Site facilities along with other government-owned and commercially available systems were assessed to determine their suitability for interim-storing solidified HLW. In addition, alternative concepts (proposed system architectures) were identified and evaluated to determine whether they meet system functions and requirements.

Three general categories of potential architectures for HLW product interim storage were evaluated: building, pad, and bore hole. Building storage concepts include using existing Hanford Site facilities and constructing new structures. Existing facilities included surplus shielded structures located in the Hanford Site 200 Area [B Plant, T Plant, U Plant, the PUREX Plant] and 400 Area [Fuels and Materials Examination Facility, and a Washington Power Supply System Site (modifying the Washington Nuclear Plant 1 (WNP-1) spray ponds]. In addition, the SNF CSB was considered. The SNF CSB is representative of storage vault facilities dominating storage of immobilized HLW worldwide. (i.e., this concept is used to store HLW in the US at DOE's Savannah River Site in Aiken South Carolina) and internationally (i.e., France and Great Britain). New facilities included constructing new CSB-type facilities for both Phase 1 and 2 required capacities. New facility construction was limited to a building concept based on passive cooling by natural convection. Many commercial pad storage systems exist and were evaluated. The pad storage system selected for detailed evaluation was the NUHOMS.[1] The NUHOMS facility consists of a concrete pad, a fenced perimeter, and several modular prefabricated bunkers (vaults). The vaults are cooled by natural convection. Bore holes (or dry well) are essentially storage tubes, similar to those used in the CSB-type alternatives, that are embedded in the ground in non-shrink concrete.

A decision process was developed and implemented to select Phase 1 and 2 architectures. The process determined that sufficient information was available to select the Phase 1 architecture, but additional development and evaluation of Phase 2 architecture options was required. Development and evaluation of Phase 2 alternative architectures will be initiated in 2003 and completed by 2005 (before contract award in 2005) to support the Phase 2 Privatization schedule. Chapter 7 summarizes the IHLW Storage Subproject schedule.

At the conclusion of the decision process, the Phase 1 interim storage architecture was recommended (Calmus 1996b) and approved (Taylor 1997) for Phase 1 HLW interim storage. The selected Phase 1 architecture entails outfitting the SNF CSB to make the CSB suitable to interim-store solidified HLW. After the Phase 1 architecture was selected, the SNF Project and TWRS Subproject established the MOA (Hanson 1996) that assigned CSB Vaults 2 and 3 to the IHLW Storage Project. On approval of the MOA, the Phase 1 and 2 functions and requirements were established (LMHC 1996) and served as the basis for preparing the Phase 1 Design Requirements Document (DRD) (Calmus 1996a). The DRD lists all applicable constraint

---

[1]NUHOMS is a trademark of Vectra Technologies, Inc.

documents [i.e., the *U.S. Code*, *Code of Federal Regulations* (CFR), *Washington Administrative Code* (WAC), DOE directives and standards, and other DOE requirements] and requirement documents (i.e., federal and state codes and standards and Hanford Site standards and miscellaneous documents) and provides system and performance requirements specific to Phase 1 HLW products and quality assurance provisions. These requirements and quality assurance provisions are currently being used as the basis for Phase 1 transportation system and CSB conceptual design. The DRD will require revision before the Phase 1 detailed design phase to incorporate information developed by the Phase 1 privatization contractors during the Phase 1a contract period (conceptual design). The final Phase 1 DRD will be used as the basis for establishing Phase 2 design requirements. Interface control documents are currently being prepared to establish the interface activities between the IHLW Storage Project and private contractors. (Also see Section 11.10.)

Design, construction, and preoperation activities will be performed to meet a June 2002 startup date to accommodate the planned start of Phase 1 HLW vitrification plant operations in June 2002. Conceptual design of the CSB to accommodate HLW Phase 1 products has been initiated and is scheduled to be complete by January 30, 1998.

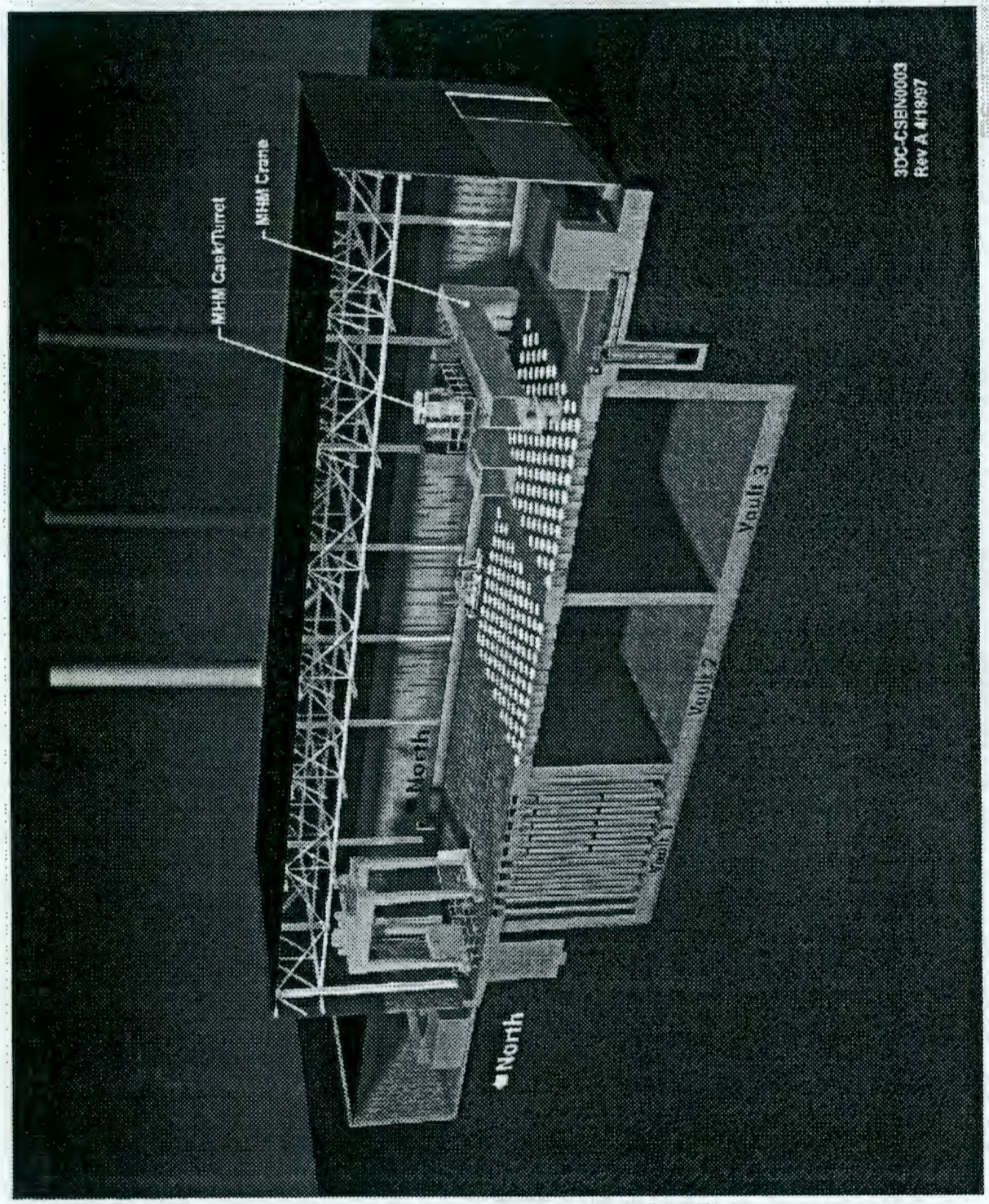
5.2 EXISTING PHASE 1 INTERIM STORAGE FACILITY DESCRIPTION

This section provides a general description of the existing CSB design (Project W-379). Section 5.3 covers the required modifications to the CSB to provide interim storage of Phase 1 HLW products.

The CSB was originally designed, and construction initiated, for storage of canisters of vitrified HLW from the Hanford Waste Vitrification Plant. Construction of the Hanford Waste Vitrification Plant CSB was halted in conjunction with cessation Hanford Waste Vitrification Plant construction, which resulted from program redirection. The CSB is now being modified and construction is being completed for storage of Hanford K-Basin SNF. The K-Basin SNF will not require use of the full CSB storage capacity. Two of the three vaults are reserved for storage of Phase 1 HLW products.

The CSB is located in the 200 East Area of the Hanford Site, approximately 48 km (30 mi) northwest of Richland, Washington. The CSB facility is depicted in Figure 3. It consists of 3 below-grade, concrete vaults approximately 50 m (164 ft) wide by 55 m (180 ft 6 in.) long by 14 m (46 ft 11 in.) deep. SNF will be stored in the northernmost vault, Vault 1. The CSB structure includes a steel shelter 41 m (134 ft 6 in.) wide by 62 m (203 ft 6 in.) long by 17 m (55 ft 9 in.) tall. The shelter provides an operating area for load-in/load-out. A metal building 15 m (49 ft 3 in.) wide by 37 m (121 ft 5 in.) long by 9 m (29 ft 6 in.) tall houses the mechanical, electrical, and support services. The load-in/load-out area contains two service pits. One is designed specifically for transferring multicanisters overpacks (MCO) containing SNF from the onsite transport cask to the CSB shielded handling machine, referred to as the MCO handling machine (MHM). The second is much larger and is designed to accommodate service/transfer of larger SNF packages [i.e., Test Reactor and Isotope Production General Atomics (TRIGA) and Fast Flux Test Facility (FFTF) SNF].

Figure 3. Canister Storage Building Configuration.



The vaults are covered by a concrete deck and each vault has concrete air plenums on opposite sides. The below-deck concrete partition walls allow independent vault cooling. The northernmost vault, Vault 1, is equipped with carbon steel tubes installed vertically, an air intake, and an exhaust stack. Storage tubes and intake/exhaust stacks will not be installed in Vaults 2 and 3 as part of Project W-379.

Each vault can provide for a storage tube matrix of 22 rows by 10 columns for a total of 220 'standard' storage tubes. Each vault also can accommodate six larger diameter tubes for canister overpack. Both the standard and overpack tubes are constructed of carbon steel and can accommodate two 4.5 m (14-ft 10-in.)-tall by 0.61 m (2-ft)-diameter IHLW canisters and impact limiters at the bottom of the tube and between the canisters. A storage tube provides approximately 11.1 m (36 ft 6 in.) of vertical space for canisters and impact limiters with a 68 cm (27-in.) internal diameter. The storage tubes are designed to be closed and sealed with a shielded plug installed at the deck level and a 2.54 cm (1-in.) plate seal-welded to the bottom of the tube. No shield plugs have been designed for or are provided for Vaults 2 and 3 as part of Project W-379.

Decay heat will be removed from each vault by natural convection. Cooling air is drawn through an inlet duct into a plenum that feeds each vault. The air flows across the outer surface of the storage tubes, and exits through an elevated exhaust stacks.

An annex to the southernmost vault, Vault 3, is included as part of Project W-379. The annex is referred to as the hot conditioning annex (HCA) and will provide features to chemically stabilize the SNF before the MCOs are sealed for interim storage.

The HCA is a reinforced concrete structure that houses mounting plates for the process modules and seven process pits for HCA equipment. The HCA operating deck is 10.7 m (35 ft 3 in.) by 42.3 m (138 ft 11 in.) by 1.5 m (5 ft) thick; the reinforced concrete slab is supported at grade level. Its design does not include a wet-pipe sprinkler system because significant combustible loading will not exist, and the transient combustible loading is controlled. The CSB safety support functions are provided by backup electrical power and fire protection and monitoring systems.

5.3 ADDITIONAL CSB AND TRANSPORTATION SYSTEM FEATURES

Using the CSB for interim storage of Phase 1 HLW will require installation of equipment and subsystems that are not needed for the SNF CSB design. The existing CSB facility also may need to be modified.

The CSB equipment retrofits will include the following:

- Remote handling equipment and a shield cover in the receipt/transfer pit (FFTF pit)

- New or modified MHM (shielded CSB transport system; Vault 2 and 3 inlet and outlet stacks
- Vault 2 and 3 storage tubes, tube shield plugs, and tube impact absorbers; cesium canister-handling assemblies
- Air louvers on the inlet stack plenum
- Temperature and air flow monitoring equipment
- Minor upgrade to CSB instrumentation and control systems; remote operating equipment, welders, shielding, and maintenance and other equipment needed to perform overpack operations in the HCA building space.

In addition to the required CSB equipment, a new onsite transporter system, including a tractor/trailer and onsite shielded transport cask, will need to be specified and procured. To transport and handle cesium canisters, the onsite shielded transport cask may need to be modified and a unique transport system and CSB handling equipment may need to be designed and fabricated.

The extent of CSB modifications will be determined in the conceptual and detailed design phases; however, preliminary evaluations (Jacobs 1996a, 1996b) have identified the following potential key modifications.

- Modify the inlet plenum to allow louver installation.
- Deepen the HCA pit to accommodate a 4.5 m (14-ft 10-in.) IHLW canister.

6.0 LINE-ITEM PROJECT MANAGEMENT APPROACH

The TWRS S&D Project includes providing for interim storage of all HLW generated as a result of the Phase 1 and 2 Privatization effort and to ensure that the HLW is acceptable to the designated disposal site at time of shipment. To meet these objectives the Subproject was established and structured to support the privatization phased approach (Phase 1 and 2). Two design/construction projects (line-item projects) are included as part of the Subproject. Project W-464, a line-item project to retrofit the CSB to accommodate the Phase 1-generated HLW (IHLW and separated cesium canisters), has already been approved by DOE (Critical Decision 1). A line-item project to design and construct new facilities to accommodate Phase 2-generated HLW will be established after the system architecture is selected. This project plan is specific to the overall HLW Storage Subproject; more detailed project management plans (PMP) will be prepared for the Phase 1 and 2 line-item projects. The line-item PMPs will be prepared in accordance with approved Project Hanford Management Contractor (PHMC) procedures and include planning specific to approved, validated projects. The line-item project PMPs will identify the plans, organizational interfaces, management control systems, and reporting requirements that will be used by those responsible for managing the line-item projects. The PMPs will be part of the line-item project baseline and will be controlled documents subject to disciplined configuration management procedures. Documents to be developed after and to support the PMPs also will be controlled documents subject to configuration management. The PMPs will be updated annually and supplemented to meet the requirements of the U.S. Department of Energy, Richland Operations Office (RL) Site Management System and the MYWP.

7.0 PROJECT-CONTROLLING MILESTONES AND CRITICAL ACTIVITIES SCHEDULE

The Subproject is structured to meet Tri-Party Agreement milestones (Ecology et al. 1996). Table 3 lists the Tri-Party Agreement milestones that apply to the IHLW Storage Subproject.

Table 3. Tri-Party Agreement Milestones.

Milestone	Description	Due Date
M-90-00	Complete acquisition of new facilities, modification of existing facilities, and modification of planned facilities as necessary to store Hanford Site Immobilized Tank Waste.	TBD[1]
M-90-01	Submit interim storage and disposal ILAW and interim storage IHLW project management plans to Ecology in accordance with the Tri-Party Agreement, Section 11.5	December 1997
M-90-11	Complete canister storage building construction. This requires completing all construction, internal/external facilities modifications and startup activities necessary for canister storage facility receipt of all Phase 1 Hanford Site HLW canisters from TWRS processing. For purposes of this interim milestone, Phase 1 IHLW canister storage is defined as the capability to store at least 500 IHLW canisters. Interim milestones and associated target dates establishing work schedules for Phase 2 IHLW canister storage will be established pursuant to the Phase 2 request for proposal for TWRS privatization.	December 2002
M-90-12	Submit revised canister storage facility Part A dangerous waste permit application to Ecology pursuant to WAC 173-303.	June 1999
M-20-00	Submit Part B permit application or closure/postclosure plans for all RCRA TSD units. Permit applications, closure, and postclosure plans will be submitted to Ecology and/or EPA for approval in accordance with their respective authorities.	December 2003
M-20-56	Submit canister storage facility Part B dangerous waste permit application to Ecology. This interim milestone supports Major Milestones M-90-00 and M-20-00.	December 2000

Table 3. Tri-Party Agreement Milestones.

Milestone	Description	Due Date
M-51-00	Complete vitrification of Hanford Site high-level tank waste.	December 2028

[1]The completion date will be negotiated 6 months after this project plan is completed.

Ecology = Washington State Department of Ecology
EPA = U. S. Environmental Protection Agency
HLW = high-level waste
IHLW = immobilized high-level waste
RCRA = *Resource Conservation and Recovery Act of 1976*
TBD = to be determined
TSD = treatment, storage, and disposal
TWRS = Tank Waste Remediation System
WAC = *Washington Administrative Code*

The Subproject baseline schedule is provided in the FY 1998 MYWP (FDH 1997a) and identifies major Tri-Party Agreement, DOE, and PHMC milestones. The activities making up the Subproject baseline schedule have been defined and are included in milestone logs, which will be maintained under Project change control (see Chapter 11). Table 4 identifies the major Subproject activities and associated start and finish dates. A more detailed Subproject schedule is provided in Appendix E. This schedule includes Subproject activities according to established Subproject WBS (see Section 11.1.1), and identifies critical activities, and DOE and Tri-Party Agreement milestones.

Table 4. Major Subproject Activities and Activity Durations.

Major Subproject Activity	Start	Finish
Phase 1	----	----
Conceptual design	10/01/97	04/30/98
Post- validation activities	05/01/98	09/30/98
Advanced conceptual design	10/01/98	09/30/99
Design/construction (capital)	10/01/99	09/28/01
Startup	10/01/01	05/31/02
Hot operations	06/03/02	09/30/11
Post-production operations	10/03/11	09/28/12

Major Subproject Activity		Start	Finish
Phase 2		----	----
Conceptual design	(modules 1-5)	03/01/06	09/30/11
Advanced conceptual design	(modules 1-5)	10/01/07	03/31/21
Design (capital)	(modules 1-5)	04/01/08	09/29/23
Construction (capital)	(modules 1-5)	10/01/10	09/30/24
Startup	(modules 1-5)	01/03/12	09/30/25
Hot operations	(modules 1-5)	10/01/12	09/29/28
Post-production operations	(modules 1-5)	10/02/28	09/30/43
Facility Decontamination and Decommissioning		----	----
Decontamination and decommissioning of Phase 1 and 2 facilities		10/01/43	09/30/48

8.0 PROJECT COST

The total projected cost for the Subproject is provided in Table 5. The cost figures are provided for the life of the Subproject and are presented according to the established IHLW Storage Subproject WBS, Level 6. A more detailed cost breakdown for each discreet Project activity is provided in the PHMC MYWP (FDH 1997a).

More definitive total project cost estimates for the IHLW Storage line-item projects will be developed as part of each project's conceptual design activities. The total project cost comprises a total estimated cost (plant and capital equipment funding) and other project costs, including operating expense and capital equipment not related to construction funding. Other project costs are based on estimates conducted as part of the Project budget submission to the U.S. Department of Energy-Headquarters (DOE-HQ), as validated by DOE-HQ, and are provided by the project performer, the PHMC.

Table 5. IHLW Storage Subproject Estimated Life-Cycle Costs.[1,2,3,4]

WBS	FY98 ($)	FY99 ($)	FY00 ($)	FY01 ($)	FY02 ($)	FY03 ($)	FY04 ($)	FY05 ($)	FY06 ($)	FY07 ($)	FY08 ($)	FY09 ($)	FY10 ($)	FY11 ($)	FY12 ($)	FY13 ($)	FY98-FY13 ($)	FY14-FY46 ($)	Total Activity Cost ($)
1.1.3.4.02.01 Project Management/Administration																			
Phase 1 and 2 Expense	170	109	110	152	153	153	154	153	152	152	154	153	153	153	152	153	2377	3366	5743
1.1.3.4.02.02 Systems Definition																			
Phase 1 Expense	602	90	91	74	76	—	—	—	—	—	—	—	—	—	—	—	933		933
Phase 2 Expense	—	—	—	—	—	—	214	305	248	99	100	99	99	99	78	78	1,486	1,047	2,473
1.1.3.4.02.03 IHLW (Project W-464)																			
Phase 1 Expense	1,514	1,289	542	560	3,327	—	—	—	—	—	—	—	—	—	—	—	7,232	—	7,232
Phase 1 Capitol	—	—	17,560	24,910	—	—	—	—	—	—	—	—	—	—	—	—	42,469	—	42,469
1.1.3.4.02.04 Operations																			
Phase 1 Expense	—	—	—	—	1,083	3,276	3,289	3,276	3,263	3,263	3,289	3.276	3,276	3,276	1,071	—	3,0563	—	30,563
Phase 2 Expense	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6,632	87,325	93,957
1.1.3.4.02.05 Future Projects																			
Phase 2 Expense	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24,879	24,879
Phase 2 Capital	—	—	—	—	—	—	—	—	—	—	—	2,2371	2.2371	19,3569	82,397	—	320,709	1,518,735	1,839,444
1.1.3.4.02.06 Facility Decontamination and Decommissioning																			
Phase 2 Expense	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	96,137	86,137

Notes:

[1]All cost numbers are rounded to values in MYPP; total costs may not equal annual costs.
[2]All costs in thousands of dollars ($1000's).
[3]All costs for FY 1998-2002 are escalated at 3% per year. All later costs are based on FY 2002 escalated rate.
[4]Source of cost numbers is FY 1998 MYWP (draft as of December 1997)

FY = fiscal year
IHLW = immobilized high-level waste
ILAW = immobilized low-activity waste
WBS = work breakdown structure

9.0 PROGRAMMATIC RISK ASSESSMENT

Risk planning, assessment, analysis, and management (Figure 4) will be used throughout the Subproject to identify significant risk factors and formulate mitigation plans. Risk management will be conducted in accordance with the TWRS programmatic risk management plan and procedure, *TWRS Administration*, WHC-IP-0842, Volume IV (Davis 1997) and the storage and disposal project risk management procedures (Murkowski 1995). Identified risks will be incorporated into the TWRS risk management list for assessment and analyses. Risk assessment will be an ongoing, iterative, integrated process. The process will provide information needed to manage programmatic (cost and schedule), technical, environmental, safety, and health risks. Initial risk screening has been performed as part of the initial decision process to select Phase 1 and 2 interim storage architectures and as part of ongoing interaction with the SNF CSB Project.

PERCEIVED SOURCES OF HIGH RISK

The high-risk items that could significantly affect Project W-464 are a result of integration with Project W-379.

The most significant high-risk items are the following:

- The significant schedule impact that could result from a significant delay in Project W-379.
- Risk to the Project W-464 schedule caused by uncertainties associated with concurrent SNF operations and the associated sharing or redistribution of equipment.

Use of the CSB depends on outfitting two of the three vaults to accommodate the Phase I HLW products. Modification of primary CSB equipment is scheduled to begin at the completion of Project W-379. The Project W-464 project activities were developed assuming that the Project W-379 would be completed in calendar year 2000. Delay of the Project W-379 schedule could affect the start of Project W-464 retrofit activities. Project W-464 design, procurement, and construction activities may need to be replanned to accommodate delays of 1 year or less to the SNF CSB Project. For SNF CSB Project delays longer than 1 year that significantly affect the Project W-464 scheduled completion date (facility hot operations in June 2002), DOE may need to reassess Hanford Site Project priorities and develop a mitigation path forward. This path forward could include delay of all or part of the Project W-379 activities or selection of an alternative facility for Phase 1 HLW interim storage to meet Phase 1 privatization milestones corresponding to hot operations of the HLW/LAW demonstration vitrification plants (hot startup in June 2002). The CSB HLW hot operation is assumed to coincide with hot startup of the Phase I HLW/LAW vitrification facilities as described in the privatization contracts.

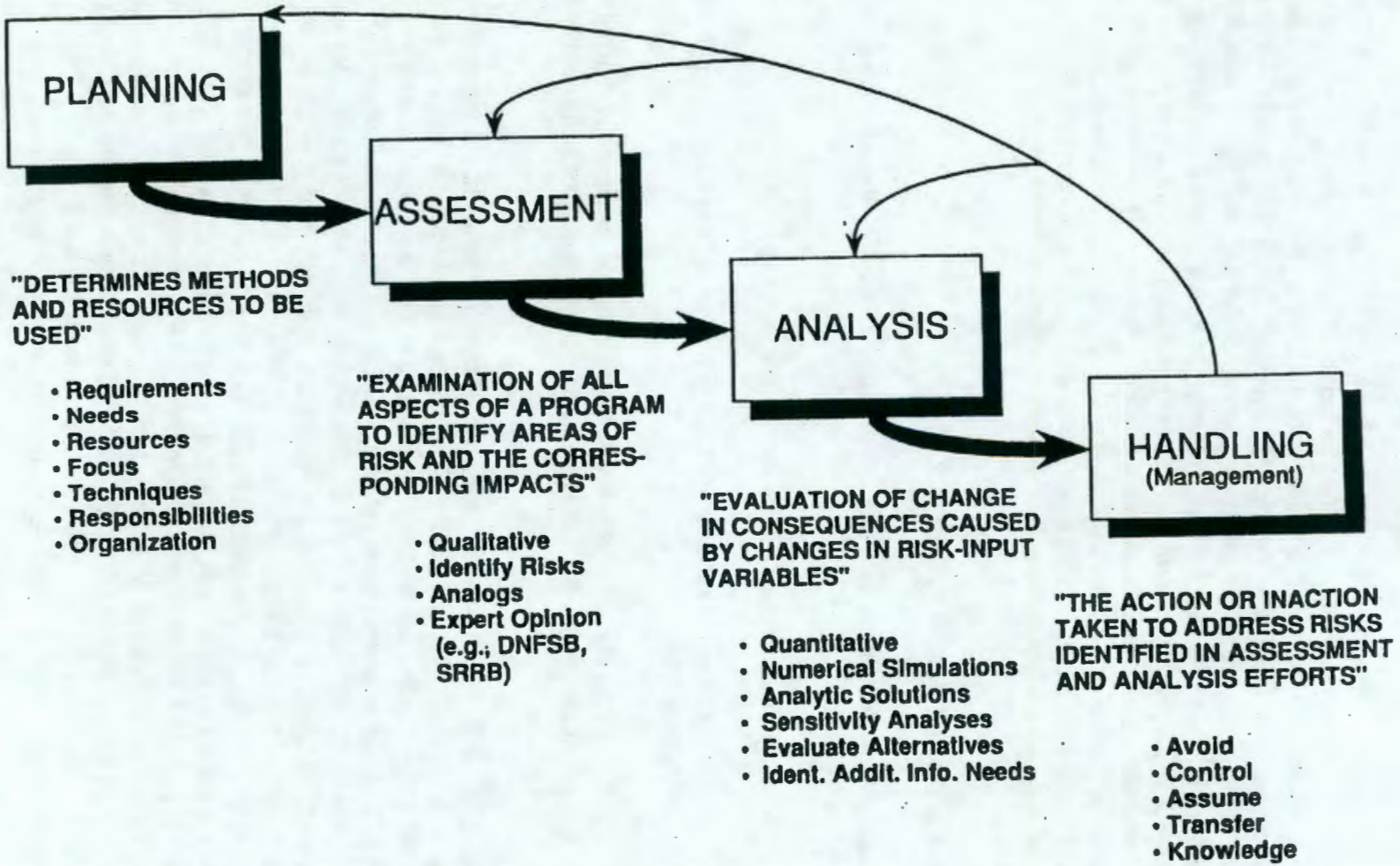


Figure 4. Programmatic Risk Management Process.

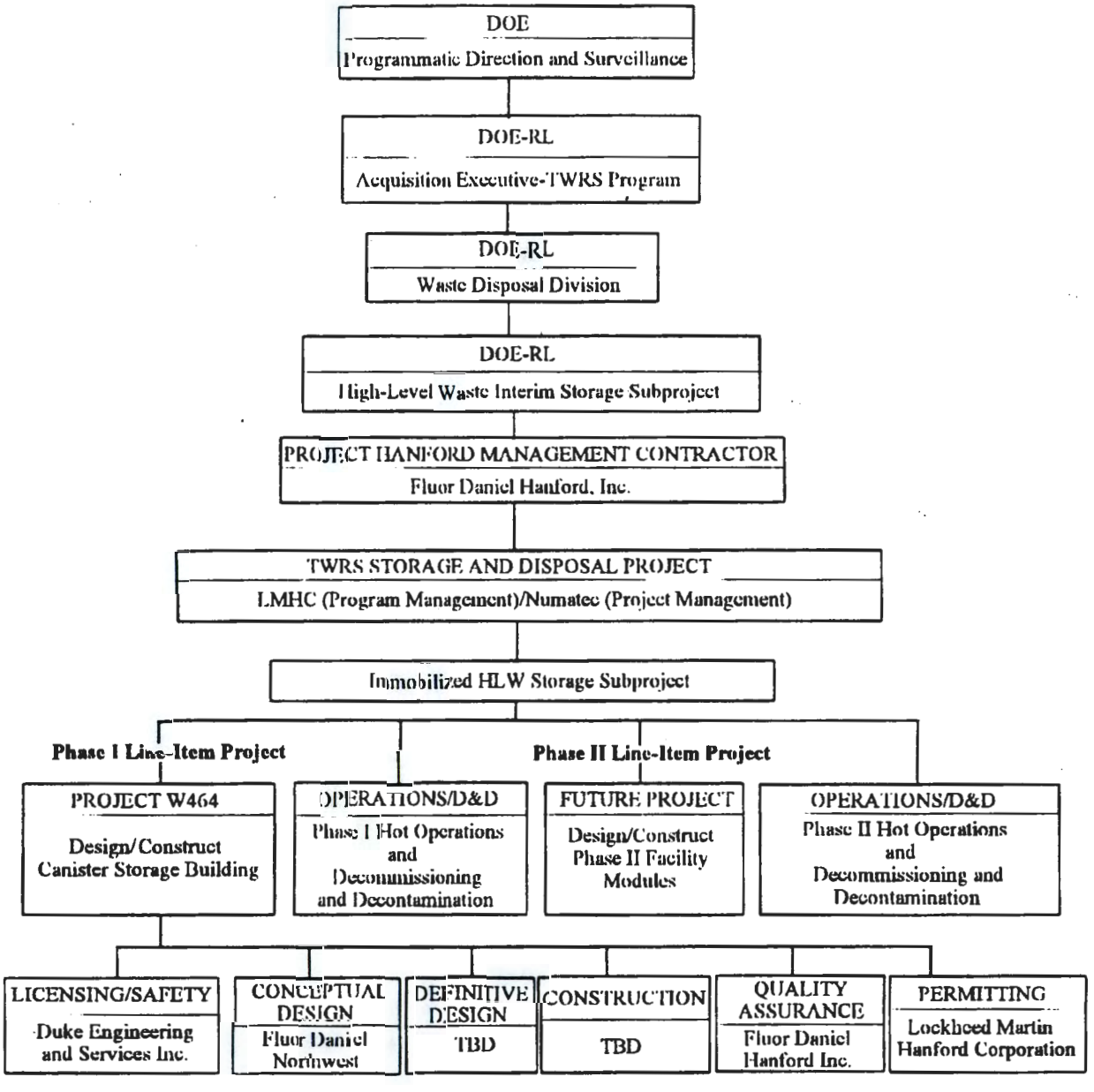
CSB HLW operation will include accommodating unit operations required for SNF MCOs and HLW products. Project W-379 operating parameters are still being developed and could influence the Project W-464 baseline operation. For example, the type and extent of monitoring for SNF MCOs in storage has yet to be established. The type and degree of monitoring could affect HLW operations if the MHM is required. Both the HLW and SNF products will be transported in the CSB using the MHM.

10.0 PROJECT ORGANIZATION, ROLES, AND RESPONSIBILITIES

The Subproject organization is based on the PHMC team concept. Active participants include RL, the performing TWRS program or project organization, the engineer/constructor, and, as appropriate, the subcontracted architect-engineer and construction contractors. The performing Subproject organizations provide program or project management and technical direction for RL during all phases of the project. Appropriate onsite support services, including quality, safety , environmental, and health organizations, are called on to provide expert support in their areas of expertise.

The Subproject organizational relationships are shown in Figure 5. The overall responsibility matrix is provided in Appendix D. The responsibilities, authorities, and activities required of each participating organization throughout the projects are summarized in DOE (1992a). Before definitive design activities begin, a more definitive subset will be developed using guidance provided in Hanford Site procedures specific to line-item PMPs [HNF-PRO-563, *Project Management System* (FDH 1997b)].

Figure 5. IHLW Storage Subproject Organizational Relationships.



TWRS = Tank Waste Remediation System
TBD = To Be Determined
DOE = Department of Energy
RL = Richland Operations Office
LMHC = Lockheed Martin Hanford, Inc.

11.0 PROJECT MANAGEMENT AND CONTROL

The Subproject management and control process consists of the following elements: project planning, baseline management and control, performance measurement and reporting, work authorizations, funds management, contingency management, meetings and reviews, project validation, critical decisions, and external interface control. Sections 11.1 through 11.10 discuss these elements. Section 11.1 includes a discussion of the Subproject work breakdown structure, line-item project management, systems engineering, configuration management and project files management. Section 11.2 discusses technical, schedule, and cost baseline management and control.

11.1 PROJECT PLANNING

The intent of the project management system and project planning is to ensure the successful execution of the Subproject management and system definition activities, and design, procurement, construction, testing, and start up of the Subproject facilitates (Phase 1 and 2) within baseline cost and schedule and meeting criteria and requirements.

Sections 11.1.1 through 11.1.5 describe the Subproject management systems to be used, including procedures, practices, hardware, and software.

The Subproject control organization will assess the participant's management systems annually. The assessment scope and content will be tailored to evaluating implementation or execution and relate to some or all of the management system elements listed in Sections 11.1.1 through 11.1.5.

11.1.1 Work Breakdown Structure

A WBS was established for planning, execution, and control of the Subproject work. The WBS represents the way in which work will be estimated, scheduled, budgeted, performed, and managed. The WBS defines all authorized Subproject work regardless of funding source by relating elements of work to each other and to the end products. Because it describes all the work to be done on the Subproject, the WBS provides the basis for technical, schedule, and cost control. The status of each active element is monitored regularly to determine if the planned work is being accomplished on schedule and within budget.

The Subproject WBS is broken into discrete packages for performance tracking and reporting. Major work activities for the Project have been defined as shown in the WBS, shown in Figure 6, and are detailed in activity data sheets, which are held as backup to the TWRS MYPP and are available from the TWRS S&D Project files. The Subproject level (Level 5) dictionary sheets are provided in Appendix C.

As Phase 1 and Phase 2 line-item projects are validated in accordance with applicable DOE Orders (i.e., DOE Order 4700.1 or equivalent), contractor participants will be responsible for developing contractor work breakdown structures (CWBS) and preparation for DOE of CWBS dictionaries at the cost account level in support of the Subproject WBS. Each CWBS dictionary will specify the work to be performed and how and by whom it will be accomplished. The CWBS dictionary also will identify the technical work scope and planning documents that further describe the work activities and provide other significant data.

11.1.2 Project Management Plans (Phase 1 and 2 IHLW Storage Line-Item Projects)

A PMP will be developed for both Phase 1 and 2 validated line-item projects in accordance with relevant PHMC procedures and DOE orders. Each line-item project PMP will identify the plans, organizational interfaces, management control systems, and reporting requirements that will be used by those responsible for managing the respective line-item projects. The line-item PMPs will be part of the line-item project-specific baseline and will be controlled documents subject to configuration management. Documents to be developed after and supporting the line-item PMP also are controlled documents. The line- item PMPs will be updated annually and supplemented to meet the requirements of the RL Site Management System and MYWP. Each line-item PMP will be developed after that line-item project's conceptual design activity is complete.

11.1.3 System Engineering Management

The Subproject will use the *Tank Waste Remediation System Systems Engineering Management Plan* (SEMP), WHC-SD-WM-SEMP-002 (Peck 1996), as the basis for tailoring the systems engineering process to apply scientific and engineering principles to accomplish the following goals:

- Transform an operational need into a system of defined performance and configuration characteristics through iterative, disciplined, and documented processes
- Ensure that all necessary related parameters are integrated to optimize a system design that meets program cost, schedule, and technical performance goals
- Maintain a controlled definition of the system over its life cycle.

The TWRS systems engineering approach will provide the following benefits:

- An orderly and structured approach to systems development.
- A common understanding of program goals and expectations by all participants.
- An integrated schedule of activities showing how they relate to each other.

Figure 6. Subproject Work Breakdown Structure.

1.1.3.4.02	**IHLW STORAGE SUB-PROJECT (Level 5)**
1.1.3.4.02.01	**Project Management/Administration (Level 6)**
1.1.3.4.02.01.01	Fiscal Year Work Plan (FYWP) Maintenance
1.1.3.4.02.01.02	Prepare Project Baseline Summary (PBS)
1.1.3.4.02.01.03	Prepare Multi-Year Program Plan
1.1.3.4.02.01.04	Project Management Support
1.1.3.4.02.02	**System Definition (Level 6)**
1.1.3.4.02.02.01	Systems Documentation (Phase I and II)
1.1.3.4.02.02.02	ICD Studies and Issue Resolution
1.1.3.4.02.02.03	RW/QARD Compliance
1.1.3.4.02.03	**Immobilized High-Level Waste (IHLW) (Project W-464) (Level 6)**
1.1.3.4.02.03.01	W-464 Project Management
1.1.3.4.02.03.02	W-464 Conceptual Design
1.1.3.4.02.03.03	W-464 Advanced Conceptual Design
1.1.3.4.02.03.04	W-464 Preliminary Detailed Design (Title I)
1.1.3.4.02.03.05	W-464 Detailed Design (Title II)
1.1.3.4.02.03.06	W-464 Building Modifications/ Transport Systems
1.1.3.4.02.03.07	W-464 Startup
1.1.3.4.02.03.08	W-464 Permitting
1.1.3.4.02.03.08.01	CSB SEPA/NEPA
1.1.3.4.02.03.08.02	CSB Notice of Intent
1.1.3.4.02.03.08.03	Part A Permit Application
1.1.3.4.02.03.08.04	Part B Permit Application, Rev. 0
1.1.3.4.02.03.08.05	Part B Permit Application, Rev. 1
1.1.3.4.02.03.08.06	Transportation and Packaging
1.1.3.4.02.03.08.07	Listing Exclusion Application
1.1.3.4.02.03.08.08	Environmental Assessment
1.1.3.4.02.03.08.09	W-464 Safety
1.1 3.4.02.04	**Operations (Level 6)**
1.1.3.4.02.05	**Future Projects (Phase II Interim Storage Facility Design Construction) (Level 6)**
1.1.3.4.02.05.01	Project Management
1.1.3.4.02.05.02	Conceptual Design
1.1.3.4.02.05.03	Advanced Conceptual Design
1.1.3.4.02.05.04	Preliminary Detailed Design (Title I)
1.1.3.4.02.05.05	Detailed Design (Title II)
1.1.3.4.02.05.06	Construction
1.1.3.4.02.05.07	Startup
1.1.3.4.02.05.08	Permitting
1.1.3.4.02.05.09	Safety
1.1.3.4.02.06	**Facility Decontamination and Decommissioning (D&D) (Level 6)**

- Documented evidence of the current condition or status.
- Traceability of significant program characteristics and system configuration at any point in the program life cycle.
- Control of project cost, schedule, and technical performance.
- Ensurance that the system being built will accomplish the mission.

A line-item project-specific SEMP will be prepared for each line-item project, as necessary, after that project's conceptual design is complete, to ensure that the technical requirements and basic design criteria of the line-item projects are clearly defined and traceable throughout the design, acquisition, construction, and operation phases. See Figure 7 for a typical line-item project life cycle and associated systems engineering documents.

The line-item project SEMPs will conform to the DOE requirements (DOE Order 4700.1 or equivalent) as well as to the TWRS SEMP (Peck 1996). The TWRS systems engineering process, presented in Figure 8, will be used to develop an optimal cost-effective solution to the identified system need. The end product of the process is documentation describing the preferred system and required performance. The process is a systematic approach that integrates the development, construction, test, operations, support, and decommissioning of the system. It will be used throughout the system's life cycle.

The line-item projects (Phase 1 and 2) have been assigned a project risk/complexity factor of "moderate" and an associated systems engineering level of 2. The systems engineering level will be formally documented in the line-item specific project SEMPs. A Level SE-2 project is defined in the TWRS SEMP (Peck 1996) as a project requiring a full set of systems engineering activities and documentation that, because of its moderate degree of risk or complexity, can be tailored to the project's specific needs. The systems engineering activities and resulting documentation determined necessary for the Project W-464 (Phase 1) and Phase 2 IHLW Storage line-item projects are presented in Figures 9 and 10, respectively. These figures show the status of the systems engineering process as of the end of FY 1997.

The TWRS SEMP provides guidance to adopt the approved systems engineering process for Hanford Site projects that were established before the approved TWRS SEMP was issued. Project W-464 was defined and proceeding in parallel with development of the TWRS SEMP. The systems engineering approach adopted by Project W-464 is essentially the same as that presented in the TWRS SEMP except that the Project W-464 DRD was developed and approved in lieu of preparing both a technical requirements specification and a DRD. Both documents have the same format and contain essentially the same information; however, the DRD includes more detail. Therefore, a technical requirements specification will not be prepared for Project W-464. A technical requirements specification will be developed for the Phase 2 line-item project before the DRD is developed.

Figure 7. A Typical Project Life Cycle with Associated Systems Engineering Documents.

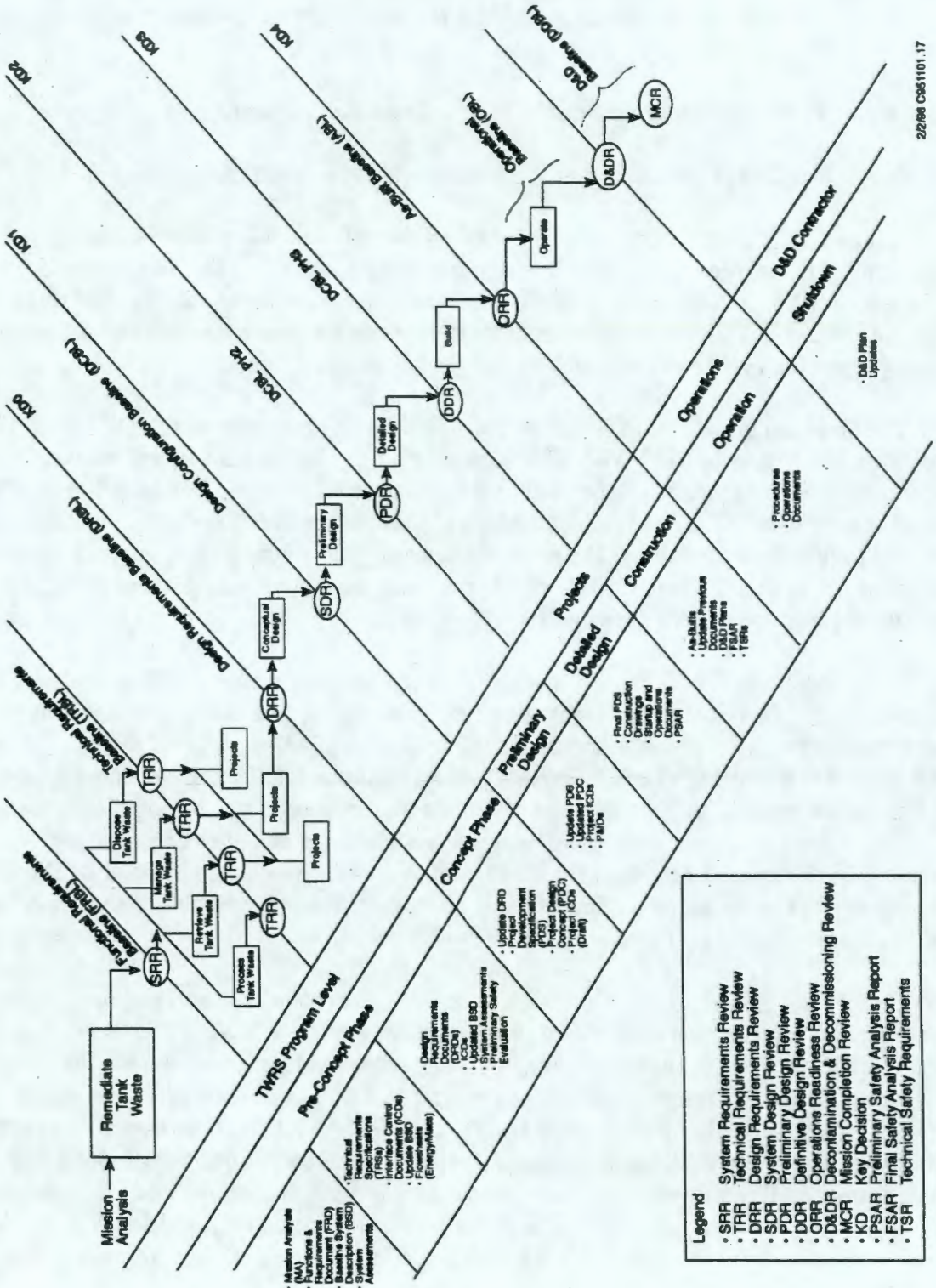
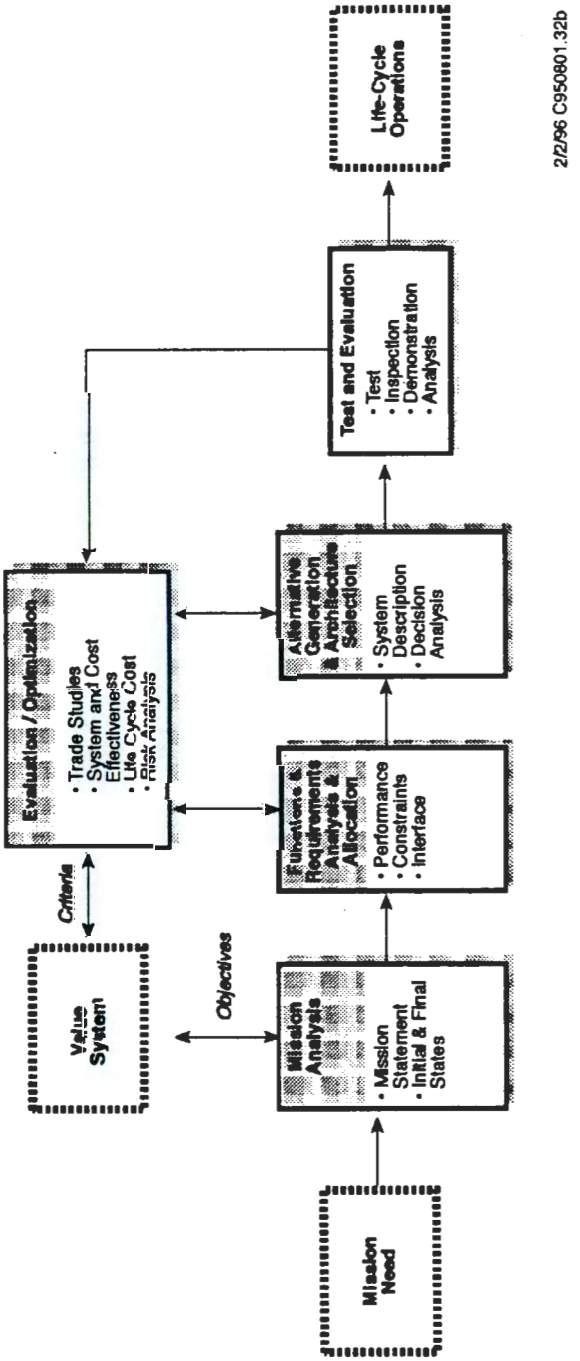


Figure 8. TWRS Systems Engineering Process.



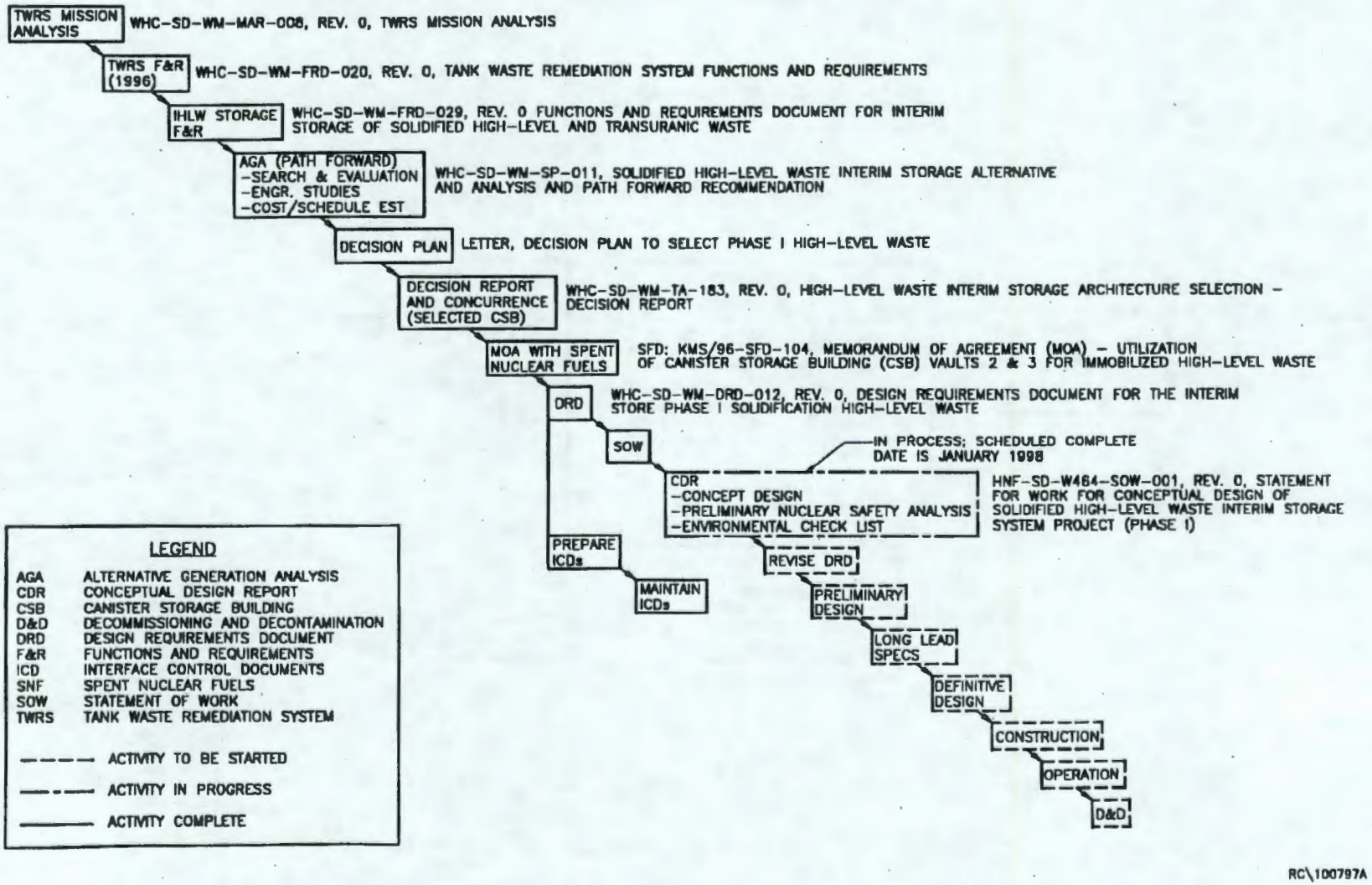


Figure 9. Systems Engineering Activities and Documentation, Project W-464.

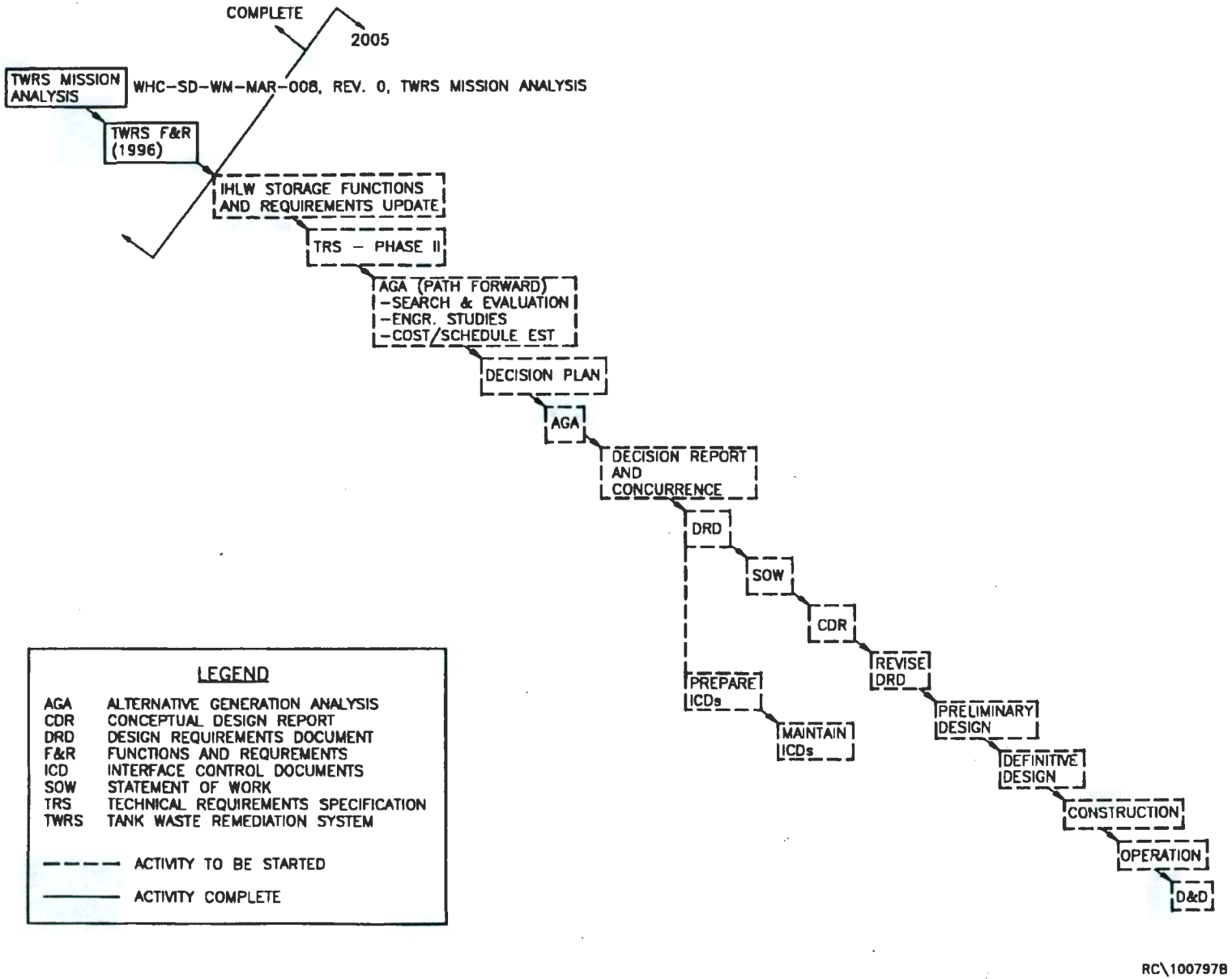


Figure 10. Systems Engineering Activities and Documentation, Phase 2.

Changes to the Hanford Site and TWRS technical baselines in the Hanford Site Technical Database will be incorporated as updates to the Project W-464 DRD.

Risk will be managed in accordance with the TWRS SEMP, TWRS programmatic risk management plan, and the appropriate risk management procedures in HNF-IP-0842, Volume IV (Davis 1997) and the *Storage and Disposal Project Risk Management Plan* (Murkowski 1995).

Interface control will be managed in accordance with the TWRS SEMP and the appropriate interface control procedures found in WHC-IP-0842, Volume IV.

11.1.4 Configuration Management

Configuration management is an integrated approach to controlling the technical cost, schedule, and administrative tasks necessary to manage the project. The Hanford Site configuration management requirements are prescribed in the PHMC Configuration Management Plan, HNF-MP-013 (FDH 1997b). The TWRS SEMP, WHC-SD-WM-SEMP-002 (Peck 1996), provides the requirements for a program documenting the functional and physical characteristics of a product to be controlled during its life cycle, control changes to those characteristics, and provide information on the status of the product. These relationships are active throughout the product's life cycle, and when a change occurs to any one of these relationships, the others are evaluated to determine impacts.

The purpose of a change control process is to provide an avenue to revise a product and determine the effects of the revision on other attributes of the product or on other products. Selected products will be identified and placed under Configuration Management control; the rigor of that control will be differentiated, and procedures will be established to define the rigor of control. The TWRS Baseline Change Control procedure, found in HNF-IP-0842, Volume VIII, Section 1.1, will be the vehicle for making changes to the integrated baseline.

11.1.5 Project Files

The Hanford Information Resource Management System develops and maintains the project technical files and ensures that information is available to support the Subproject and line-item projects and that the information product is complete and accurate for the staging and interim storage of Phase 1 and 2 HLW products. Information resources are managed throughout the information life-cycle, including information creation, collection, processing, distribution, management, and disposition or retirement. Life-cycle activities shall be managed to make information useful, available, and effective in accomplishing the Subproject and line-item project objectives.

Project files will be developed and maintained in accordance with the Subproject's configuration management plan and the line-item project's document management plan. The line-item project's document management plan will be developed after the conceptual design is complete.

11.2 BASELINE MANAGEMENT AND CONTROL

A total IHLW Storage Subproject baseline has been established for all activities to completion of the Subproject. All these activities are reflected in the IHLW Storage Subproject WBS (Figure 6). The technical baseline is the basis for the schedule and cost baselines reflected in the IHLW Storage Subproject MYWP. Effective control of the Subproject baseline is essential; changes to the baseline will be implemented in a disciplined fashion. The approach to managing baseline changes is based on maintaining an accurate description of the Subproject baseline, methodically evaluating proposals to alter it, and maintaining configuration to the technical baseline. This will be done by establishing change class levels (levels of approval authority) and a project change control board as specified in HNF-MD-008, *Baseline Change Control* (FDH 1997c). This management directive defines the responsibilities and requirements for management, administration, and use of the technical, schedule, and cost baseline control systems for the Subproject.

Controlled baseline documents will be changed through submittal of change requests that justify the proposed changes. Specific baseline change control requirements will be managed in accordance with Hanford Site change control procedures and established thresholds in accordance with appropriate procedures from HNF-IP-0842 (Davis 1997).

11.2.1 Technical Baseline Control

A technical baseline has been established for the IHLW Storage Subproject as depicted by the Subproject WBS and specific WBS activities. A more detailed technical baseline will be developed for each IHLW Storage Subproject line-item project following conceptual design. The technical baseline is the reference set of technical data used in establishing the Subproject and line-item projects. The Subproject technical baseline defines the technical data needs and requirements and data generation necessary to establish the line-item projects and includes the more detailed technical data developed by the line-item project to design, construct, start up, and operate the line-item project interim storage facilities. More specifically, the line-item project technical baseline includes functions and requirements, Level 1 process flow diagrams, performance specifications, interface control documentation, and design packages including specifications and drawings, quality assurance provisions, safety basis documents, and test and inspection requirements.

The PHMC will ensure that configuration management activities and systems engineering activities are performed and will maintain definition and control of the line-item project baseline and associated documentation. These activities will be applied to all systems and subsystems necessary to achieve all functional requirements and deliver all products to satisfy the integrated technical baseline and overall line-item project objectives. At all times during the life of the line-item projects, current configuration will be maintained in orderly and auditable project files. These project files will include, but not be limited to system descriptions, system specifications, conceptual and definitive system designs, system and material inspection reports, test reports, operating and surveillance procedures, and vendor documentation.

Technical baseline change control will be implemented in HNF-IP-0842 (Davis 1997) in accordance with direction provided in HNF-MD-029, *Site Technical Baseline Change Control* (FDH 1997d), and HNF-MD-008.

Appendix D defines the approval authority for changes to the defined technical baseline.

11.2.2 Schedule Baseline Control

The Subproject baseline schedule is reflected in the MYWP.

For each WBS element identified in the Subproject summary WBS, separate detail schedules will be prepared that identify the activities needed to successfully complete that phase of the Subproject work scope. Each detail schedule will identify the logic ties and interfaces necessary to coordinate the completion of that phase of the work scope with the other elements of the Subproject summary schedule, and will contain sufficient detail to allow integration of all detail schedules into the Subproject summary schedule.

Schedule control of the Subproject is implemented through critical path schedule analyses (resulting in the identification of schedule float) and establishment of milestones and corrective actions for schedule variances (determined by Earned Value Methodology). PHMC and its subcontractors analyze schedule variances and evaluate trends on schedule performance using acceptable methodologies on their PHMC-approved master schedule. Performance reporting and variance analyses are reported to the Subproject manager as specified in Section 11.6. When variance analyses reveal problems, the PHMC and its subcontractors ensure that the affected participants take appropriate corrective actions. Changes to the Subproject schedule baseline will be processed in accordance with HNF-MD-008 and implemented in accordance with the appropriate procedures in HNF-IP-0842.

11.2.3 Cost Baseline

The Subproject cost baseline is the Subproject cost estimate and is established and controlled in the MYWP. The cost estimate level of detail is specified in the general guidance for preparing program plans issued annually by RL and is generally at the activity level. The Subproject estimate includes contingency as identified in the validated line-item project cost estimate. The budget authorization requirement will consider the requirements of contract commitments and phase funding allowances. Carryover of funds to support the budget authorization/budget outlay profile will be required.

Cost control is implemented by the PHMC through corrective action in response to cost variances reflected in the routine Earned Value analysis of the established cost performance baseline. The PHMC will prepare estimates to complete for the Subproject and line-item projects, taking into account the cost-performance index. The PHMC and other Subproject contractors

will prepare, and seek appropriate approval for, documentation of corrective action of cost estimate changes that exceed the thresholds established in HNF-MD-008.

The PHMC prime contractor, Fluor Daniel Hanford, has the primary responsibility for preparing and reporting cost performance data to the DOE Waste Disposal Division (WDD). Significant variances, corresponding variance analyses, and recommended corrective actions will be included in the report to DOE WDD. The estimates to complete for each Subproject WBS element will be prepared by the PHMC subcontractors based on the status of the work element and the cost-performance index, and reported monthly in the PHMC team status review meeting. The estimates to complete will be based on the latest performance data, current assessment conditions, current and projected pricing factors and rates, and knowledgeable forecasts of projected conditions.

Changes to the Project and Subproject cost baselines will be processed through Change Control in accordance with established thresholds in accordance with the procedures found in HNF-MD-008. The PHMC will ensure that all Subproject cost estimates and revised estimates are based on current schedules and that the basis for cost estimates is consistent with the documented Subproject scope baseline.

11.3 PERFORMANCE MEASUREMENT AND REPORTING

Earned value methodology will be used to measure performance on this Subproject. Each PHMC contractor and subcontractor will use and maintain internal cost and schedule performance measurement information that provides responsible managers with timely, accurate, and objective performance data. Performance will be measured against the MYPP cost estimate and the total project cost for the line-item projects.

The line-item projects will submit monthly status information to the Subproject for integration in their overall reporting documentation. Reporting format and content will comply with DOE Order 4700.1 or equivalent. The Progress Tracking System and the Site Management System will be used for the monthly reporting. Line-item project reporting will be coordinated with the overall Subproject reporting. The line-item project will support the overall Subproject weekly and monthly planning and other reporting systems and meetings.

11.4 WORK AUTHORIZATION

Overall work authorization occurs by contractual arrangements between the RL contracting officer and the PHMC. All funding and work scope will be authorized by the DOE Contracting Officer. A PHMC internal process will be established to authorize specific projects.

Capital work will be controlled within the Subproject by cost account plans following project authorizations from RL. Appropriate work performed by the PHMC architect-engineer (A-E) will be authorized by a letter of instruction.

11.5 FUNDS MANAGEMENT

Allocation and authorization of funds will come from DOE to the integrating contractor and then to the responsible subcontractor. Control of fiscal year cost will be accomplished in accordance with financial plan ceilings. Line-item project expense and capital expense not related to construction funding that is authorized but not spent (i.e. carry-over) within a fiscal year can remain with the Subproject for use to meet the next fiscal year, capital expense not related to construction line-item project needs in accordance with the Subproject's cost, schedule, and technical baselines. Uncosted commitments will be carried over as budget outlay.

Cost, commitment, and funding authority information are provided by the PHMC prime contractor, Fluor Daniel Hanford, in monthly status review meetings, as requested by the DOE WDD. This information is used to keep the DOE WDD and management advised of current cost and commitment levels and potential funding impacts in a monthly project report. Controls are established to ensure that costs and commitments do not exceed available funding.

11.6 CONTINGENCY MANAGEMENT

Formal contingency will be included for Subproject activities approved as part of a validated line-item project. Contingency will be included in the IHLW Storage Subproject as a part of the Subproject's total project cost. Contingency is intended to cover the costs that may result from unforeseen and unpredictable conditions and uncertainties within the defined line-item project scope. Contingency analysis will be performed on all line-item project cost estimates to determine contingency requirements. Contingency will be managed and controlled as identified in Section 11.2.3, "Cost Baseline Control."

11.7 MEETINGS AND REVIEWS

The Subproject will conduct monthly management review meetings (MRM) with DOE WDD. The line-item projects have dedicated MRMs. The Subproject team leader will be responsible for recording action items, agreements, and commitments resulting from the meeting. Monthly reviews will focus on immediate decisions, critical issues, cost and schedule variances and assessments, corrective actions, and general status of work in progress. Status data from the monthly status report should be used as much as possible. The review is intended to be exception oriented and focus on major significant issues that require management decisions.

11.8 PROJECT VALIDATIONS

The line-item projects will be validated in accordance with DOE Order 4700.1 or equivalent and Office of Management and Budget requirements if required by DOE-HQ Facilities Management. An independent review of the design and construction cost estimates will be conducted. The validation will be based on the technical information and cost estimates developed during conceptual design. The cost estimate review will be held late in FY 1998 for

FY-1999 through FY-2002 authorizations. A complete validation review will be conducted during FY 1998 for Project W-464. Validation for the Phase 2 line-item project is scheduled for April 2007.

11.9 CRITICAL DECISIONS

The first critical decision (CD), CD-1, Authorization to Initiate Conceptual Design, for Project W-464, was delegated by Alvin L. Alm, DOE Assistant Secretary for Environmental Management to J. D. Wagoner, Manager, RL, who granted the authorization. Future CDs also are delegated to the RL manager. CD-2, Authorization to Begin Definitive Design, will be granted by the RL manager. CD-3 is authorization to begin construction activities and CD-4 is authorization to begin operation.

11.10 EXTERNAL INTERFACE CONTROL

Interface activities between the Subproject and the privatization contractor will be conducted in accordance with ICDs specific to each Phase 1 HLW product. The final ICDs will be issued by the private contractor; however, the Subproject will have input to it. The final version of the ICDs will include concurrence from RL, the PHMC, which includes the IHLW Storage Subproject, and the private contractor. The final version will include procedures, issues and their mitigation path forward to transfer HLW projects from the private contractors to the interim storage location and store the products in the CSB.

Interface with federal and state agencies will be controlled in accordance with applicable federal and state regulations. The regulatory and permitting process is discussed in Chapter 13.

12.0 ACQUISITION STRATEGY

Conceptual design information and cost estimates developed during the Project W-464 conceptual design activity will be used to prepare the Project W-464 PMP. A construction-procurement strategy will be developed during conceptual design and will be used to develop a detailed acquisition strategy that will be included in the PMP. The PMP is described in Section 11.1.2. The primary purpose of the PMP acquisition strategy is to describe line-item project acquisition objectives and contracting processes and provide them to line-item project participants for implementation. The PMP acquisition strategy is intended to be a framework for providing the requirements for lower tier documents to direct implementation, not a detailed roadman for implementation.

The Subproject's intent is that retrofit of the CSB to accommodate Phase 1 HLW will be performed based on fixed-price, competitive-bid contracts. Long-lead materials, including items and components, may be procured by either the line-item project construction manager's subcontractors or the PHMC Procurement organization. Contracting for construction will be performed by the line-item project construction manager.

Facility startup will be planned by a dedicated onsite PHMC organization. Actual startup will be performed by either an in-house group or a qualified subcontractor under direction of the Subproject.

13.0 QUALITY, SAFETY, AND ENVIRONMENTAL PROTECTION

Effective quality and environmental safety and health protection programs will be established and maintained to ensure a requisite level of quality, safety, and environmental compliance in all areas of transportation and CSB design, construction, test evaluation, and waste form qualification.

13.1 QUALITY ASSURANCE

IHLW Storage Subproject quality assurance activities are currently covered by the TWRS Quality Assurance Program Plan (QAPP) and associated implementing procedures. This program addresses the requirements of the FDH Quality Assurance Program Description (HNF-MP-599) which is based on 10 CFR 830.120 and DOE Order 5700.6C. 10 CFR 830.120 applies to all activities involving a nuclear facility and DOE Order 5700.6C applies to the remainder.

The scope of the project Phase 1 line-item is defined as the transportation and interim storage of immobilized high-activity waste products provided by a private contractor. Interim storage is to be provided until the product's shipment and ultimate disposal in a federal repository. (The period of interim storage has not been specifically defined.) This scope limits the ability of project and subsequent storage operations. The project can only influence the quality of the immobilized product by confirming, documenting, and enforcing the continued quality of the private contractor's product. Project W-464 will implement the quality requirements to ensure that systems, structures, and components (design features) needed to ensure and document product quality are provided and available for use by individuals during the conduct of operations phase of the facility life cycle.

The project quality assurance requirements will be contained in a project-specific QAPP. Operational quality assurance will be provided by existing operational quality assurance plans.

Requirements from HNF-MP-599, *Quality Assurance Program Description* (FDH 1997e) and applicable implementing procedures will be used as the baseline to produce line-item project-specific QAPP. The project-specific QAPP will also address requirements from DOE/ER/0333P Rev. 7, *U.S. Department of Energy Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program* (DOE 1992b) that are appropriate to the Project W-464 scope. These will help the contractors comply with the requirements for the ultimate transportation and final disposal in the federal repository. Once the CSB is operational for interim storage of Phase 1 HLW products, the operations contractor will modify their QAPP to include the RW-0333P requirements.

13.2 NUCLEAR SAFETY ACTIVITIES AND AUTHORIZATION BASIS PROCESS

This section covers the tasks needed to support the project activities to design and construct a facility that can be operated safely to protect the health of the public and the workers and preserve the environment.

The following discussion provides the approach to be used to implement the Project Safety Program based on implementation of HNF-PRO-430, Rev. 0, *Safety Analysis Program* (FDH 1997f) and HNF-PRO-705, Rev. 0, *Safety Basis Planning, Documentation, Review, and Approval*, in accordance with applicable DOE orders, standards, and policies, as well as Hanford Site-specific guidelines and work procedures.

13.2.1 Nuclear Safety Activities

A comprehensive, graded approach to safety is being developed for the Subproject. This approach will integrate the appropriate level of safety analysis and review process in order to provide the project with a continuous flow of safety inputs and requirements into the Subproject's technical, cost, and schedule baselines throughout the project life cycle. The approach will be implemented by establishing or performing the following activities.

- Preliminary safety evaluation (PSE) studies will be performed during the conceptual design stage (i.e., facility hazard categorization, preliminary hazard analysis, bounding accident scenario analysis and unmitigated consequences evaluations). These studies are expected to establish a set of safety functions to be further analyzed and tracked during the preliminary and definitive design phase. The PSE studies will be documented by a preliminary safety evaluation report as part of the conceptual design report budget validation package. The primary objective of the PSE is to identify significant safety functions to support critical design report budget validation and to establish the safety basis for follow-on project phases. The PSE will not be submitted to DOE as an Authorization Basis document requiring a 3 Tier review. However, if the PSE contains a Facility Hazard Categorization, then it will be required to be DOE approved per compliance with DOE Order 5480.23 and 5481.1B as Facility Hazard Categorization constitutes a safety basis.

- Detailed safety analysis will be performed as necessary, depending on the PSE results (i.e., items needing further analysis), throughout the preliminary and detailed design phases. These studies will be used to establish the basis of the preliminary safety analysis report to be submitted to DOE approval before the start of procurement and construction.

- Safety requirements will be addressed in the project design package using the safety equipment list, specific procurement requirements, and specific testing during start up.

Engineering task plans will be prepared to identify specific activities before work begins. PSE and preliminary safety analysis report will undergo a Tier 1 PHMC functional review and an accelerated DOE review for approval (one Tier instead of two). The 3 Tiers review process will be reserved for the final Authorization Basis package to be approved for operation (see section 13.4.2).

13.2.2 Authorization Basis Documentation and Approval Process

The safety process will be implemented in accordance with PHMC guidance on implementation of the authorization basis (Davis 1997). A safety plan (Safety Basis Criteria Document) will be developed in FY 1998 to present the overall nuclear safety documentation development, integration and approval in accordance with HNF-PRO-705 requirements.

13.2.2.1 Program Level. The current TWRS authorization basis for the Hanford Site (TWRS basis for interim operations and future TWRS final safety analysis report [FSAR]) does not include Project W-464 and future Phase 2 IHLW interim storage facility line-item projects. An integrated authorization basis will be developed to address this line-item project and any interfaces with other Site projects or private contractors.

The baseline for the new integrated authorization basis will be a DOE approved FSAR addendum to the coming up TWRS FSAR (top-level up-front document assuming that the TWRS FSAR will be approved at this time, otherwise it would become an addendum to the TWRS basis for interim operations) that addresses the following issues for both the IHLW (Subproject W-464) and ILAW storage (Subproject W-465) and disposal (Subproject W-520):

- Site characteristics and natural phenomena data (boundaries, demography, climatology, meteorology, geology, etc), which will rely on the existing approved TWRS Authorization Basis
- Overall vitrified waste management strategy among the Hanford Site (transportation, interim storage, and disposal)
- IHLW and ILAW products description (i.e, radioactive material inventory, conditioning process, general characteristics, and certification)
- Interim storage and disposal facilities general description and purpose
- Overall hazard identification and control strategy (i.e, bounding potential scenarios including criticality, external exposure, heat removal, and canister drop)
- General nuclear safety functions that must be maintained
- Identification and discussion of applicable DOE, State, and Federal rules and requirements
- Interfaces with other Site projects and private contractor facilities

- Site transportation basis (tracks, requirements, procedures, shipping and cask maintenance)

- Operational safety basis and organization (should refer to the existing TWRS and SNF health and safety plan)

This TWRS FSAR addendum will form the basis for developing the line-item project SARs. The FSAR will be updated as the line-item project safety analysis reports are developed and specifically approved for each facility operation.

13.2.2.2 Subproject Level. For Project W-464, the strategy is to develop an addendum to the Spent Nuclear Fuel Canister Storage Building (SNF-CSB) FSAR prepared by Project W-379. The current schedule for completion of this FSAR is by October 1998. The addendum to be developed to cover the IHLW interim storage will follow the existing CSB safety analysis report format and reflect only those activities specific to the IHLW storage mission. In addition, the addendum will identify interfaces with Project W-379 for design features, analysis, requirements, and controls specific to the IHLW mission. The IHLW-specific Technical Safety Requirements (TSRs) and controls will be managed as part of the CSB safety basis.

Transportation of Immobilized High-Level Waste. This includes the transportation of radioactive materials within Hanford Site boundaries. These areas are not accessible to the public and are not subject to U.S. Department of Transportation regulations. Transportation and packaging operations are authorized and controlled by contractor-approved procedures and safety evaluations.

The strategy for IHLW products packaging and transportation operations is addressed in HNF-SD-ENV-EE-002, Rev. 0, *Permitting Plan for the High-Level Waste Interim Storage* (Deffenbaugh 1997). The permitting plan identifies the activities needed to conduct the design and safety evaluations in the onsite transportation program as described in WHC-CM-2-14, *Hazardous Material Packaging and Shipping*.

13.2.3 Safety Activity Schedule

At of TWRS Storage and Disposal Project W-464 safety-related tasks, task duration, and performing organizations is provided in Table 6. The tasks and associated information (i.e., schedule, organizations) will be identified in more detail in the specific engineering task plans once the results of the PSE are known. Safety basis documentation development and the Project W-464 safety activity are identified in WBS No. 1.1.3.4.02.03.08.09, W-464 Safety (see Figure 6).

Table 6. Safety-Related Activities.

Tasks	Responsible and Performing Organizations	Observations/Project Stages	DOE approval required	Tier review		
W-464				1	2	3
Preliminary Safety Evaluation	TWRS NS&L	Conceptual design	Validation as part of the conceptual design report - Facility Hazard Categorization needs to be approved	x	x	(x)
Prepare safety plan	TWRS NS&L, OPSS	Advance conceptual design and congress budget cycle	Approval per HNF-PRO-705	x	x	(x)
Preliminary TWRS FSAR addendum development	TWRS NS&L, SA	Basis for low- and high-activity PSAR/FSAR development - detailed design	No			
Update and final TWRS FSAR addendum	TWRS NS&L, SA	Facility construction. Updates with separate facilities FSARs addendums (Grout Treatment Facility and SNF CSB)	Tier 3 review if for each facility separate safety basis documentation for operation	x	x	(x)
Engineering Task Plan for development of a PSAR	TWRS NS&L, OPSS	Mobilization for detailed design	No	x		
Development and DOE approval of a PSAR	TWRS NS&L, SA and OPSS	Detailed design and before start of procurement	Authorization to start procurement	x	x	(x)
Development of transportation criteria related to safety	TWRS NS&L, OPSS and WMH	Procurement specifications for trucks and casks	No			
SARP	TWRS NS&L, OPSS, and WMH	Detailed design, construction, and cold testing	Yes	x	x	x
USQ screening	TWRS NS&L, OPSS	Check that construction activities are covered by current AB	No			
Development and approval of a FSAR	TWRS NS&L, SA, and OPSS	Construction and inactive testing	Yes	x	x	x

(x) Tier 3 review is assumed to be reserved to the specific facility Safety Basis Documentation required to authorize operation

AB = authorization basis
CSB = Canister Storage Building
DOE = U.S. Department of Energy
FSAR = final safety analysis report
NS&L = Nuclear Safety and Licensing
OPSS = Operation and Project Safety Support
PSAR = preliminary safety analysis report
SA = Safety Analysis
SARP = Safety Analysis Report for Packaging
SNF = Spent Nuclear Fuel
TWRS = Tank Waste Remediation System
WMF = Waste Management Federal Services Hanford

13.2.4 Safety References

- HNF-PRO-430, Rev. 0, *Safety Analysis Program* (FDH 1997f), based on the following orders, standards, and policies:
  - DOE 5480.21, *Unreviewed Safety Questions* (DOE 1992c)
  - DOE 5480.22, *Technical Safety Requirements* (DOE 1992d)
  - DOE 5480.23, *Nuclear Safety Analysis Reports* (DOE 1992e), and DOE-STD-3009-94, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*
  - DOE-STD-3009-94 and 3011-94, *Guidance for Preparation of Nuclear Facility Safety Analysis Reports, Technical Safety Requirements and SAR Implementation Plans*
  - DOE 5481.1B, *Safety Analysis and Review Systems* (DOE 1987)
  - DOE 6430.1A, *General Design Criteria* (DOE 1989)
  - SEN-35-91, *DOE Nuclear Safety Policy* (DOE 1991)
  - DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23*
  - DOE-EM-STD-5502-94, *Hazard Baseline Documentation*
- Lockheed Martin Hanford Company Manual HNF-IP-0842, Volume IV, *Authorization Basis Amendment Process* (Davis 1997)
- HNF-SD-ENV-EE-002, Rev. 0, *Permitting Plan for the High-Level Interim Storage Project* (Deffenbaugh 1997)
- WHC-CM-2-14, *Hazardous Material Packaging and Shipping*.
- HNF-PRO-705, Rev.0, *Safety Planning, Documentation, Review and Approval* (FDH 1997g)
- HNF-SD-BIO-001, Rev.0, *Tank Waste Remediation System Basis for Interim Operation* (LMHC 1997a)

13.3 ENVIRONMENTAL MANAGEMENT

The environmental protection program for the Subproject, the *TWRS Environmental Program Plan for M&I Contractor Work Scope in Support of TWRS Phase 1B Privatization*, HNF-1773, Rev. 0 (LMHC 1997b), will be followed to ensure that all Subproject activities are carried out in compliance with federal, state, and local regulations, laws, and standards for the protection of the environment and the safety and health of employees and the public. Regulating agencies will be kept informed of Subproject plans and major activities.

The Subproject and line-item projects will cooperate with DOE and other federal, state, and local agencies and stakeholders, as appropriate, to ensure that their activities comply with environmental protection regulations and requirements. The necessary environmental permits and approvals will be procured at the appropriate times. Regulatory integration and public involvement are the responsibility of the PHMC organization charged with coordinating regulatory requirements and activities for the Subproject.

An environmental requirements checklist and a permitting plan are required for both the Phase 1 and Phase 2 line-item projects. The environmental requirements checklist documents the TWRS Environmental Compliance organization's evaluation of the required environmental permits, approvals, and other documentation necessary for the project and lists the contact person for each requirement. The permitting plans address environmental permitting requirements for the transportation and interim storage of HLW produced during Phases 1 and 2 of the privatization effort. An environmental requirements checklist and permitting plan have been prepared for Project W-464 (Deffenbaugh 1996). The permitting activities identified in the Project W-464 Permitting Plan (Deffenbaugh 1997) are included in the IHLW Storage Subproject portion of the TWRS MYWP (LMHC 1997c). Important permitting activities are summarized in the Subproject activities schedule (Appendix E). For each applicable regulation, the permitting plan provides the following: a summary of data requirements, a discussion of alternatives, a recommended implementation strategy, and an estimated cost of implementing the recommended alternative.

The applicable environmental regulations identified in the Project W-464 permitting plan are as follows:

- NEPA, 42 *United States Code* (USC) 4321, et seq., which was enacted to ensure that environmental matters are considered before federal actions are initiated that might affect the quality of the human environment.

- "State Environmental Policy Act of 1971" (SEPA), Chapter 43.21C, *Revised Code of Washington*, which is the Washington State equivalent of NEPA and is considered implementing regulations.

- RCRA, 42 USC 6901, which was enacted as a comprehensive program to mandate that hazardous waste be treated, stored, and disposed of so as to minimize the present and future threat to human health and the environment.

- "Dangerous Waste Regulations," WAC 173-303, as amended, 1996, which is the Washington State equivalent to RCRA and are considered implementing regulations.

- *Federal Clean Air Act of 1970*, 42 USC 7401 et seq., as amended in 1977, and overhauled and expanded in 1990. This act protects the public health and welfare through operations management, emissions control, and monitoring.

- *Hazardous Material Packaging and Shipping*, WHC-CM-2-14, which documents the PHMC onsite transportation safety program.

- *General Environmental Protection Program*, DOE Order 5400.1 (DOE 1988) and *Radiation Protection of the Public and the Environment*, DOE Order 5400.5 (DOE 1993a). These documents require that monitoring be performed to determine any impact on the environment from activities that involve potential emission of radionuclides.

Carry-Over Compliance Responsibilities

One of the proposed DOE product acceptance requirements for the Phase 1 HLW products is that the PHMC Team provide supplemental compliance basis information about each HLW product canister during Phase 1 onsite transportation and onsite interim storage. This requirement is based on RL's and the DOE Office of Environmental Management's (EM) intention to comply with the DOE Office of Civilian Radioactive Waste Management's (RW) acceptance requirements. The acceptance requirement were established for two versions of a vitrified HLW disposal product design that EM proposed and RW approved. RW calls such approved designs, "standard form" products; RL and EM have adopted them as IHLW Product candidates for Phase 1. The Phase 1 proposed non-routine high-level solid waste also is intended for disposal by the federal repository program (RW); however, because the specific designs are still being developed, RW has not defined the product acceptance requirements yet. The cesium-intermediate waste product is currently intended for further onsite processing to incorporate the cesium into a disposal product. Consequently, the product design description and the proposed Phase 1 DOE (Hanford Site) product acceptance requirements so far only cover the "intermediate product" concept.

The PHMC team will produce whatever types of documentation that DOE decides it needs to allow the PHMC team to implement its Phase 1 tasks and to support follow-on DOE disposal actions (i.e., RL and EM negotiations with RW) for Phase 1 HLW Products. Currently, the PHMC Team is assuming that such supplemental compliance documentation will include at least the following types of documentation, as indicated by the following RW/WA-SRD requirements (DOE-RW 1996).

- A document will be provided that contains the compliance approach that the PHMC team proposes to use for each applicable Phase 1 DOE product acceptance requirement.

- A document will be provided that contains evidence (e.g., analyses, test results, etc.) confirming that the proposed compliance approach is capable of meeting each such requirement.

14.0 TEST AND EVALUATION PLAN

A test and evaluation program based on systems engineering principles will be implemented on the Phase 1 IHLW Storage Subproject to ensure that the completed facility and installed systems meet the performance specifications. Detailed test plans, specifications, and procedures will be prepared, approved, controlled, and maintained in accordance with the requirements of this project plan and subsequent PMPs. These test plans or specifications and procedures will address testing requirements for plant systems, subsystems, and individual pieces of equipment. The test planning and scheduling will coordinate development testing with design and plant testing with plans for construction, turnover, and startup. The Subproject testing activities include construction and preoperational and operational testing.

Construction Testing. The Phase 1 Subproject startup program is an engineered multiphase sequence of activities culminating in successful startup and initial operation of the CSB retrofit to accommodate HLW interim storage. Startup activities physically begin during construction acceptance testing, continue with preoperational testing, and are completed during operational testing. These startup activities will be detailed in the CSB IHLW Storage Subproject startup plan.

Construction Acceptance Testing. Construction testing activities are factory acceptance tests and construction acceptance tests that demonstrate compliance with procurement and construction specifications. Satisfactory completion of these tests is required to allow transition into startup testing activities, which are preoperational and operational testing.

The A-E will prepare test requirements and acceptance criteria for factory acceptance tests and construction acceptance tests for inclusion in procurement and construction specifications. Detailed test plans and/or acceptance test procedures may be prepared by the A-E, construction contractor, vendors, or subcontractors in accordance with requirements of procurement and construction specifications and vendor data. These detailed test plans and/or acceptance test procedures will be reviewed and approved by the A-E and PHMC. The factory acceptance tests and construction acceptance tests will be performed by the responsible organization (i.e., the construction contractor, vendor, or subcontractor). The tests will be witnessed by DOE WDD and the PHMC as required to ensure that test requirements are met. The test data will be included in the structures, systems, and components (SSC) turnover package.

The construction acceptance tests culminate with turnover of individual SSC segments to PHMC for preoperational testing. The scope of each SSC segment and its turnover sequence will be determined by the PHMC. All test data and reports will be transferred to the PHMC along with the SSC segment. The construction contractor is responsible for controlling the vendor and construction test data until that time. Information copies of the vendor data will be provided to the PHMC as requested to support preoperational testing.

Although Startup is not responsible for acceptance testing, it may take administrative control of equipment and portions of systems before completion of acceptance testing to begin preoperational testing to meet Subproject milestones. Maintaining custody control while allowing

both acceptance testing and preoperational testing to proceed simultaneously is done by the use of a "blue tag" system, which passes jurisdictional control of the SSC, or a portion of the SSC, to Startup.

Preoperational Testing. Preoperational testing is performed on individual segments of the SSC to demonstrate that plant systems or subsystems perform as designed. The A-E will prepare test specifications for preoperational tests. The test specifications will contain test requirements and acceptance criteria. The Subproject Startup organization will use these specifications to prepare test procedures that provide instructions for conducting the tests. The procedures will be reviewed and approved by the Subproject Test Review Board before testing. The Startup administrative procedures manual, which will provide the requirements and guidance for preoperational testing activities, will be prepared by the Subproject Startup organization and approved by the Test Review Board.

Operational Testing. Operational testing is performed to demonstrate integration of the entire facility. Systems are brought on line and operated under anticipated standard operating conditions and off-normal conditions using simulated, non-radioactive HLW canisters. Operational testing is performed using the actual plant equipment, operating procedures, and personnel. To ensure correct performance of the operational testing, all testing activities will be performed in accordance with the requirements of detailed test procedures. These procedures will be prepared by the Subproject Startup organization and approved by the Subproject Test Review Board. Operational testing will be planned and scheduled to follow completion of preoperational testing.

Dry-Run Demonstrations. A dry-run phase will follow completion of CSB preoperational testing to demonstrate that operators, procedures, and CSB equipment are in a final satisfactory state of readiness to safely and efficiently receive, handle, and store hot HLW canisters. The dry runs will be performed as part of the readiness review process and culminate with receipt of Key Decision 4 from DOE to commence receipt of hot HLW canisters.

15.0 REFERENCES

10 CFR 830.120, "Quality Assurance Requirements," *Code of Federal Regulations*, as amended.

Ashley, D. J., 1997, Subcontract Number 80232764-9-K001; *Tank Waste Remediation System High-Level Waste Canister*, Correspondence Number FDH-9758282A, memo to L. E. Hall, Lockheed Martin Hanford Company, dated September 15, 1997, Fluor Daniel Hanford Company, Richland, Washington.

Calmus, R. B., 1996a, *Design Requirements Document for Interim Storage Phase I Solidification of High-Level Waste*, WHC-SD-WM-DRD-012, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Calmus, R. B., 1996b, *HLW Interim Storage Architecture Selection - Decision Report*, WHC-SD-WM-TA-183, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Claghorn, R. D., 1997, *Decision Document for the Final Disposition of Cesium and Strontium Capsules*, HNF-SD-WM-RPT-294, Revision 0, Numatec Hanford Corporation, Richland, Washington.

Davis, J. S., 1997, *Authorization Basis Amendment Process*, HNF-IP-0842, Volume IV, Lockheed Martin Hanford Company, Richland, Washington.

Deffenbaugh, M. L., 1996, *Checklist for the High-Level Waste Storage Project Canister Storage Building*, letter from TWRS Environmental Compliance to HLW IS Subproject, Correspondence No. 70100-96-004, dated November 4, 1996, Lockheed Martin Hanford Company, Richland, Washington.

Deffenbaugh, M. L., 1997, *Permitting Plan for the High-Level Waste Interim Storage Project*, HNF-SD-ENV-EE-002, Rev.0, Lockheed Martin Hanford Company, Richland Washington.

DOE, 1987, *Safety Analysis and Review Systems*, DOE Order 5481.1B, U.S. Department of Energy, Washington, D.C.

DOE, 1988, *General Environmental Protection Program*, DOE Order 5400.1, U.S. Department of Energy, Washington, D.C.

DOE, 1989, *General Design Criteria*, DOE Order 6430.1A, U.S. Department of Energy, Washington, D.C.

DOE, 1991, *DOE Nuclear Safety Policy*, SEN-35-91, U.S. Department of Energy, Washington, D.C.

DOE, 1992a, *Project Management System*, DOE Order 4700.1, U.S. Department of Energy, Washington, D.C.

DOE, 1992b, *U.S. Department of Energy Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program*, DOE-RW-0333P, Rev. 7, U.S. Department of Energy, Washington, D.C.

DOE, 1992c, *Unreviewed Safety Questions*, DOE 5480.21, U.S. Department of Energy, Washington, D.C.

DOE, 1992d, *Technical Safety Requirements*, DOE 5480.22, U.S. Department of Energy, Washington, D.C.

DOE, 1992e, *Nuclear Safety Analysis Reports*, DOE 5480.23, U.S. Department of Energy, Washington, D.C.

DOE, 1992f, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23*, DOE-STD-1027-92, U.S. Department of Energy, Washington, D.C.

DOE, 1992, *Technical Safety Requirements*, DOE Order 5480.22, U.S. Department of Energy, Washington, D.C.

DOE, 1992, *Nuclear Safety Analysis Reports*, DOE Order 5480.23, U.S. Department of Energy, Washington, D.C.

DOE, 1993, *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy, Washington, D.C.

DOE, 1993, *Startup and Restart of Nuclear Facilities Operational Readiness Review and Readiness Assessments*, U.S. Department of Energy, Washington, D.C.

DOE, 1994, *Hazard Baseline Documentation*, DOE-EM-STD-5502-94, U.S. Department of Energy, Washington, D.C.

DOE, 1994, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, DOE-STD-3009-94, U.S. Department of Energy, Washington, D.C.

DOE, 1994, *Guidance for Preparation of Nuclear Facility Safety Analysis Reports, Technical Safety Requirements and SAR Implementation Plans*, DOE-STD-3011-94, U.S. Department of Energy, Washington, D.C.

DOE, 1995, *K Basins Spent Nuclear Fuel Project - Regulatory Policy*, May, 1995 (draft), U.S. Department of Energy, Washington, D.C.

DOE-RW, 1996, *Waste Acceptance System Requirements Document (WASRD)*, WASRD.DOE/RW-0351P, Rev. 2, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D.C.

Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Richland Operations Office, Olympia, Washington.

FDH, 1997a, *Project Management System*, HNF-PRO-563, Fluor Daniel Hanford, Inc, Richland, Washington, Internet address: http://docs.rl.gov/phpp/pro-563.htm.

FDH, 1997b, *PHMC Contract DE-AC06-96RL3200 Configuration Management Plan*, HNF-MP-013, Rev. 0, Fluor Daniel Hanford, Inc., Richland, Washington, Internet address: http://docs.rl.gov/phpp/index/mp-013r0.htm.

FDH, 1997c, *Baseline Change Control*, HNF-MD-008, Fluor Daniel Hanford, Inc., Richland, Washington, Internet address: http://docs.rl.gov/phpp/MP-008r0.htm.

FDH, 1997d, *Site Technical Baseline Change Control*, HNF-MD-029, Fluor Daniel Hanford, Inc., Richland, Washington, Internet address: http://docs.rl.gov/phpp/md-029r0.htm.

FDH, 1997e, *Quality Assurance Program Description*, HNF-MP-599, Fluor Daniel Hanford, Inc., Richland, Washington, Internet address: http://docs.rl.gov/phpp/mp-599r0.htm.

FDH, 1997f, *Safety Analysis Program*, HNF-PRO-430, Fluor Daniel Hanford, Inc., Richland, Washington, Internet address: http://docs.rl.gov/phpp/pro-430r0.htm.

FDH, 1997g, *Safety Planning, Documentation, Review and Approval*, HNF-PRO-705, Rev.0, Fluor Daniel Hanford, Inc., Richland, Washington, Internet address: http://docs.rl.gov/phpp/pro-705r0.htm.

Federal Clean Air Act of 1970, 42 USC 7401 et. seq., as amended.

Grier, G. W., S. A. Byers, L. Bibb, 1997, *Quality Assurance Program Description*, HNF-MP-599, Fluor Daniel Hanford Company, Richland, Washington.

Hansen, C. A., 1996, *Memorandum of Agreement (MOA) - Utilization of Canister Storage Building (CSB) Vaults 2 and 3 for Immobilized High-Level Waste*, SFD: KMS/96-SFD-104, DOE, memorandum to Jackson Kinzer, Assistant Manager, Office of Tank Waste Remediation System dated April 18, 1996, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Jacobs, E. R., 1996a, *Canister Storage Building (CSB) High-Level Waste (HLW) Implementation Study*, letter to J. J. Jones, Westinghouse Hanford Company, WHC P.O. TAA-SBW-400584, Fluor Daniel Contract 80455300, Correspondence No. FRF-034, dated May 13, 1996, Fluor Daniel, Inc. Irvine, California.

Jacobs, E. R., 1996b, *Final CSB High-Level Waste Supplemental Report*, letter to J. J. Jones, Westinghouse Hanford Company, WHC purchase order TAA-SBW-400584, Fluor Daniel Contract 80455300, Correspondence No. FRF049 dated September 19, 1996, Fluor Daniel, Inc., Irvine, California.

Knutson, B., 1995, *Tank Waste Remediation System Mission Analysis*, WHC-SD-WM-MAR-008, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Kupfer, M. J., A. L. Boldt, B. A. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, R. A. Watrous, M. D. LeClair, G. L. Borsheim, R. T. Winward, R. M. Orme, N. G. Colton, S. L. Lambert, D. E. Place, and W. W. Schulz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1996, Tank Waste Remediation System Function and Requirements, WHC-SD-WM-FRD-020, Rev. 0, Lockheed Martin Hanford Corp., Richland, Washington.

LMHC, 1997a, Rev.0, *Tank Waste Remediation System Basis for Interim Operation*, HNF-SD-BIO-001, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1997b, *TWRS Environmental Program Plan for M&I Contractor Work Scope in Support of TWRS Phase 1B Privatization*, HNF-1773, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

LMHC, 1997c, *Tank Waste Remediation System Fiscal Year 1998 Work Plan-WBS 1.1*, HNF-SP-1230, Rev. 0, Lockheed Martin Hanford Corp., Richland, Washington

Murkowski, R. J., 1995, *Storage and Disposal Project Risk Management Plan*, Correspondence No. 73300-95-011, Letter 47 to J. D. Thompson, U.S. Department of Energy, dated December 29, 1995, Westinghouse Hanford Company, Richland, Washington.

National Environmental Policy Act of 1969, 42 USC 4321, et seq.

Numatec, 1997, *Decision Document for the Final Disposition of Cesium and Strontium Capsules*, HNF-SD-WM-RPT-294, Rev. 0, Numatec Hanford Corporation, Richland,. Washington.

Peck, L. G., 1996, *Tank Waste Remediation System Systems Engineering Management Plan*, WHC-SD-WM-SEMP-002, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

RL, 1996a, TWRS Privatization Contract No. DE-RP06-96RL13308, contract with British Nuclear Fuels Ltd., U.S. Department of Energy, Richland Operations Office, Richland, Washington.

RL, 1996b, TWRS Privatization Contract No. DE-RP06-96RL13309, contract with Lockheed Martin Advanced Environmental Systems, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

"State Environmental Policy Act of 1971" (SEPA), Chapter 43.21C, *Revised Code of Washington*.

Taylor, W. J., 1997, *Contract Number DE-AC06-96-RL13200 - Decision Document for the Final Disposition of Cesium and Strontium Capsules , HNF-SD-WM-294, Rev. 0,* , Correspondence No. 97-WDD-058A, Letter to H. J. Hatch, Fluor Daniel Hanford Inc., dated April 1997, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WAC-173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

Wagoner, J. D., 1996, *TWRS Privatization Request for Proposals,* Solicitation Number DE-RPOG-96RL13308, (February 1996) U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WHC, 1995, *Tank Waste Remediation System Fiscal Year 1996 Multi-Year Work Plan - WBS 1.1*, WHC-SP-1101, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-2-14, *Hazardous Materials Packaging and Shipping*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-6-2, *Project Management,* Westinghouse Hanford Company, Richland, Washington.

WHC-CM-6-12, *Project Procedures,* Westinghouse Hanford Company, Richland, Washington.

WHC-CM-7-5, *Environmental Compliance,* Westinghouse Hanford Company, Richland, Washington.

Wodrich, D. D., W. T. Alumkal, H. Babad, G. L. Dunford, and J. O. Honeyman, 1995, *Tank Waste Remediation System: An Update*, WHC-SA-2623-FP, presented at Waste Management 1995, February 26-March 2, 1995, Tucson, Arizona.

This page intentionally left blank.

APPENDIX A

CROSS-CHECK MATRIX OF PLAN ELEMENTS

This page intentionally left blank.

APPENDIX A

CROSS-CHECK MATRIX OF PLAN ELEMENTS

In Section 11.5 of the *Hanford Federal Facility Agreement and Consent Order*[1] (Tri-Party Agreement) as modified on December 31, 1996, the Washington State Department of Ecology requested that certain elements be included in project management plans. Table A-1 is the road map showing where these elements are located in this document.

Table A-1. Cross-Check Road Map Between the Tri-Party Agreement and the Subproject.

Required Elements	Location in Document
1. Project Goals and Objectives	Sec. 2.0 Hanford Site Mission and Objectives Sec. 3.0 Mission and Objective of the IHLW Storage Subproject
2. Project background	Sec. 5.0 Program/Project Background
2.1 Waste stream physical information (inventories etc.)	Sec. 4.2 General Characteristics of Tank Waste and Vitrification Feeds to be Processed Sec 4.3 Projected Inventories for HLW Products (Phase I and II) App B Immobilized High-Level Waste Storage Subproject High-Level Waste Inventory and Composition Basis
2.2 Discussion of current commercial activities	Sec 5.1 Options for Government and Commercial Activities and Concept Selection and Implementation

[1]Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Table A-1. Cross-Check Road Map Between the Tri-Party Agreement and the Subproject.

Required Elements	Location in Document
2.3 Discussion of component and stream stability	Sec 4.2 General Characteristics of Tank Waste and Vitrification Feeds to be Processed Sec 4.3 Projected Inventories for HLW Products
2.4 Summary of earlier evaluation/ disposition options for each waste stream	Sec 5.1 Options for Government and Commercial Activities and Concept Selection and Implementation
2.5 Applicable regulatory requirements and impacts to project.	Sec 5.1 Options for Government and Commercial Activities and Concept Selection and Implementation Sec 13.0 Quality, Safety, and Environmental Protection
3. Project scope	Sec 4.0 Scope of IHLW Storage Subproject
3.1 Description of facilities	Sec 4.1 Facility Description Sec 5.0 Program/Project Background

Table A-1. Cross-Check Road Map Between the Tri-Party Agreement and the Subproject.

Required Elements	Location in Document
3.2 Description of planned approach	Sec 3.0 Mission and Objectives of the IHLW Storage Subproject Sec 4.0 Scope of IHLW Storage Subproject Sec 5.3 Additional CSB and Transportation System Features Sect 6.0 Line-Item Project Management Approach Sec 7.0 Project-Controlling Milestones and Critical Activities Schedule Sec 9.0 Programmatic Risk Assessment Sec 11.1.3 System Engineering Management Sec 12.0 Acquisition Strategy Sec 13.0 Quality, Safety, and Environmental Protection Sec 14.0 Test and Evaluation Plan
3.3 Top-level WBS with WBS dictionary	Sec 4.4 Top-Level Work Breakdown Structure Sec 11.1.1 Work Breakdown Structure App C TWRS WBS Dictionary Level 5
3.4 Projected TSD capability with performance requirements and projected capacity needs.	Sec 3.0 Mission and Objectives of IHLW Storage Subproject
4. Project constraints with Tri-Party Agreement milestones and externally established schedule requirements.	Sec 7.0 Project-Controlling Milestones and Critical Activities Schedule Sec 9.0 Programmatic Risk Assessment
5. Schedule and critical-path analysis	Sec 7.0 Project-Controlling Milestones and Critical Activities Schedule

Table A-1. Cross-Check Road Map Between the Tri-Party Agreement and the Subproject.

Required Elements	Location in Document
6. Key deliverables and products plus performance parameters.	Sec 7.0 Project-Controlling Milestones and Critical Activities Schedule Sec 11.0 Project Management and Control
7. Performance measurement: specific performance measures.	Sec 7.0 Project-Controlling Milestones and Critical Activities Schedule Sec 11.3 Performance Measurement and Reporting
8. Project control	Sec 11.0 Project Management and Control
8.1 Project interface control	Sec 11.10 External Interface Control
8.2 Reporting and notification Requirements.	Sec 11.3 Performance Measurement and Reporting
9. Change management: change control requirements	Sec 11.2 Baseline Management and Control

CSB = Container Storage Building
HLW = high-level waste
IHLW = immobilized high-level waste
Tri-Party Agreement = *Hanford Federal Facility Agreement and Consent Order*
TSD = treatment, storage, and disposal
TWRS = Tank Waste Remediation System
WBS = work breakdown structure

APPENDIX B

IMMOBILIZED HIGH-LEVEL WASTE STORAGE SUBPROJECT HIGH-LEVEL WASTE INVENTORY AND COMPOSITION BASIS

This page intentionally left blank.

APPENDIX B

IMMOBILIZED HIGH-LEVEL WASTE STORAGE SUBPROJECT HIGH-LEVEL WASTE INVENTORY AND COMPOSITION BASIS

Phase 1 - Immobilized High-Level Waste

The estimated chemical and radionuclide compositions, respectively, of the Phase 1 immobilized high-level waste (IHLW) (glass) are provided in the Phase 1 contract. These values are based on HLW feed composition estimates developed for the Phase 1 tank waste (Manuel 1996).

As specified in the Phase 1 contract, the minimum order quantity is 245 MT (metric tons) of non-volatile oxide (excluding silicon and sodium) minimum average non-volatile oxide loading in glass is 25%, glass density is 2.64 MT/m^3 and the 4.5 m canister glass-fill volume is 1.05 m^3 (at 87 percent full). Therefore, 353 are estimated to be produced during the 5-year minimum operating period. The maximum order quantity to be processed over 9 years (minimum operation plus optional extended operation) is 465 MT of waste oxide, corresponding to 670 canisters. A canister fill height of 87 percent or 1.05 m^3 glass is assumed for projecting inventories of 4.5 m-long canisters.

Phase 1—Separated Cesium

The composition for the separated cesium product to be received by the Phase 1 IHLW Storage Subproject (Subproject) will be provided by the private vendors during the Phase 1 conceptual design of the vitrification demonstration plants. Until the specific composition can be provided, the Subproject has assumed a composition and cesium content based on engineering judgement and contract limits imposed on the separated cesium container size [i.e., 1.37 m (4 ft 6 in.) long by 0.70 m (2 ft 4 in.) in diameter], waste type (i.e., producing no combustible gases), and waste form (i.e., free-flowing powder). This information will be updated as vendor information becomes available. The separated cesium product volume is assumed to be essentially a function of the ion-exchange process.

The amount of cesium product produced during Phase 1 is projected to be 153 containers with a heat load of 500 W per container.

Phase 1—Non-Routine High-Level Waste

Non-routine HLW currently is an undefined waste type. The Subproject planning basis assumes that the bulk of this waste will come from failed melter equipment. The amount of non-routine HLW was estimated based on life of potential Phase 1 melters and the glass residuals in selected melter types. The number of IHLW canisters [4.5 m (14 ft 10 in.) long by 0.61 m (2 ft) in diameter) filled with non-routine HLW is estimated at 32. The canisters filled with non-routine HLW are assumed to meet all external canister criteria imposed on IHLW canisters.

Phase 2—Immobilized High-Level Waste

The estimated chemical composition of Phase 2 IHLW (glass) is based on HLW feed composition estimates developed for an all-tank blend (Orme 1994). A canister approximately 4.5 m (14 ft 10 in.) long by 0.61 m (2 ft) in diameter is assumed. The number of long glass canisters generated by the Phase 2 vendors (less the canisters generated during Phase 1) is estimated to be between 7,592 and 21,726). The minimum canister count assumes a caustic wash pretreatment and a 45-percent-by-weight loading on nonvolatile feed oxides including silicon and sodium. (The maximum projected canister count assumes a water wash pretreatment and a 25 percent-by-weight loading on nonvolatile feed oxides including silicon and sodium). For planning purposes, a nominal canister count of 13,294 is assumed. Subtracting the Phase 1 canisters (670), 12,624 4.5-m canisters will be produce assuming 2,780 kg of glass per 4.5-m canister. This assumption was adopted based on direction from DOE's Office of Tank Waste Remediation System to the Hanford Site prime management contractor at the time (Westinghouse Hanford Company).

The DOE-directed canister count is close to the average canister count predicted for the all-blend tank composition.

Phase 2—Non-Routine High-Level Waste

The amount of non-routine HLW was estimated based on the life of potential Phase 2 melters, which is different from that selected for Phase 1 estimates, including glass residuals in failed melters, and melter materials impregnated with glass. The number of long IHLW canisters [4.5 m (14 ft 10 in.) long by 0.61 m (2 ft) in diameter] filled with the non-routine HLW produced by the Phase 2 HLW vendor is estimated at 26. The canisters filled with non-routine HLW are assumed to meet all external canister criteria imposed on IHLW canisters.

REFERENCES

DOE, 1996, *Office of Tank Waste Remediation System (TWRS) High-Level Waste (HLW) Canister Projection Assessment and Project Baseline Guidance*, 96-WDD-029, U.S. Department of Energy, Waste Disposal Division, Washington, D.C.

Manuel, A. F., J. D. Galbraith, S. L. Lambert, and G. E. Stegen, 1996, *Phase I High-Level Waste Pretreatment and Feed Staging Plan*, WHC-SD-WM-ES-370, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Orme, R. M., 1994, *TWRS Process Flowsheet*, WHC-SD-WM-TI-613, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

APPENDIX C

TANK WASTE REMEDIATION SYSTEM WORK BREAKDOWN STRUCTURE DICTIONARY LEVEL 5

This page intentionally left blank.

APPENDIX C

TANK WASTE REMEDIATION SYSTEM WORK BREAKDOWN STRUCTURE DICTIONARY LEVEL 5

C.1 Level 5, Storage and Disposal

Table C-1. Level 5, Storage and Disposal.

1. Program/Title Participant 1.1.1 Tank Waste Disposal System 1.1.1.3 Waste Disposal 1.1.1.3.4 Storage and Disposal		
2. WBS Element Code/Level 1.1.1.3.4.2/V	3. WBS Element Title Immobilized High-Level Waste Interim Storage Project	
4. Current Revision Number 1	5. Effective Revision Date October 1, 1997	6. Approved Changes

Element Description

1. Technical Bases

A. Goals and Objectives

Successfully identify requirements for immobilized high-level waste (IHLW) interim storage and onsite transport. Design and construct interim storage facilities to accept IHLW and other high-level waste (HLW) products for Phases I and II privatization. Successfully operate the HLW interim storage to accept the immobilized waste. Load HLW for transfer to ultimate disposal facilities and close interim storage facility building.

B. Major End-Item Deliverables

Completion of design requirements, design, and construction of facility by December 2001, operate the facility starting in June 2002, and ultimate offsite disposal of waste in 2034-2042. The interim storage facility will be phased to meet the requirements of privatization with Phase I starting in 2002 and Phase II available in 2013.

C. Statement of Work

1. Project Management and Administration

Project management and administration will perform those activities necessary to support the development of the IHLW Interim Storage Project including input to the multi-year program plan (MYPP), status reports, scheduling, financial analysis, change management, project breakdown structure (PBS) preparation, project management, and site integration.

2. Systems Definition

During fiscal year (FY) 1996, systems definition studies were performed to determine if existing facilities or new facilities would be utilized for HLW interim storage. The systems definition work determined using the spent nuclear fuels (SNF) canister storage building (CSB) for Phase I privatization and new facilities for Phase II.

Near-term systems definition work (FY 1997) completed studies identified in FY 1996 to support the design requirements document (DRD) and conceptual design.

Product acceptance strategy for the HLW products will be developed to ensure that the HLW product meets repository requirements and can be safely stored. In addition, requirements for documentation of storage of HLW product will be developed to ensure that proper documentation can be provided to the repository.

3. Project W-464

A statement of work (SOW) was developed based on the DRD for the HLW interim storage utilizing the CSB for Phase I. The facility conceptual design will be developed followed by detail design. The facility will be constructed based on the approved project design. Concurrent with the facility design, safety and permitting documentation will be developed to allow for operation of the HLW interim facility. For Phase I privatization, the two available vaults of the SNF CSB will be outfitted to receive HLW product.

4. HLW Operations

HLW interim storage facility operations will include support in the early phases for facility definition and engineering. During construction, preparation of required documentation, personnel training, and qualification will occur. After construction, cold and hot testing and an operational readiness review (ORR) will be performed. These will be followed by the actual hot operations of the facility to continue until all IHLW products are shipped to the repository.

5. Future Projects

Facilities for the storage of IHLW produced during Phase II privatization will be designed, constructed, and turned over for operations. Design activities for the Phase II storage facility are scheduled to commence in FY 2006. The program plan is based on a series of storage vault modules that can be added as needed.

6. Facility Decontamination and Decommissioning

The facilities will be decontaminated and decommissioned following final shipments of waste. At this time, it is assumed that minimal contamination will occur and the facility will not have future uses after its mission.

This page intentionally left blank.

APPENDIX D

DIVISION OF RESPONSIBILITY MATRIX—IMMOBILIZED HIGH-LEVEL WASTE STORAGE SUBPROJECT.

This page intentionally left blank.

APPENDIX D

DIVISION OF RESPONSIBILITY MATRIX—IMMOBILIZED HIGH-LEVEL WASTE STORAGE SUBPROJECT

Table D-1. Division of Responsibility Matrix - IHLW Storage Subproject.

Activity / Organization	HLW IS Project Office (DOE WDD)	PHMC HLW IS Project	Phase I IHLW Storage Subproject (PHMC/ subcontractors)	Design Agent
Preconceptual Phase Activities				
Program functions and requirements (DOE approval)	A	PI/C	R	R
Design authority during Subproject definition		P		
Engineering trade studies (Subproject definition)	I	A	R	P
Integrated flowsheet	I	P/A	R	
Subproject design requirements document (DOE approval)	A	P/C	C	R
Justification of mission need	A	P/A	PI	
Multi-year program plan	A	P/A	PI	
Conceptual Phase Activities				
Subproject-specific budget documentation	I	I	P/A	PI
Status reporting	I		P(1)	PI
Define program and Subproject changes	A	P/A	PI/C(4), A(1)	PI
Subproject budget validation	A	R	P	PI
Subproject Level 1 schedule	R	R	P/A	PI
Design authority during Subproject (after CD 1)		PI	P	PI
Design statement of work and letter of instruction	I	PI/R	P/A	R
Design agent during Subproject				P
Conceptual design	A	R	PI	P
Subproject-specific technology development needs and dates	C	P/A	PI/A(1)	PI

Table D-1. Division of Responsibility Matrix - IHLW Storage Subproject.

Activity / Organization	HLW IS Project Office (DOE WDD)	PHMC HLW IS Project	Phase I IHLW Storage Subproject (PHMC/ subcontractors)	Design Agent
Subproject-specific engineering development needs and dates	I	PI	P/A[1]	PI
Subproject supplemental design requirements, design specification	I	PI/R	P/A	PI
Total project cost estimate details	I		P/A	PI
Project management plan (PHMC)	A	R	P/A	PI
Execution Phase Activities				
Definitive design	R		A	P
Design reviews (design agent)	R	(6)(2)	A	P
Construction (contracted constructor)			P/A	PI
Operating and maintenance procedures	R	PI	PI, P/A[3]	PI
Technical safety requirements	R	PI/R	P	
Acceptance Phase Activities				
System startup testing (cold)	R	PI	P/A[5][3]	
Operational testing	R	PI	P/A[5][3]	PI
Readiness review for hot operations	P/A	PI	PI	PI

Key:
- A - Responsibility and authority to commit contractor (or the government for DOE "A")
- C - Concur with adequacy; documents cannot be issued or actions taken without concurrence (formal resolution of comments required)
- R - Review to assure vested interest is addressed (formal resolution of comments is not required)
- P - Responsibility to prepare product or perform action
- PI - Provide specific (or specialized) support to preparer (may include majority of preparation activities)
- I - Receive for information or implementation

Notes:
[1]For Subproject-specific activities only.
[2]Perform reviews of selected design items in Title II; drawing-by-drawing reviews are not intended.
[3]Could be scope of turnkey contractor, if contracted in that manner.
[4]For assigned responsibilities/milestones.
[5]Startup testing will be performed using personnel who are assumed to transition to plant operations.
[6]Process engineers and operations personnel are assumed to be members of the project team. Specific responsibilities will be detailed in project documents.

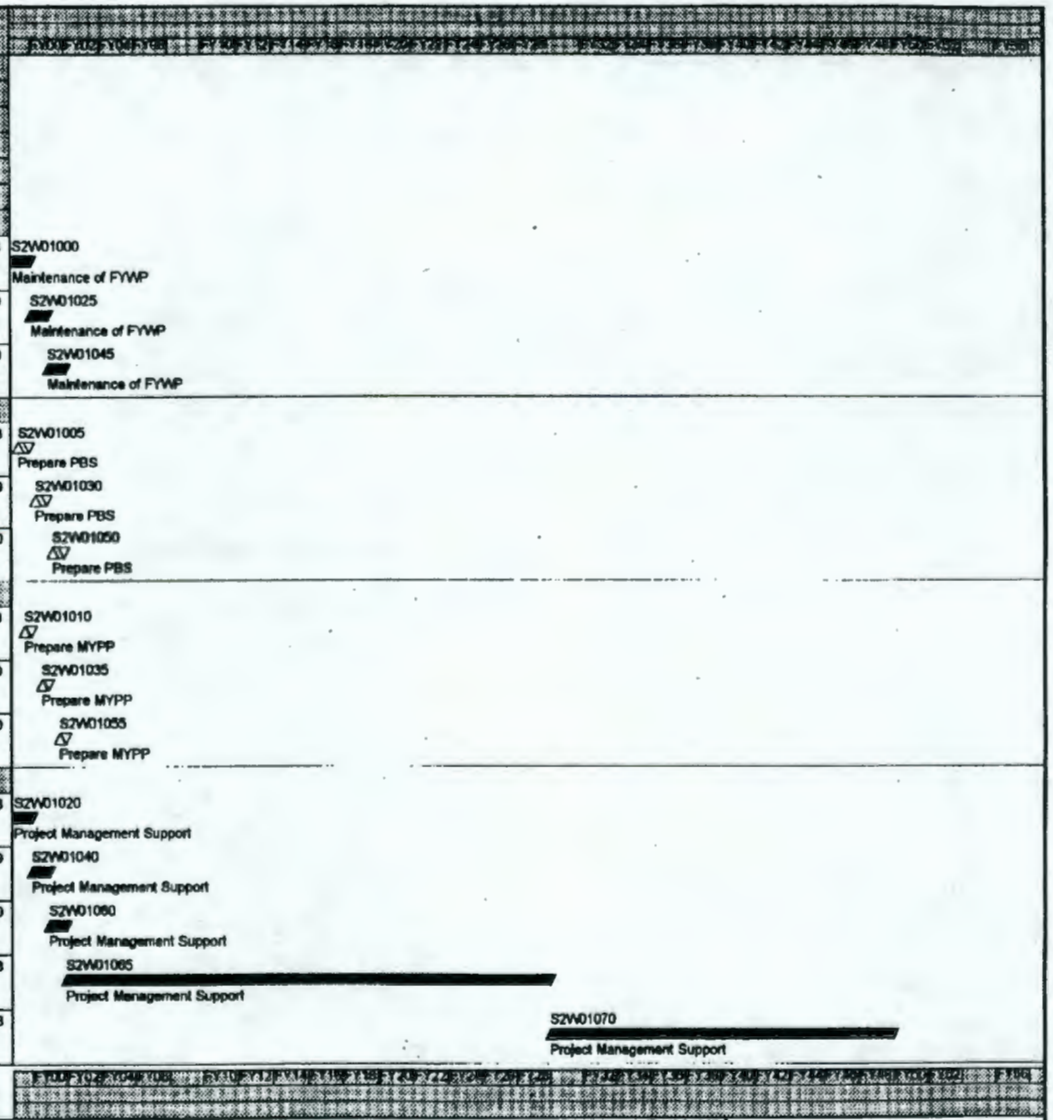
CD critical decision
DOE U.S. Department of Energy
HLW high-level waste
IHLW immobilized high-level waste
IS interim storage
PHMC Project Hanford Management Contractor

APPENDIX E

IMMOBILIZED HIGH-LEVEL WASTE STORAGE SUBPROJECT SCHEDULE

This page intentionally left blank.

Activity ID	Activity Description	Early Start	Early Finish
1 Hanford			
1.1 Tank Waste Remediation System			
1.1.3 Waste Disposal			
1.1.3.4 Immobilized Tank Waste Storage and Disposal (RL-TW09)			
1.1.3.4.02 IHLW Storage			
1.1.3.4.02.01 Project Management/Administration			
1.1.3.4.02.01.01 FYWP Maintenance			
S2W01000	Maintenance of FYWP	01OCT97	30SEP98
S2W01025	Maintenance of FYWP	01OCT98	30SEP99
S2W01045	Maintenance of FYWP	01OCT99	29SEP00
1.1.3.4.02.01.02 Prepare PBS			
S2W01005	Prepare PBS	02JAN98	31AUG98
S2W01030	Prepare PBS	04JAN99	31AUG99
S2W01050	Prepare PBS	04JAN00	31AUG00
1.1.3.4.02.01.03 Prepare MYPP			
S2W01010	Prepare MYPP	01JUN98	24SEP98
S2W01035	Prepare MYPP	01JUN99	24SEP99
S2W01055	Prepare MYPP	01JUN00	26SEP00
1.1.3.4.02.01.04 Project Management Support			
S2W01020	Project Management Support	01OCT97	30SEP98
S2W01040	Project Management Support	01OCT98	30SEP99
S2W01060	Project Management Support	01OCT99	29SEP00
S2W01065	Project Management Support	02OCT00	29SEP28
S2W01070	Project Management Support	02OCT28	30SEP48



Project Start	01OCT97
Project Finish	30SEP48
Data Date	01OCT97
Run Date	08DEC97

Early Bar
Progress Bar
Critical Activity

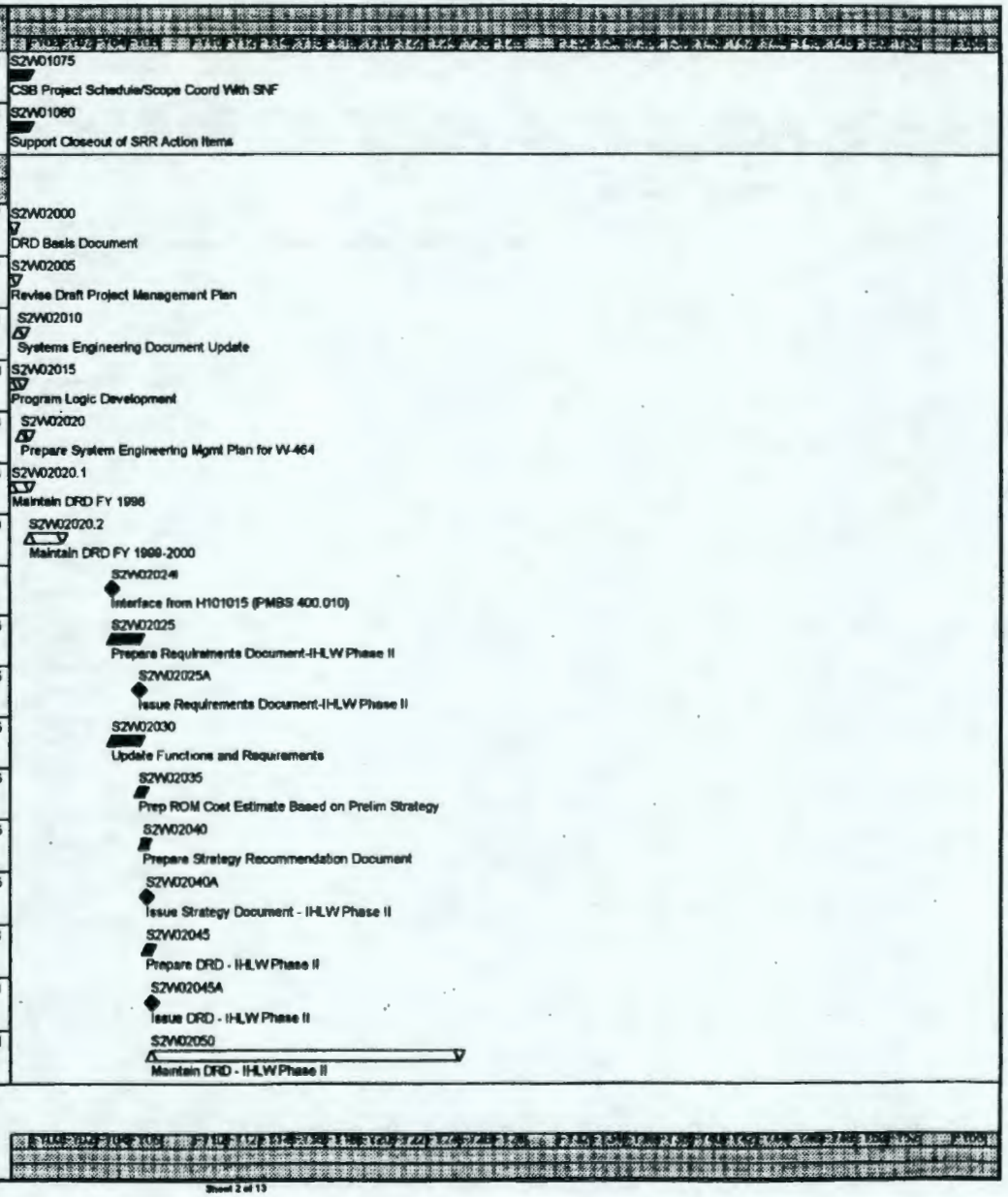
© Primavera Systems, Inc

TW91

Sheet 1 of 13

Lockheed Martin Hanford Corporation
Immobilized Waste
TW91 (10/97)

Activity ID	Activity Description	Early Start	Early Finish
S2W01075	CSB Project Schedule/Scope Coord With SNF	01OCT97	30SEP98
S2W01080	Support Closeout of SRR Action Items	01OCT97	30SEP98
1.1.3.4.02.02 Systems Definition			
1.1.3.4.02.02.01 System4 Documentation			
S2W02000	DRD Basis Document	01OCT97	26NOV97
S2W02005	Revise Draft Project Management Plan	01OCT97	31DEC97
S2W02010	Systems Engineering Document Update	02FEB98	30JUN98
S2W02015	Program Logic Development	01OCT97	29MAY98
S2W02020	Prepare System Engineering Mgmt Plan for W-464	01MAY98	30SEP98
S2W02020.1	Maintain DRD FY 1998	01OCT97	30SEP98
S2W02020.2	Maintain DRD FY 1999-2000	01OCT98	29SEP00
S2W02024I	Interface from H101015 (PMBS 400.010)	01OCT03*	
S2W02025	Prepare Requirements Document-IHLW Phase II	01OCT03	31MAY05
S2W02025A	Issue Requirements Document-IHLW Phase II		31MAY05
S2W02030	Update Functions and Requirements	01OCT03	31MAY05
S2W02035	Prep ROM Cost Estimate Based on Prelim Strategy	01JUN05	31AUG05
S2W02040	Prepare Strategy Recommendation Document	01SEP05	30NOV05
S2W02040A	Issue Strategy Document - IHLW Phase II		30NOV05
S2W02045	Prepare DRD - IHLW Phase II	01DEC05	28FEB06
S2W02045A	Issue DRD - IHLW Phase II		28FEB06
S2W02050	Maintain DRD - IHLW Phase II	01MAR06	30SEP24

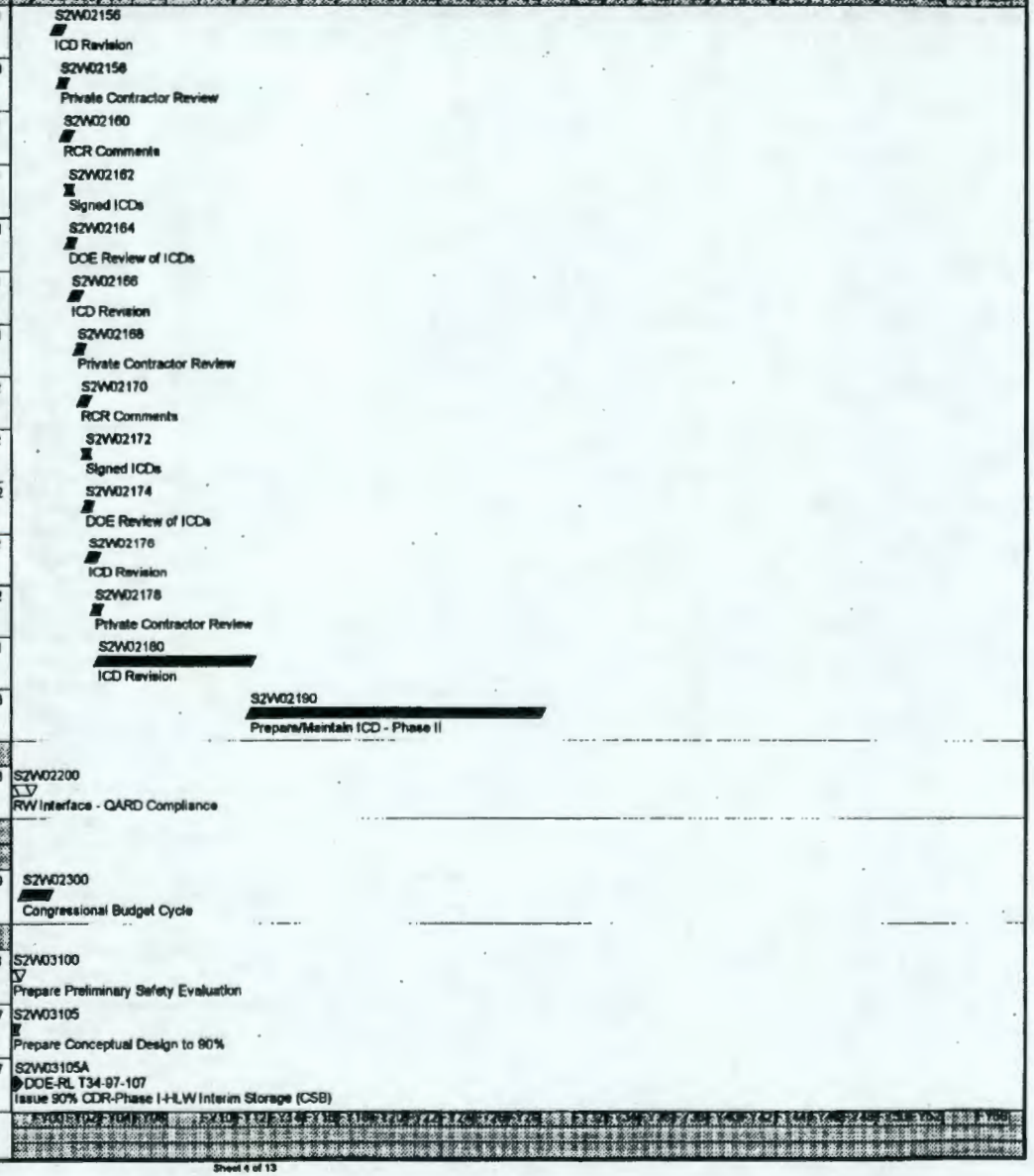


Sheet 2 of 13

Activity ID	Activity Description	Early Start	Early Finish
1.1.3.4.02.02.02	ICD Studies and Issue Resolution		
S2W02099I	Interface from C10150 (PMBS 340.030)	01OCT97*	
S2W02100	Private Contractor Information Impact Study	01OCT97	16MAR98
S2W02105	Shipping Container Smearable Compliance	17MAR98	29MAY98
S2W02110	Vitrified Cs, Heat Load/Shielding Analysis	01JUN98	30SEP98
S2W02115	HLW Products Canister Receipt	02JAN98	29MAY98
S2W02120	Decon of Casks/Transporters/MHM	01JUN98	17JUL98
S2W02125	Transportation Procedures/Safety/Compliance	01JUN98	31AUG98
S2W02130	RCR Comments	01OCT97	16JAN98
S2W02132	Signed ICDs	19JAN98	23JAN98
S2W02134	DOE Review of ICDs	26JAN98	31MAR98
S2W02136	ICD Revision	01APR98	31JUL98
S2W02138	Private Contractor Review	03AUG98	30SEP98
S2W02140	RCR Comments	01OCT98	18JAN99
S2W02142	Signed ICDs	19JAN99	25JAN99
S2W02144	DOE Review of ICDs	26JAN99	31MAR99
S2W02146	ICD Revision	01APR99	30JUL99
S2W02148	Private Contractor Review	02AUG99	30SEP99
S2W02150	RCR Comments	01OCT99	18JAN00
S2W02152	Signed ICDs	19JAN00	25JAN00
S2W02154	DOE Review of ICDs	26JAN00	31MAR00

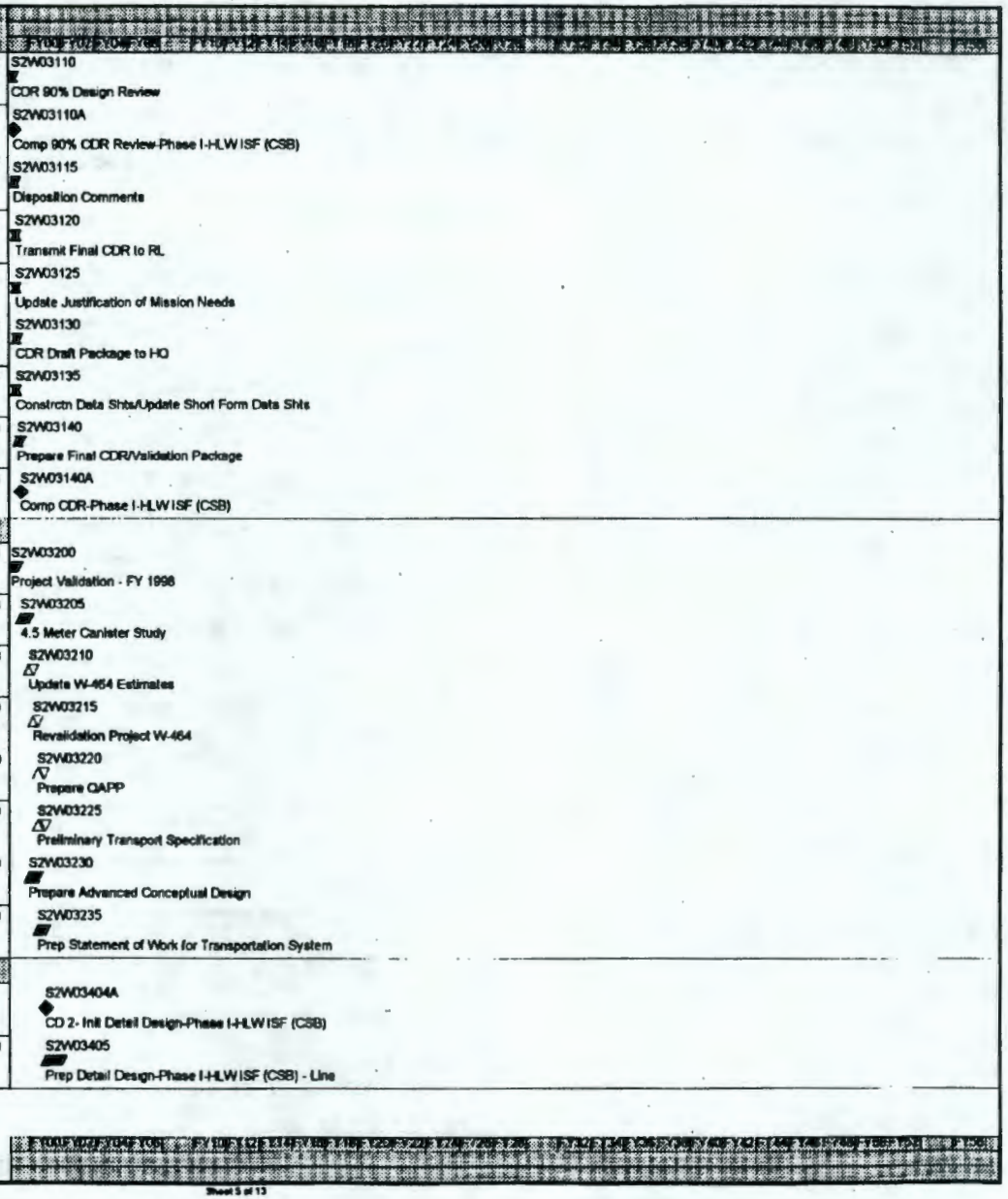
Sheet 3 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W02156	ICD Revision	03APR00	31JUL00
S2W02158	Private Contractor Review	01AUG00	29SEP00
S2W02160	RCR Comments	02OCT00	17JAN01
S2W02162	Signed ICDs	18JAN01	24JAN01
S2W02164	DOE Review of ICDs	25JAN01	30MAR01
S2W02166	ICD Revision	02APR01	31JUL01
S2W02168	Private Contractor Review	01AUG01	28SEP01
S2W02170	RCR Comments	01OCT01	16JAN02
S2W02172	Signed ICDs	17JAN02	23JAN02
S2W02174	DOE Review of ICDs	24JAN02	29MAR02
S2W02176	ICD Revision	01APR02	31JUL02
S2W02178	Private Contractor Review	01AUG02	30SEP02
S2W02180	ICD Revision	01OCT02	30SEP11
S2W02190	Prepare/Maintain ICD - Phase II	03OCT11	29SEP28
1.1.3.4.02.02.03 RW/QARD Compliance			
S2W02200	RW Interface - QARD Compliance	01OCT97	30SEP98
1.1.3.4.02.03 IHLW (Project W-464)			
1.1.3.4.02.03.01 W-464 Project Management			
S2W02300	Congressional Budget Cycle	01MAY98	30SEP99
1.1.3.4.02.03.02 W-464 Conceptual Design			
S2W03100	Prepare Preliminary Safety Evaluation	01OCT97	30JAN98
S2W03105	Prepare Conceptual Design to 90%	01OCT97	11NOV97
S2W03105A	Issue 90% CDR-Phase I-HLW Interim Storage (CSB)		11NOV97



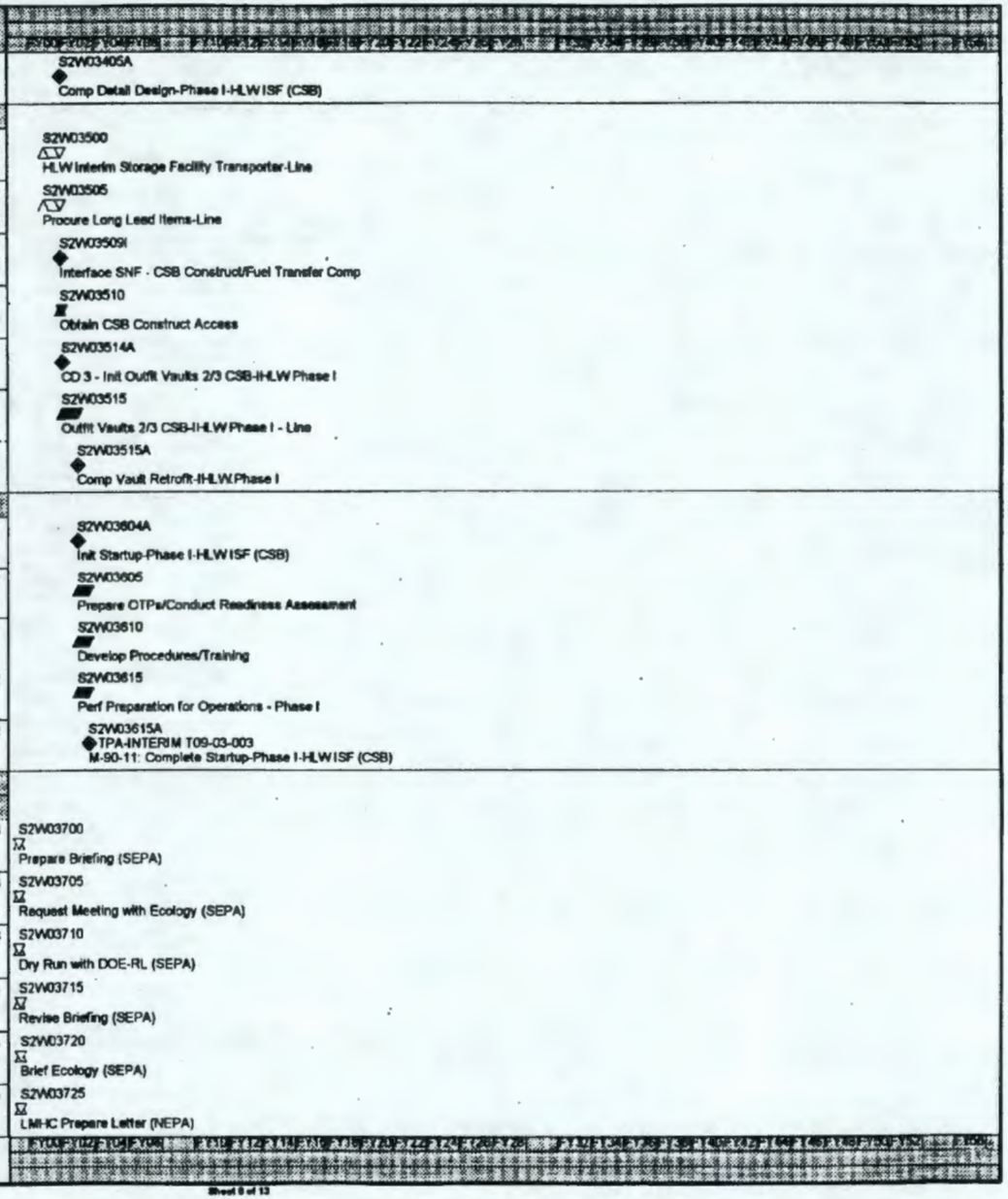
Sheet 4 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03110	CDR 90% Design Review	12NOV97	11DEC97
S2W03110A	Comp 90% CDR Review-Phase I-HLW ISF (CSB)		11DEC97
S2W03115	Disposition Comments	12DEC97	29DEC97
S2W03120	Transmit Final CDR to RL	30DEC97	09JAN98
S2W03125	Update Justification of Mission Needs	30DEC97	09JAN98
S2W03130	CDR Draft Package to HQ	12JAN98	13FEB98
S2W03135	Constrctn Data Shts/Update Short Form Data Shts	30DEC97	09JAN98
S2W03140	Prepare Final CDR/Validation Package	17FEB98	30APR98
S2W03140A	Comp CDR-Phase I-HLW ISF (CSB)		30APR98
1.1.3.4.02.03.03 W-464 Advanced Conceptual Design			
S2W03200	Project Validation - FY 1998	01OCT97	13FEB98
S2W03205	4.5 Meter Canister Study	01MAY98	30SEP98
S2W03210	Update W-464 Estimates	01OCT98	31DEC98
S2W03215	Revalidation Project W-464	04JAN99	30APR99
S2W03220	Prepare QAPP	03MAY99	31AUG99
S2W03225	Preliminary Transport Specification	03MAY99	30SEP99
S2W03230	Prepare Advanced Conceptual Design	01OCT98	30APR99
S2W03235	Prep Statement of Work for Transportation System	03MAY99	30SEP99
1.1.3.4.02.03.04 W-464 Detailed Design (Title II)			
S2W03404A	CD 2- Init Detail Design-Phase I-HLW ISF (CSB)	01OCT99	
S2W03405	Prep Detail Design-Phase I-HLW ISF (CSB) - Line	01OCT99	29SEP00



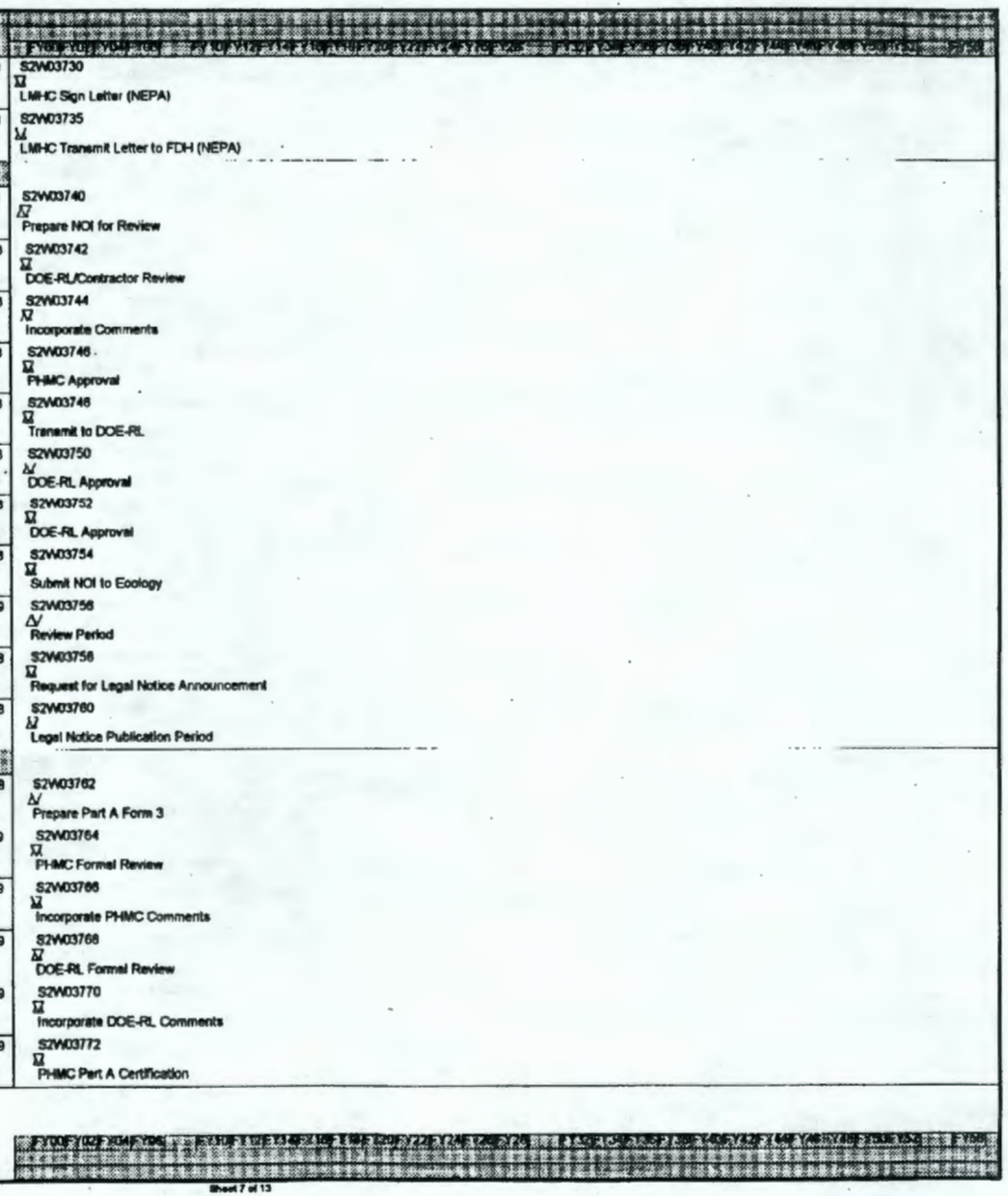
Sheet 5 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03405A	Comp Detail Design-Phase I-HLW ISF (CSB)		29SEP00
1.1.3.4.02.03.06 W-464 Building Modifications/Transport Systems			
S2W03500	HLW Interim Storage Facility Transporter-Line	01OCT99	29SEP00
S2W03505	Procure Long Lead Items-Line	01OCT99	29SEP00
S2W03509I	Interface SNF - CSB Construct/Fuel Transfer Comp	02OCT00	
S2W03510	Obtain CSB Construct Access	02OCT00	31OCT00
S2W03514A	CD 3 - Init Outfit Vaults 2/3 CSB-I-HLW Phase I	01NOV00	
S2W03515	Outfit Vaults 2/3 CSB-I-HLW Phase I - Line	01NOV00	28SEP01
S2W03515A	Comp Vault Retrofit-I-HLW Phase I		28SEP01
1.1.3.4.02.03.07 W-464 Startup			
S2W03604A	Init Startup-Phase I-HLW ISF (CSB)	01OCT01	
S2W03605	Prepare OTPs/Conduct Readiness Assessment	01OCT01	31MAY02
S2W03610	Develop Procedures/Training	01OCT01	31MAY02
S2W03615	Perf Preparation for Operations - Phase I	01OCT01	31MAY02
S2W03615A	M-90-11: Complete Startup-Phase I-HLW ISF (CSB)		31MAY02
1.1.3.4.02.03.08 W-464 Permitting			
1.1.3.4.02.03.08.01 CSB SEPA/NEPA			
S2W03700	Prepare Briefing (SEPA)	17MAR98	30MAR98
S2W03705	Request Meeting with Ecology (SEPA)	17MAR98	30MAR98
S2W03710	Dry Run with DOE-RL (SEPA)	31MAR98	31MAR98
S2W03715	Revise Briefing (SEPA)	01APR98	06APR98
S2W03720	Brief Ecology (SEPA)	07APR98	08APR98
S2W03725	LMHC Prepare Letter (NEPA)	14APR98	16APR98



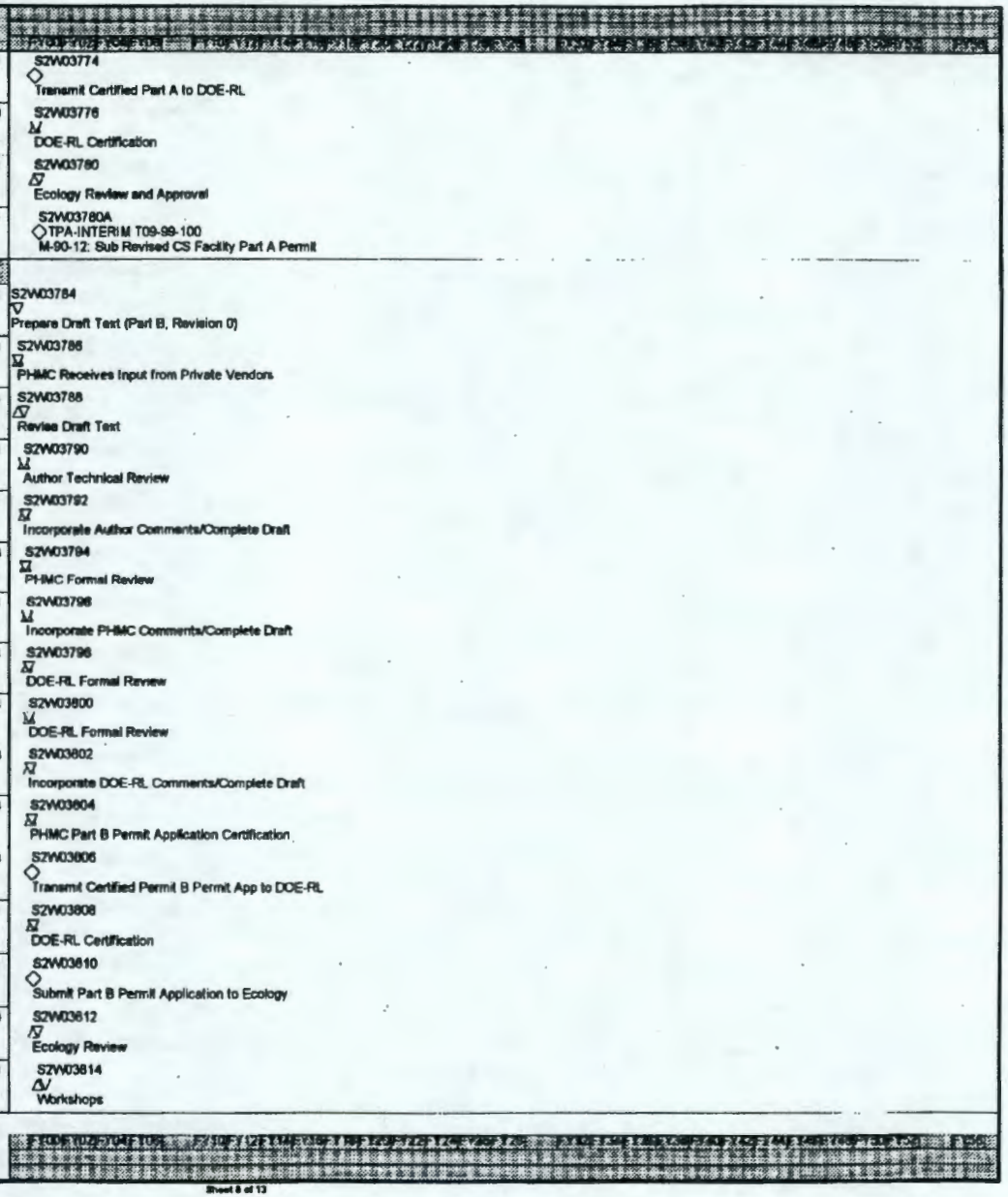
Sheet 8 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03730	LMHC Sign Letter (NEPA)	17APR98	17APR98
S2W03735	LMHC Transmit Letter to FDH (NEPA)	20APR98	20APR98
1.1.3.4.02.03.06.02 CSB Notice of Intent (NOI)			
S2W03740	Prepare NOI for Review	02JUN98	16JUL98
S2W03742	DOE-RL/Contractor Review	17JUL98	05AUG98
S2W03744	Incorporate Comments	07AUG98	27AUG98
S2W03746	PHMC Approval	28AUG98	10SEP98
S2W03748	Transmit to DOE-RL	11SEP98	11SEP98
S2W03750	DOE-RL Approval	14SEP98	30SEP98
S2W03752	DOE-RL Approval	01OCT98	02OCT98
S2W03754	Submit NOI to Ecology	05OCT98	05OCT98
S2W03756	Review Period	06OCT98	02MAR99
S2W03758	Request for Legal Notice Announcement	06OCT98	06OCT98
S2W03760	Legal Notice Publication Period	07OCT98	22OCT98
1.1.3.4.02.03.06.03 Part A Permit Application			
S2W03762	Prepare Part A Form 3	11NOV98	28DEC98
S2W03764	PHMC Formal Review	29DEC98	08JAN99
S2W03766	Incorporate PHMC Comments	11JAN99	18JAN99
S2W03768	DOE-RL Formal Review	20JAN99	02FEB99
S2W03770	Incorporate DOE-RL Comments	03FEB99	10FEB99
S2W03772	PHMC Part A Certification	11FEB99	24FEB99



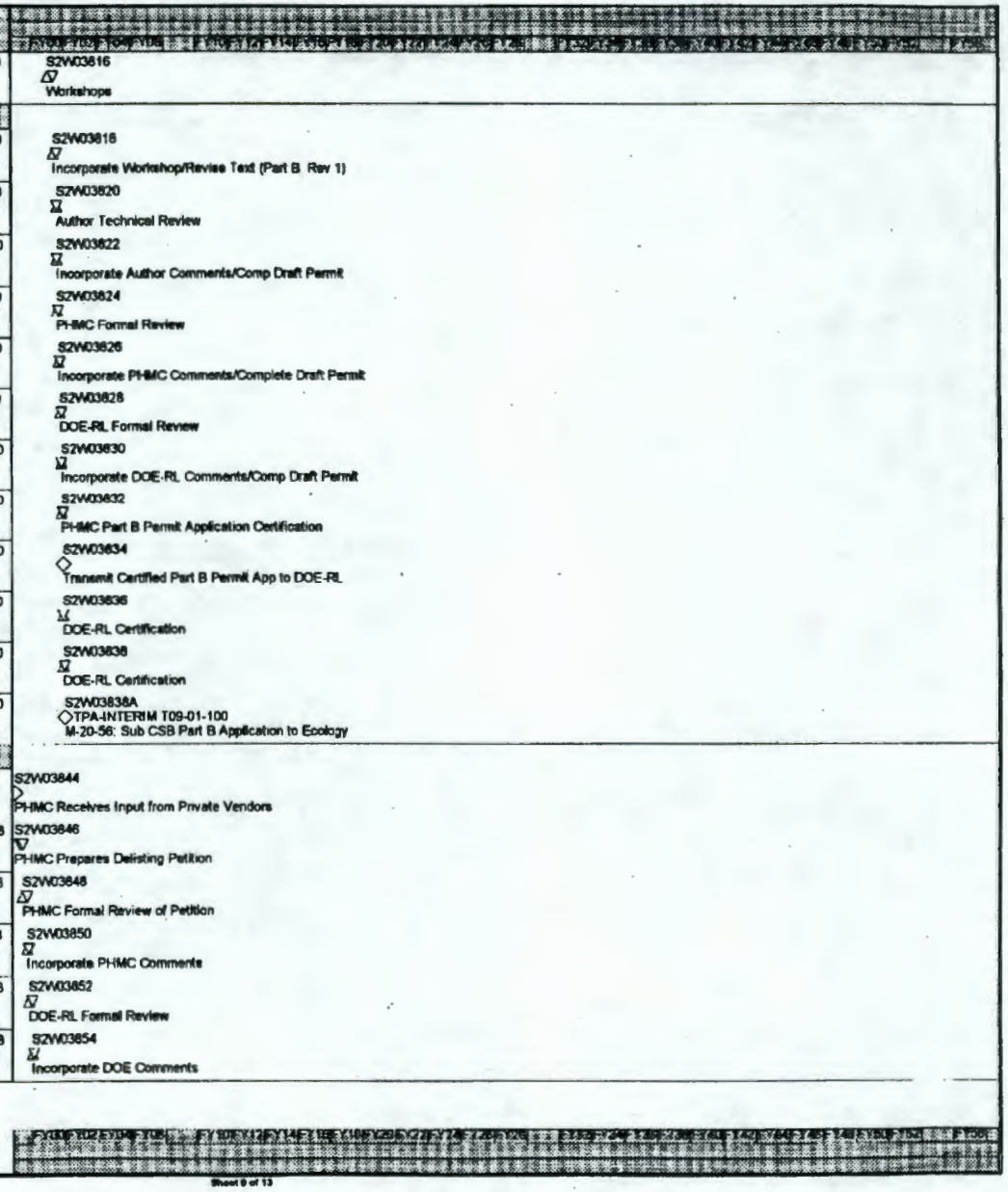
Sheet 7 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03774	Transmit Certified Part A to DOE-RL		24FEB99
S2W03776	DOE-RL Certification	25FEB99	11MAR99
S2W03780	Ecology Review and Approval	03MAR99	01JUN99
S2W03780A	M-90-12. Sub Revised CS Facility Part A Permit		01JUN99
1.1.3.4.02.03.06.04 Part B Permit Application, Rev. 0			
S2W03784	Prepare Draft Text (Part B, Revision 0)	01OCT97	13FEB98
S2W03786	PHMC Receives Input from Private Vendors	17FEB98	17FEB98
S2W03788	Revise Draft Text	18FEB98	15JUN98
S2W03790	Author Technical Review	16JUN98	30JUN98
S2W03792	Incorporate Author Comments/Complete Draft	01JUL98	15JUL98
S2W03794	PHMC Formal Review	16JUL98	14AUG98
S2W03796	Incorporate PHMC Comments/Complete Draft	17AUG98	11SEP98
S2W03798	DOE-RL Formal Review	14SEP98	30SEP98
S2W03800	DOE-RL Formal Review	01OCT98	13OCT98
S2W03802	Incorporate DOE-RL Comments/Complete Draft	14OCT98	12NOV98
S2W03804	PHMC Part B Permit Application Certification	13NOV98	11DEC98
S2W03806	Transmit Certified Permit B Permit App to DOE-RL		11DEC98
S2W03808	DOE-RL Certification	14DEC98	13JAN99
S2W03810	Submit Part B Permit Application to Ecology		13JAN99
S2W03812	Ecology Review	14JAN99	07MAY99
S2W03814	Workshops	10MAY99	30SEP99



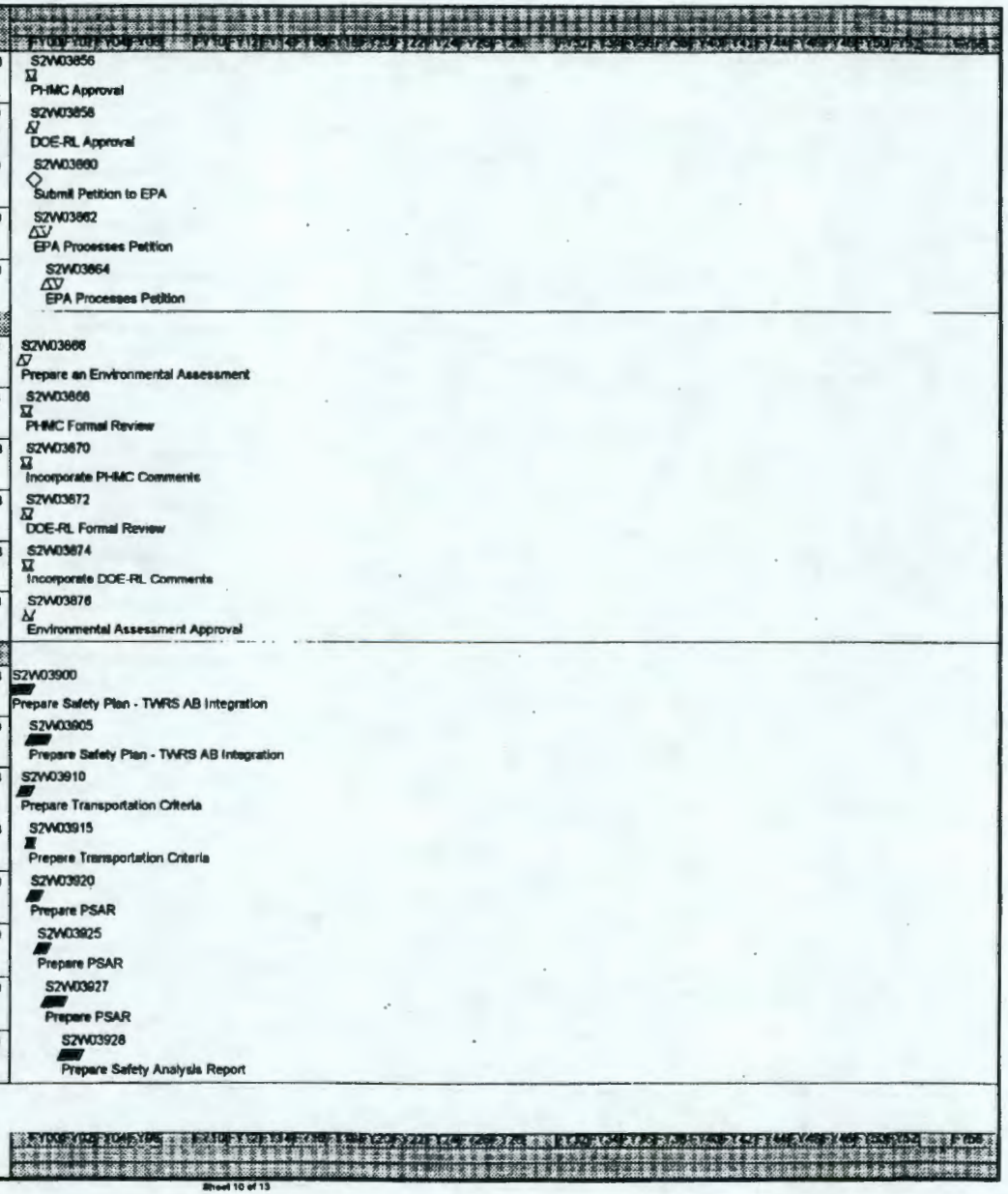
Sheet 8 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03816	Workshops	01OCT99	15FEB00
1.1.3.4.02.03.06.05 Part B Permit Application, Rev. 1			
S2W03818	Incorporate Workshop/Revise Text (Part B, Rev 1)	16FEB00	13APR00
S2W03820	Author Technical Review	14APR00	27APR00
S2W03822	Incorporate Author Comments/Comp Draft Permit	28APR00	09MAY00
S2W03824	PHMC Formal Review	10MAY00	06JUN00
S2W03826	Incorporate PHMC Comments/Complete Draft Permit	07JUN00	27JUN00
S2W03828	DOE-RL Formal Review	28JUN00	27JUL00
S2W03830	Incorporate DOE-RL Comments/Comp Draft Permit	28JUL00	17AUG00
S2W03832	PHMC Part B Permit Application Certification	18AUG00	31AUG00
S2W03834	Transmit Certified Part B Permit App to DOE-RL		31AUG00
S2W03836	DOE-RL Certification	01SEP00	08SEP00
S2W03838	DOE-RL Certification	11SEP00	29SEP00
S2W03838A	M-20-56 Sub CSB Part B Application to Ecology		29SEP00
1.1.3.4.02.03.06.07 Listing Exclusion Application			
S2W03844	PHMC Receives Input from Private Vendors	01OCT97	
S2W03846	PHMC Prepares Delisting Petition	01OCT97	31MAR98
S2W03848	PHMC Formal Review of Petition	01APR98	30JUN98
S2W03850	Incorporate PHMC Comments	01JUL98	31JUL98
S2W03852	DOE-RL Formal Review	03AUG98	30SEP98
S2W03854	Incorporate DOE Comments	01OCT98	30OCT98



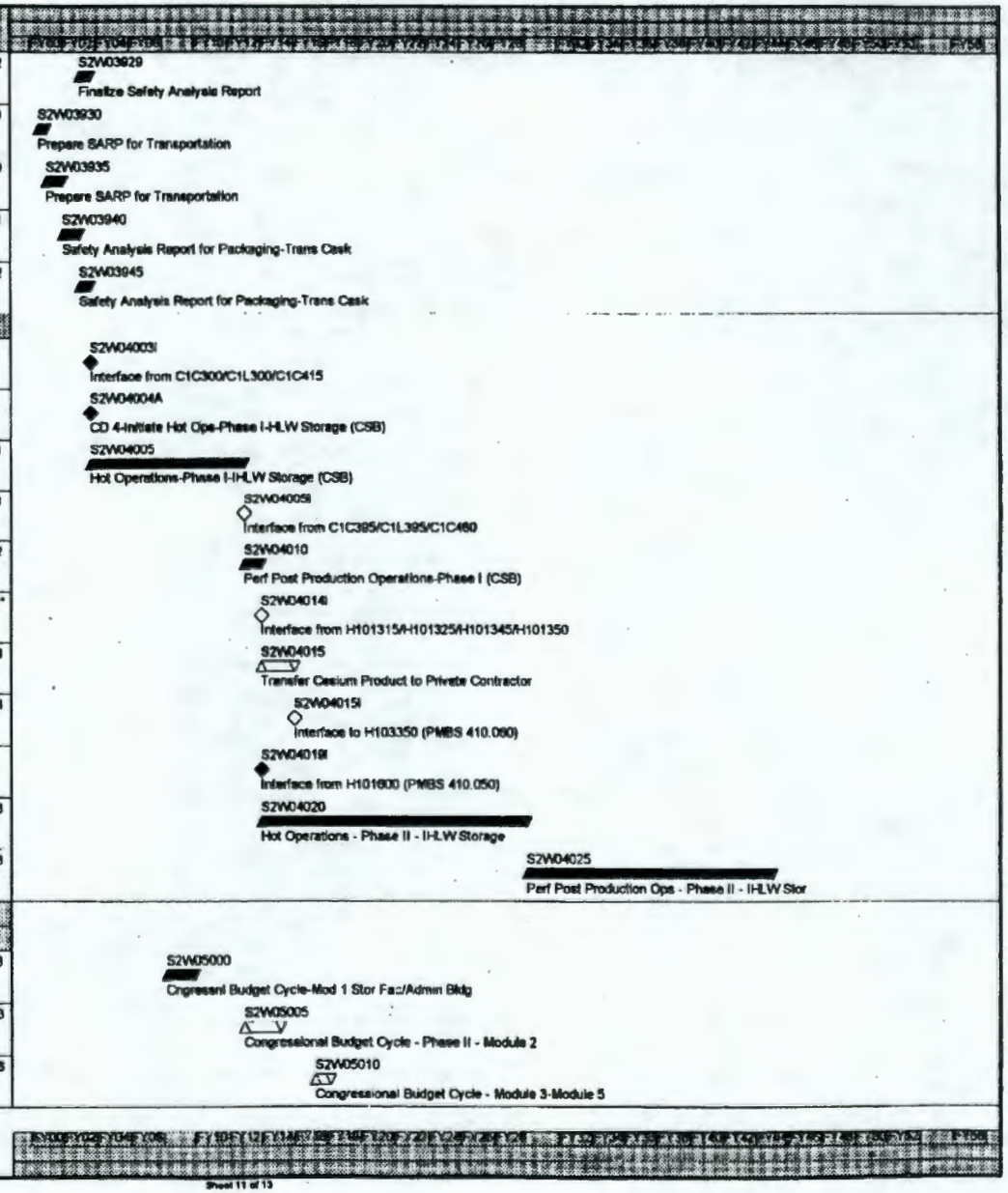
Sheet 9 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03856	PHMC Approval	02NOV98	19NOV98
S2W03858	DOE-RL Approval	20NOV98	07JAN99
S2W03860	Submit Petition to EPA		07JAN99
S2W03862	EPA Processes Petition	08JAN99	30SEP99
S2W03864	EPA Processes Petition	01OCT99	19JUN00
1.1.3.4.02.03.08.08 Environmental Assessment			
S2W03866	Prepare an Environmental Assessment	14APR98	17JUL98
S2W03868	PHMC Formal Review	20JUL98	31JUL98
S2W03870	Incorporate PHMC Comments	03AUG98	07AUG98
S2W03872	DOE-RL Formal Review	10AUG98	21AUG98
S2W03874	Incorporate DOE-RL Comments	24AUG98	31AUG98
S2W03876	Environmental Assessment Approval	01SEP98	30SEP98
1.1.3.4.02.03.09 W-464 Safety			
S2W03900	Prepare Safety Plan - TWRS AB Integration	01OCT97	30SEP98
S2W03905	Prepare Safety Plan - TWRS AB Integration	01OCT98	30SEP99
S2W03910	Prepare Transportation Criteria	01MAY98	30SEP98
S2W03915	Prepare Transportation Criteria	01OCT98	30OCT98
S2W03920	Prepare PSAR	02NOV98	30APR99
S2W03925	Prepare PSAR	03MAY99	30SEP99
S2W03927	Prepare PSAR	01OCT99	29SEP00
S2W03928	Prepare Safety Analysis Report	02OCT00	28SEP01



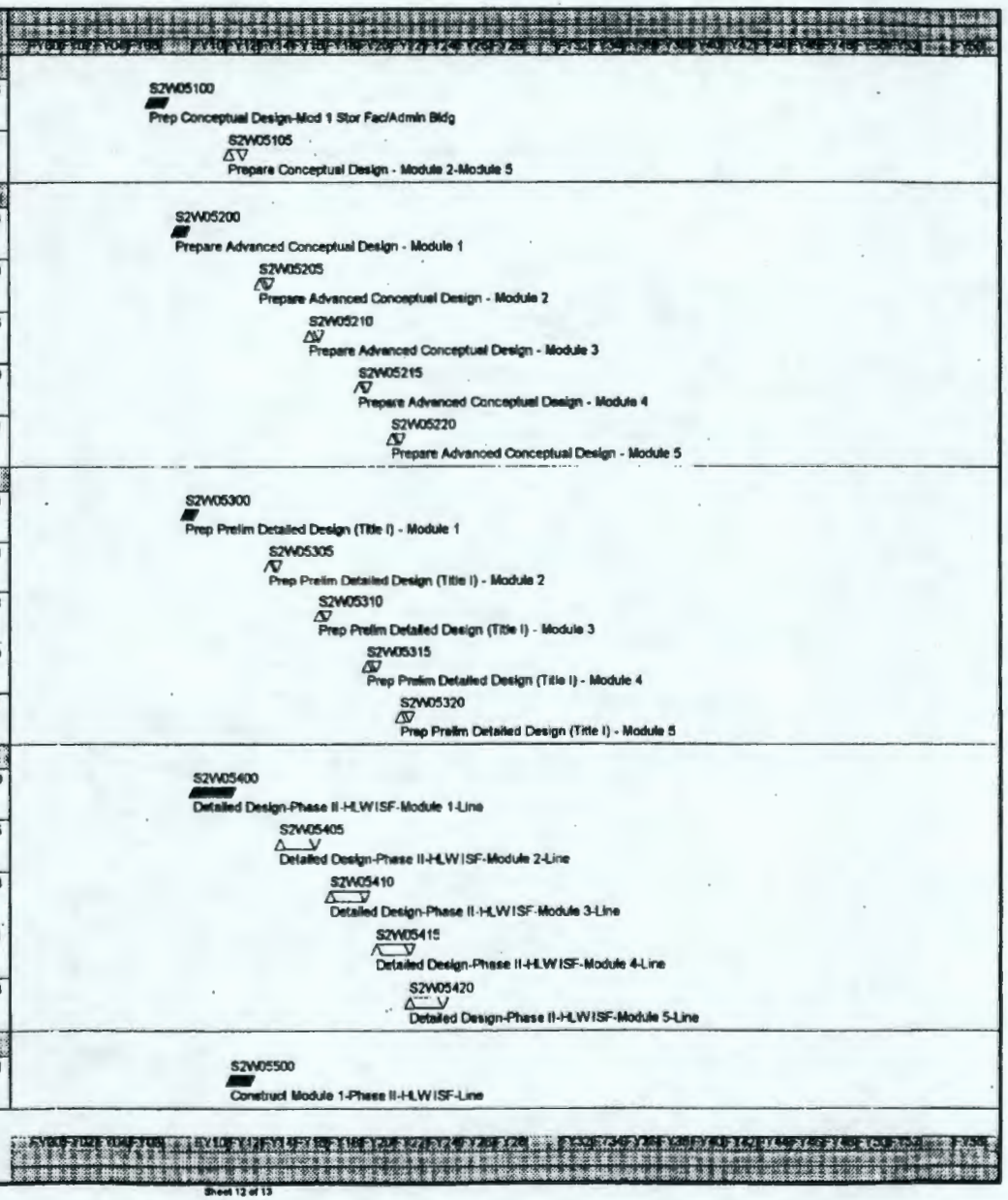
Sheet 10 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W03929	Finalize Safety Analysis Report	01OCT01	31MAY02
S2W03930	Prepare SARP for Transportation	03MAY99	30SEP99
S2W03935	Prepare SARP for Transportation	01OCT99	29SEP00
S2W03940	Safety Analysis Report for Packaging-Trans Cask	02OCT00	28SEP01
S2W03945	Safety Analysis Report for Packaging-Trans Cask	01OCT01	31MAY02
1.1.3.4.02.04 Operations			
S2W04003I	Interface from C1C300/C1L300/C1C415	03JUN02	
S2W04004A	CD 4-Initiate Hot Ops-Phase I-HLW Storage (CSB)	03JUN02	
S2W04005	Hot Operations-Phase I-HLW Storage (CSB)	03JUN02	30SEP11
S2W04005I	Interface from C1C395/C1L395/C1C480		30SEP11
S2W04010	Perf Post Production Operations-Phase I (CSB)	03OCT11	28SEP12
S2W04014I	Interface from H101315/H101325/H101345/H101350		28SEP12*
S2W04015	Transfer Cesium Product to Private Contractor	01OCT12	30SEP14
S2W04015I	Interface to H103350 (PMBS 410.060)		30SEP14
S2W04019I	Interface from H101600 (PMBS 410.050)	01OCT12	
S2W04020	Hot Operations - Phase II - HLW Storage	01OCT12	29SEP28
S2W04025	Perf Post Production Ops - Phase II - HLW Stor	02OCT28	30SEP43
1.1.3.4.02.05 Future Projects			
1.1.3.4.02.05.01 Project Management			
S2W05000	Congressnl Budget Cycle-Mod 1 Stor Fac/Admin Bldg	02JAN07	30SEP08
S2W05005	Congressional Budget Cycle - Phase II - Module 2	03OCT11	27NOV13
S2W05010	Congressional Budget Cycle - Module 3-Module 5	04JAN16	30NOV16



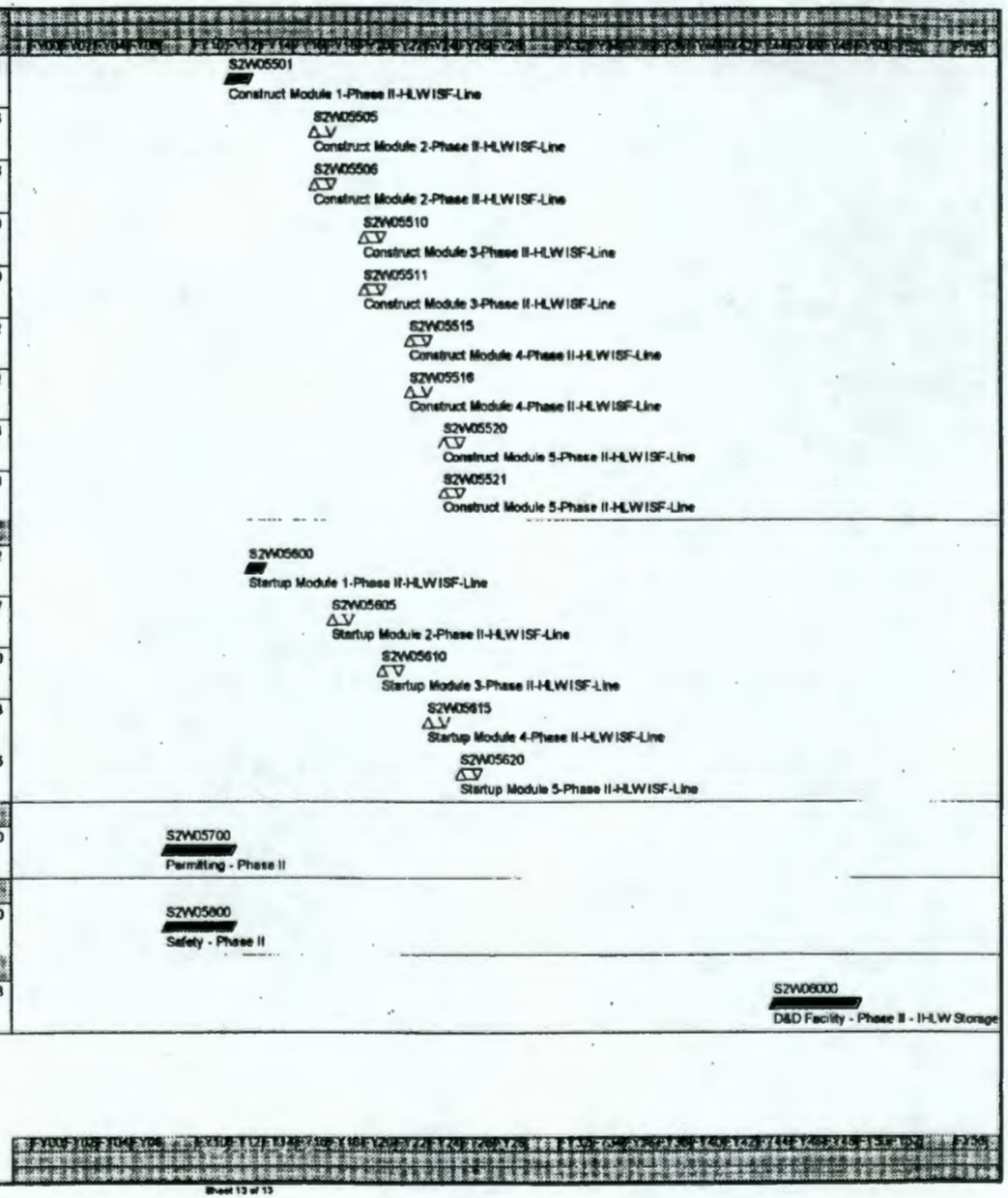
Sheet 11 of 13

Activity ID	Activity Description	Early Start	Early Finish
1.1.3.4.02.05.02 Conceptual Design			
S2W05100	Prep Conceptual Design-Mod 1 Stor Fac/Admin Bldg	01MAR06	29DEC06
S2W05105	Prepare Conceptual Design - Module 2-Module 5	01DEC10	30SEP11
1.1.3.4.02.05.03 Advanced Conceptual Design			
S2W05200	Prepare Advanced Conceptual Design - Module 1	01OCT07	31MAR08
S2W05205	Prepare Advanced Conceptual Design - Module 2	01OCT12	29MAR13
S2W05210	Prepare Advanced Conceptual Design - Module 3	01OCT15	31MAR16
S2W05215	Prepare Advanced Conceptual Design - Module 4	01OCT18	29MAR19
S2W05220	Prepare Advanced Conceptual Design - Module 5	01OCT20	31MAR21
1.1.3.4.02.05.04 Preliminary Detailed Design (Title I)			
S2W05300	Prep Prelim Detailed Design (Title I) - Module 1	01APR08	30SEP08
S2W05305	Prep Prelim Detailed Design (Title I) - Module 2	01APR13	30SEP13
S2W05310	Prep Prelim Detailed Design (Title I) - Module 3	01APR16	30SEP16
S2W05315	Prep Prelim Detailed Design (Title I) - Module 4	01APR19	30SEP19
S2W05320	Prep Prelim Detailed Design (Title I) - Module 5	01APR21	30SEP21
1.1.3.4.02.05.05 Detailed Design (Title II)			
S2W05400	Detailed Design-Phase II-HLW ISF-Module 1-Line	01OCT08	30NOV10
S2W05405	Detailed Design-Phase II-HLW ISF-Module 2-Line	02DEC13	31DEC15
S2W05410	Detailed Design-Phase II-HLW ISF-Module 3-Line	01DEC16	31DEC18
S2W05415	Detailed Design-Phase II-HLW ISF-Module 4-Line	01OCT19	30SEP21
S2W05420	Detailed Design-Phase II-HLW ISF-Module 5-Line	01OCT21	29SEP23
1.1.3.4.02.05.06 Construction			
S2W05500	Construct Module 1-Phase II-HLW ISF-Line	01DEC10	30DEC11



Sheet 12 of 13

Activity ID	Activity Description	Early Start	Early Finish
S2W05501	Construct Module 1-Phase II-HLW ISF-Line	01DEC10	30DEC11
S2W05505	Construct Module 2-Phase II-HLW ISF-Line	04JAN16	30DEC16
S2W05506	Construct Module 2-Phase II-HLW ISF-Line	04JAN16	30DEC16
S2W05510	Construct Module 3-Phase II-HLW ISF-Line	02JAN19	31DEC19
S2W05511	Construct Module 3-Phase II-HLW ISF-Line	02JAN19	31DEC19
S2W05515	Construct Module 4-Phase II-HLW ISF-Line	01OCT21	30SEP22
S2W05516	Construct Module 4-Phase II-HLW ISF-Line	01OCT21	30SEP22
S2W05520	Construct Module 5-Phase II-HLW ISF-Line	02OCT23	30SEP24
S2W05521	Construct Module 5-Phase II-HLW ISF-Line	02OCT23	30SEP24
1.1.3.4.02.05.07 Startup			
S2W05600	Startup Module 1-Phase II-HLW ISF-Line	03JAN12	28SEP12
S2W05605	Startup Module 2-Phase II-HLW ISF-Line	03JAN17	29DEC17
S2W05610	Startup Module 3-Phase II-HLW ISF-Line	02JAN20	31DEC20
S2W05615	Startup Module 4-Phase II-HLW ISF-Line	03OCT22	29SEP23
S2W05620	Startup Module 5-Phase II-HLW ISF-Line	01OCT24	30SEP25
1.1.3.4.02.05.08 Permitting			
S2W05700	Permitting - Phase II	02JAN07	30NOV10
1.1.3.4.02.05.09 Safety			
S2W05800	Safety - Phase II	02JAN07	30NOV10
1.1.3.4.02.06 Facility D&D			
S2W06000	D&D Facility - Phase II - IHLW Storage	01OCT43	30SEP48



Sheet 13 of 13

This page intentionally left blank.

DISTRIBUTION

Number of Copies Onsite		
	U.S. Department of Energy	
6	C. V. Banks	S7-53
	D. D. Button	K6-51
	C. C. Haass	S7-51
	P. E. Lamont	S7-53
	G. H. Sanders	A5-15
	Reading Room	H2-53
4	Fluor Daniel Northwest	
	T. A. Carlson	H5-27
	D. R. Ellingson	B7-41
	F. M. Mann	H0-31
	D. A. Smith	R3-15
9	Lockheed Martin Hanford Company	
	J. F. Bores	S1-57
	H. L. Boston	G3-21
	K. C. Burgard	H5-03
	M. L. Deffenbaugh	H6-37
	K. N. Jordan	G3-21
	R. J. Murkowski	H6-37
	S. M. O'Toole	G3-21
	J. A. Voogd	H6-37
	R. D. Wojtasek	G3-21
5	Lockheed Martin Services, Inc.	
	Central Files	B1-07
	OSTI (2)	H6-08
	TFIC	R1-28
	EDMC	H6-08
1	Mactec	
	D. V. Freeman	H6-37
	Numatec	
	A. M. Choho	H6-35
	P. Mouette	R1-49
	C. A. Petersen	H5-27
	J. W. Shade	H5-27
1	Pacific Northwest National Laboratory	
	Hanford Technical Library	P8-55

DISTRIBUTION (cont)

Number of Copies Onsite	SGN Eurisys Services Corp.	
13	D. A. Burbank, Jr.	H5-27
	R. B. Calmus (10)	H6-37
	E. H. Randklev	H5-27
	J. J. Zimmer	B4-51