S

ENGINEERING CHANGE NOTICE	1. ECN 660082
Page 1 of 2	Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐	S. N. O'Toole/Systems Engineering Projects/R2-53/376-4284	☐ Yes ☒ No	4/19/2000
	6. Project Title/No./Work Order No.: Systems Engineering Management Plan for the Tank Farm Contractor	7. Bldg./Sys./Fac. No.: N/A	8. Approval Designator: N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): HNF- ~~WHC~~-SD-WM-SEMP-002, Rev. 1	10. Related ECN No(s).: N/A	11. Related PO No.: N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Completed	12d. Restored to Original Condition (Temp. or Standby ECNs only)
☐ Yes (fill out Blk. 12b) ☒ No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? ☐ Yes ☒ No

Document revision reflects the following global changes:

- Creation of the Office of River Protection and creation of the River Protection Project
- Change to CH2M HILL Hanford Group, Inc. as Prime Contractor
- Update procedure references
- Replacement of the Hanford Site Technical Database (HSTD) by the Integrated Requirements Management System (IRMS)
- Incorporation of DOE RTP-1 recommendations
- Incorporation of RTP-2 Independent Internal Team Recommendations
- Responsibility for the Mission Analysis Report elevated to ORP
- Addition of ORP generated Project Management Plan and contractor generated Project Execution Plan

14a. Justification (mark one)	14b. Justification Details
Criteria Change ☒ Design Improvement ☐ Environmental ☐ Facility Deactivation ☐ As-Found ☐ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐	

15. Distribution (include name, MSIN, and no. of copies)	RELEASE STAMP
see Attached List	APR 20 2000 DATE STA: 4 HANFORD RELEASE ID: 4

A-7900-013-2 (10/97)

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 660082

16. Design Verification Required	17. Cost Impact — ENGINEERING		17. Cost Impact — CONSTRUCTION		18. Schedule Impact (days)	
☐ Yes	Additional ☐	$ N/A	Additional ☐	$ N/A	Improvement ☐	N/A
☒ No	Savings ☐	$ N/A	Savings ☐	$ N/A	Delay ☐	N/A

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐	Tickler File	☐
Environmental Report	☐	Inspection Plan	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
N/A	N/A	N/A

21. Approvals

	Signature	Date		Signature	Date
Design Authority	N/A		Design Agent	N/A	
Cog. Eng.	S.M. [illegible]	4/19/00	PE	N/A	
Cog. Mgr.	J. [illegible]	4/19/00	QA	N/A	
QA	N/A		Safety	N/A	
Safety	N/A		Design	N/A	
Environ.	N/A		Environ.	N/A	
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

N/A

ADDITIONAL

Systems Engineering Management Plan for the Tank Farm Contractor

S.M. O'Toole
CH2M HILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 660082 UC: 2030
Org Code: 74A00 Charge Code: 108521/AA30
B&R Code: EW3130010 Total Pages: 54

Key Words: River Protection Project, Systems Engineering

Abstract:
This plan describes the systems engineering process to develop and manage the technical baseline. It defines the documents, interfaces, and procedures used by the Tank Farm Contractor.

APR 20 2000
DATE
STA: 4
HANFORD RELEASE
4
ID:

4/20/00

Release Approval Date Release Stamp

Approved For Public Release

RECORD OF REVISION

RECORD OF REVISION	(1) Document Number HNF-SD-WM-SEMP-002	Page 1

(2) Title
Systems Engineering Management Plan for the Tank Farm Contractor

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Rev. 0, EDT #612837 2/6/96	LG Peck	JD Thomson
1	Revision per ECN 644864, 1/8/98	LG Peck	SJ Simon
RS 2	Revision per ECN 660082, 4/20/00	SM O'Toole	JE Ferguson

A-7320-005 (10/97)

HNF-SD-WM-SEMP-002
Revision 2

Systems Engineering Plan for the Tank Farm Contractor

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

CH2MHILL
Hanford Group, Inc.

Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC06-99RL14047

HNF-SD-WM-SEMP-002
Revision 2

Systems Engineering Management Plan for the Tank Farm Contractor

Prepared by:

S. M. O'Toole
CH2M HILL Hanford Group, Incorporated

Date Published
April 2000

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

CH2MHILL
Hanford Group, Inc.

P. O. Box 1500
Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC06-99RL14047

This page intentionally left blank.

Document Title: Systems Engineering Management Plan for the Tank Farm Contractor

Approved by:

4/20/00
J.E. Ferguson, Director Date
Systems Engineering & Integration
CH2M HILL Hanford Group, Inc.

4/20/00
R.S. Popielarczyk, Chief Engineer Date
CH2M HILL Hanford Group, Inc.

This report has been reproduced from the best available copy.
Available in paper copy and microfiche.

Available electronically at
http://www.doe.gov/bridge. Available for a processing fee to the U.S. Department of Energy and its contractors, in paper, from:
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865-576-8401
fax: 865-576-5728
email: reports@adonis.osti.gov(423) 576-8401

Available for sale to the public, in paper, from:
U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Phone: 800-553-6847
fax: 703-605-6900
email: orders@ ntis.fedworld.gov
online ordering:
http://www.ntis.gov/ordering.htm

Printed in the United States of America

This page intentionally left blank.

CONTENTS

FIGURES

TABLES

TERMS

AGA	alternative generation and analysis
CD	critical decision
CHG	CH2M HILL Hanford Group, Inc.
CLUP	Comprehensive Land Use Plan
DOE	U.S. Department of Energy
HLW	high-level waste
HSTD	Hanford Site Technical Database
ICD	interface control document
IHLW	immobilized high-level waste
ILAW	immobilized low-activity waste
IRMS	Integrated Requirements Management System
ISMS	Integrated Environment, Health, and Safety Management System
LAW	low-activity waste
MAR	*River Protection Project Mission Analysis Report*
MYWP	multiyear work plan
O&M	operations and maintenance
ORP	U.S. Department of Energy, Office of River Protection
RAM	reliability, availability, and maintainability
RPP	River Protection Project
RPP-PRO	River Protection Project Tank Farm Contractor procedure
SEMP	*Systems Engineering Management Plan*
SEN	Secretary of Energy Notice
SSC	structure, system, and component
TEMP	*Testing and Evaluation Management Plan*
TBR	technical basis review
TFC	Tank Farm Contractor
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WFD	waste feed delivery

This page intentionally left blank.

SYSTEMS ENGINEERING MANAGEMENT PLAN FOR THE TANK FARM CONTRACTOR

1.0 INTRODUCTION

This Systems Engineering Management Plan (SEMP) describes the Tank Farm Contractor's (TFC) implementation of a systems engineering process in accordance with contract DE-AC06-99RL14047 (ORP 1999). This SEMP defines the process and procedures used by the TFC. It is the basis for tailoring systems engineering applications to the development of the physical systems and processes needed to achieve the desired end states of the program. It is a living document that is revised as necessary to reflect changes in systems engineering guidance as the project evolves.

The TFC's document structure is shown in Figure 1. This SEMP is one of the Management Process Documents. The systems engineering process and the *Integrated Environment, Safety, and Health Management System* (Lake 2000) are mutually supporting. This SEMP is supported by the configuration management plan, engineering plan, testing and evaluation management plan (TEMP), and implementing procedures.

U.S. Department of Energy (DOE) Order 430.1A, *Life Cycle Asset Management,* and associated Good Practice Guides that include systems engineering were used in conjunction with EIA-632-1999, *Processes for Engineering a System* (EIA 1999), as guides to develop this SEMP.

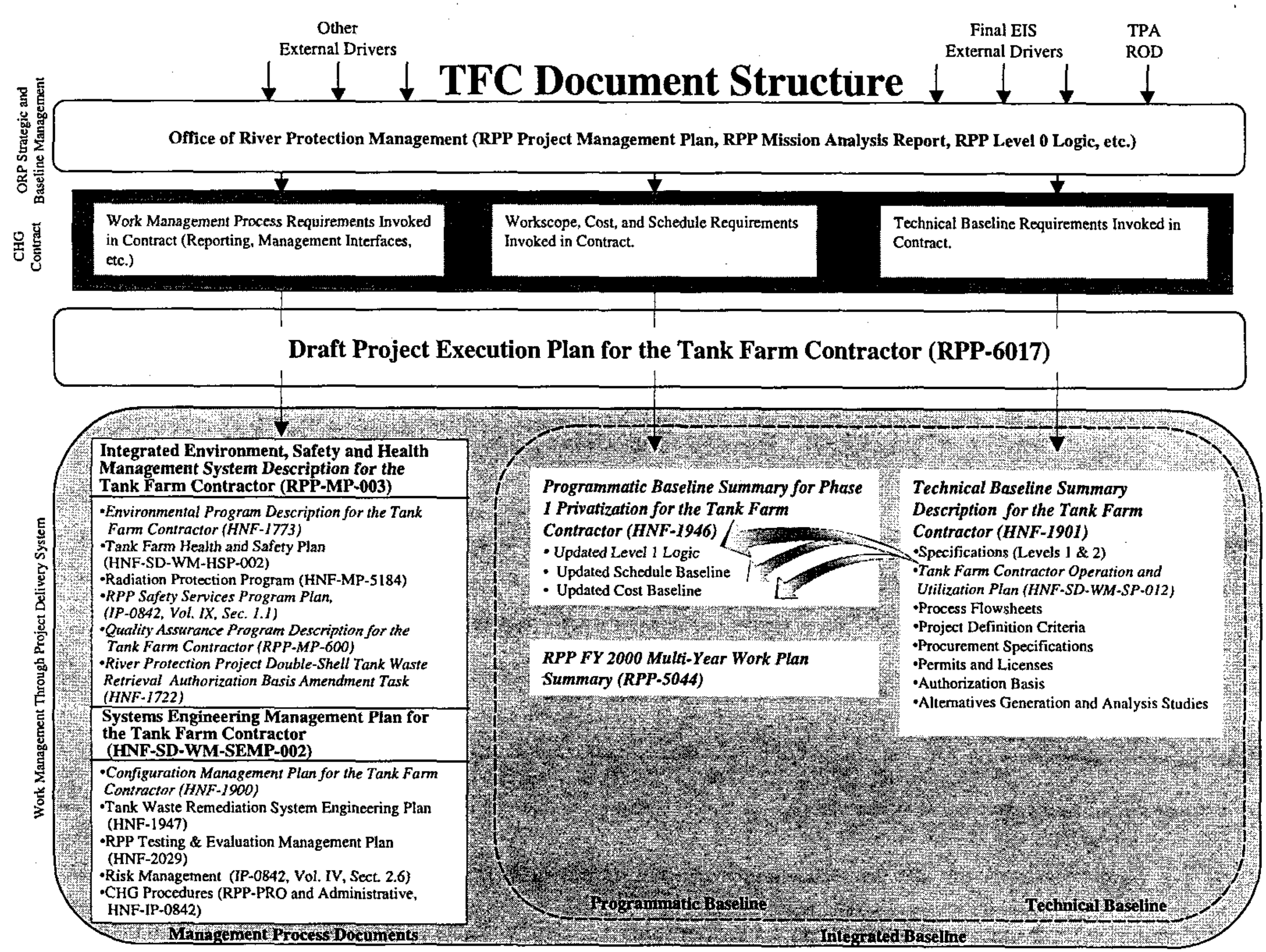
1.1 SCOPE AND APPLICABILITY

This SEMP applies to the River Protection Project's (RPP) TFC. It focuses on the systematic development of the technical baseline to ensure a complete and traceable engineering design solution to meet the mission needs and requirements.

1.2 KEY PARTICIPANTS

CH2M HILL Hanford Group, Inc. (CHG), has primary responsibility under contract DE-AC06-99RL14047 (CHG 1999) for the implementation of this SEMP. For a more complete definition of roles and responsibilities, refer to RPP-6017, *Draft Project Execution Plan for the Tank Farm Contractor* (Halverson 2000).

Figure 1. Tank Farm Contractor Document Structure.



SEMP-1-R

1.3 DOCUMENT ORGANIZATION

This document is organized into two major sections:

- Integrated Baseline Management (Section 2.0) - Defines the integrated baseline for the RPP and outlines the management controls that are used to control and maintain the baseline.

- Systems Engineering Process (Section 3.0) - Outlines the systems engineering process that is used by the RPP throughout the life of the organization; primarily focuses on the continuing systematic development of a traceable, defensible technical baseline for new and modified systems developed for Privatization Phase 1.

This page intentionally left blank.

2.0 INTEGRATED BASELINE MANAGEMENT

This section provides an overview of the integrated baseline and the role of the technical baseline as its primary component. Also included are the control processes that are used to manage the integrated baseline.

2.1 RIVER PROTECTION PROJECT INTEGRATED BASELINE

The integrated baseline is defined as the complete set of work scope, schedule, cost, and technical information used to define and manage the project. Figure 2 shows the elements of the integrated baseline, their relationship to upper-level guidance documents, and the plans and procedures that control the development of the integrated baseline. At present, the baseline definition for the near-term Privatization Phase 1 is much more detailed than the longer term Privatization Phase 2 and the future closure activities. The integrated baseline development is an ongoing activity.

The Office of River Protection (ORP)/RPP's needs, objectives and requirements are communicated through the contract. The TFC develops the management plans and the integrated baseline to satisfy RPP's needs, objectives, and requirements. The integrated baseline is composed of the technical baseline and the cost and schedule baseline. The TFC decomposes the needs, objectives, and requirements allocated to it into lower level technical baseline and resulting logic diagrams to define mission requirements further. The TFC develops scope, cost, and schedule performance baselines that drive the annual multiyear work plans (MYWP). The programmatic cost and schedule baselines mature along with the technical baseline. The management controls (e.g., configuration management, interface management, risk management, decision management) are used to control the integrated baseline.

This SEMP focuses on the systematic development of the technical baseline to ensure a complete and traceable engineering design solution to meet the mission needs and requirements. The technical baseline is defined as the set of equipment, facilities, materials, staff qualifications, and enabling documentation needed to start and complete mission objectives. The technical baseline comprises the following segments:

- Requirements baseline
- Design baseline
- Operational baseline.

The technical baseline is generated with the iterative systems engineering process defined in Section 3.0. The top-level requirements for each applicable major facility/system are developed and documented in Level 1 specifications based on the RPP's needs, objectives, and requirements. Subsystem and component requirements are captured in Level 2 specifications to which the component is designed. As the technical baseline evolves over the life of the RPP and new systems are integrated into the existing operational system, the documents and systems that make up the technical baseline evolve from mission statements and requirements documents to design drawings and interface control documents (ICD), then finally into the operational system.

2.2 SYSTEMS ENGINEERING MANAGEMENT PLAN IMPLEMENTATION

The RPP is made up of projects and existing operations in different stages of their life cycle. The tailored implementation of the systems engineering processes and requirements set forth in this document to a particular project depend on (1) the complexity of the system under development and its need for systems engineering rigor and (2) the phase of development at the time the systems engineering process is introduced for ongoing projects.

A grading process is used by the TFC to establish an appropriate level of rigor for systems engineering implementation and associated documentation to be generated for a project. Projects evaluate the structures, systems, and components (SSC) that they are responsible for developing, to determine the system engineering grading according to the complexity and risk associated with those SSCs. It is possible for a project to implement systems engineering differently for SSCs that the TFC project is responsible for developing.

Those TFC projects with a critical decision-1 (CD-1) date later than October 1, 1997, follow the processes defined in this SEMP. Active projects (i.e., W-211, W-314, , W-464, W-465, W-519) migrate their systems engineering practices to be consistent with this SEMP for technical baseline development as necessary, based on risk associated with the maturity of their systems and budget constraints. The management disciplines of configuration management, interface management, risk management, and decision management are required for all projects.

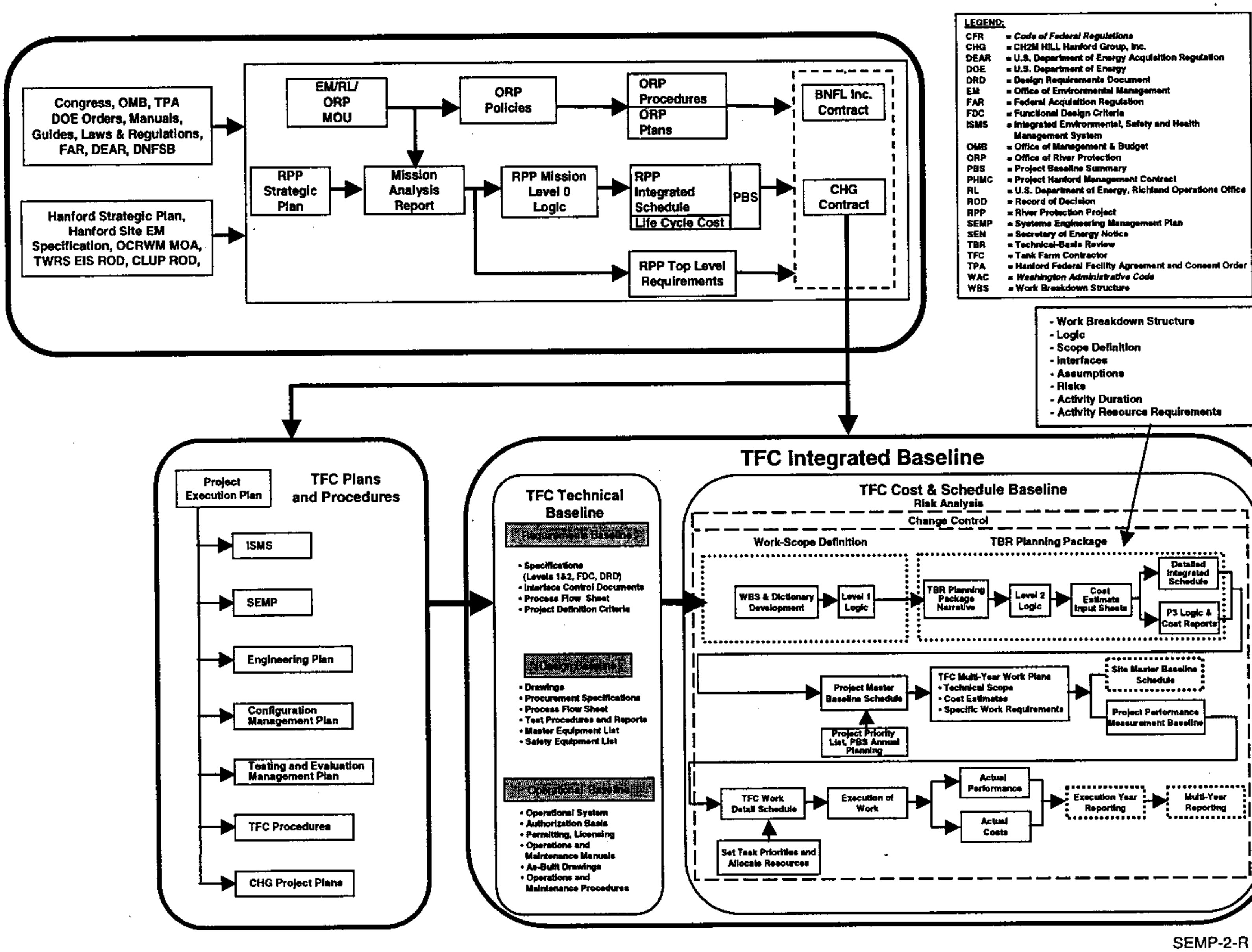
Planning for the implementation of this SEMP for projects is the responsibility of the individual project manager. This planning is documented in a systems engineering implementation plan and is subject to approval by a program-level systems engineering representative. The focus of the systems engineering implementation plan is on the project exceptions to the process defined herein.

2.2.1 Systems Engineering in Subcontracts

Many TFC activities are performed by subcontractors. The scope and content of system engineering tasks allocated to a subcontractor depend on the type of task assigned and generally fall into three basic categories: (1) engineering services, (2) design development, and (3) procure-to-specification. Subcontractor tasks and products are evaluated. System engineering tasks in the subcontract are allocated on the basis of the following general guidelines:

- Engineering Services—The standards and processes imposed by this SEMP are applicable to TFC and its engineering service contracts.

Figure 2. River Protection Project Top-Level Document Relationships.



- Design Development—For subcontractor activities that produce products requiring integration with TFC system engineering processes, the subcontractor is expected to use the standards and processes being followed by the TFC. If the products do not require direct interface with TFC processes, subcontractor processes that are consistent with commercial practices are acceptable.

- Procure-to-Specification—Subcontractors supplying off-the-shelf or build-to-specification equipment generally are not required to perform system engineering tasks.

It is the responsibility of the TFC project manager preparing the subcontractor procurement package to determine the specific content and scope of the systems engineering tasks to be included in the subcontract. The procurement packages are prepared in accordance with the *Material Request/Purchase Requisitional Contract Requisition Process,* RPP-PRO-123, and/or *Preparing a Statement of Work for Services,* RPP-PRO-186.

2.2.2 Systems Engineering Maturity Assessment

HNF-IP-0842, Volume IV, Section 2.14, "Systems Engineering Maturity Assessment and Compliance Guide" (CHG 2000), is used as a tool to provide periodic systems engineering process maturity self-assessment and improvement against industry and government standards.

2.3 MANAGEMENT OF THE INTEGRATED BASELINE

This section describes the processes that are used to control the elements of the integrated baseline. Primary emphasis is on control processes for the technical baseline.

2.3.1 Configuration Management

The technical baseline, developed in accordance with this SEMP, is controlled by configuration management. Configuration management establishes and maintains consistency and traceability among the configuration items (i.e., physical products, production processes, SSCs), requirements, and technical information. The configuration management discipline has five functional elements: configuration management administration, configuration identification, configuration status accounting, change control, and configuration management assessments.

The application of these configuration management functions is tailored to project requirements and life-cycle phases. Specific information on configuration management and its implementation is described in HNF-1900, *Configuration Management Plan for the Tank Farm Contractor* (Weir 2000); change control is described in HNF-IP-0842, Volume VIII, Section 1.1, "Baseline Change Control" (CHG 2000).

2.3.2 Interface Management

The TFC uses ICDs as the vehicle to record agreements on technical requirements and design solutions across *physical* interface boundaries between two or more system elements. The ICDs record the definition of the physical boundary in the form of design information and drawings and document agreement between the owners of each side of the boundary. Interfaces exist at the major facility level as well as at architecture indentures below the major facility level. Interface data are placed into the Integrated Requirements Management System (IRMS), which uses the DOORS software to provide configuration control. The IRMS replaces the Hanford Site Technical Database (HSTD). Changes to the interfaces are subject to configuration management and change control.

The TFC provides and receives services from prime contractors other than the Privatization Contractor by memoranda of agreement. Refer to HNF-IP-0842, Volume IV, Section 2.8, "Interface Control" (CHG 2000), for further details regarding the implementation of interface control for the RPP.

2.3.3 Risk Management

The TFC risk management process creates a work environment where issues, uncertainties, and risks are identified, understood, and managed. Issues, risks, and uncertainties are identified from sources such as lessons learned, alternative generation and analysis (AGA) studies, enabling-assumption information, and from technical basis reviews. Figure 3 shows the relationships among the enabling assumptions, risk management, decision management, and alternative generation and analysis processes. The technical basis reviews (TBR) provide technical and cost information in support of the program logic decompositions. Detailed guidance for performing risk management activities is provided in HNF-IP-0842, Volume IV, Section 2.6, "Risk Management" (CHG 2000).

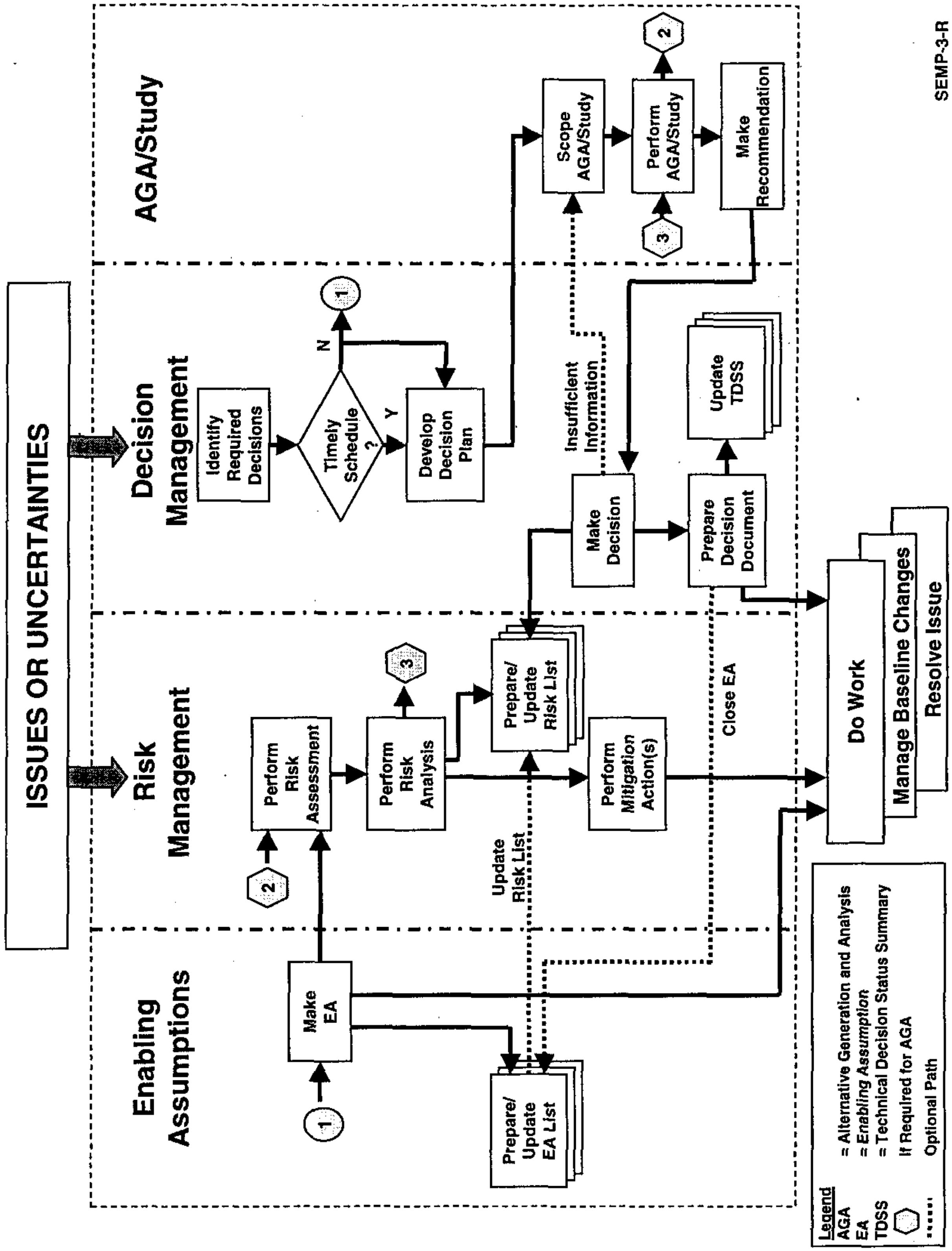
2.3.4 Decision Management

Decision management provides traceability for affected decisions through graded use of a robust and methodical decision-making process. A formal decision process is employed by the TFC for decisions of major program importance. A simplified process is employed for decisions of lesser magnitude. The decision maker or responsible manager determines to what extent the full decision process is required for each particular decision. Decision management for the TFC is accomplished according to HNF-IP-0842, Volume IV, Section 2.7, "Decision Management" (CHG 2000).

2.3.5 Enabling Assumptions

Enabling assumptions are made where uncertainties about technical and programmatic issues exist that cannot be resolved in time to support the program schedule. To proceed with its planning efforts, the TFC has made and continues to make "enabling assumptions" about the

Figure 3. Issues-Management-Process Relationships.



identified uncertainties. Key enabling assumptions are those that are key to the success of the RPP mission; they are followed and resolved by executive-level management. Enabling assumptions are documented in ORP guidance, TBRs, and the IRMS.

The enabling assumption process is conducted in concert with three other systems engineering management disciplines as shown on Figure 3:

- Risk management
- Decision management
- Alternative generation and analysis.

2.3.6 Technical Reviews

Reviews are conducted to assess the development of the integrated baseline and to verify conformance with requirements. Reviews occur at the RPP level as well as at the project level (e.g., line items).

2.3.6.1 RPP Reviews. The "Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, Washington" (62 FR 8693) requires that the following three reviews be conducted to evaluate the RPP as a total system:

- Privatization Phase 1 Readiness to Proceed (before proceeding into Privatization Phase 1B)
- Privatization Phase 1 Operational Readiness Assessment (before the start of hot operations in Privatization Phase 1B)
- Privatization Phase 2 Readiness to Proceed (before proceeding into Privatization Phase 2).

A fourth review was added following Privatization Phase 1 Readiness to Proceed (ORP 1999):

- Privatization Phase 1 Readiness to Proceed with Construction.

The TFC provides plans and evidence packages to ORP to demonstrate readiness to perform its portion of the RPP mission.

2.3.6.2 Project Reviews. Individual TFC construction projects conduct reviews and supply data as required to support the DOE CD milestones as required by RPP-PRO-1997, *Construction Program Overview.* Other reviews may be added at the discretion of the individual construction project. The ORP is responsible for CDs; the project supports successful completion of the review. The following four reviews are required during a project's life cycle.

- **Project Mission Review**. A project mission review is held before approval of mission need to validate the project's need, scope, functions, requirements, and alternatives. The program managers are responsible for conducting the review and presenting the information to the review authority. Participation from the Operations organization is included. The review authority for the project mission review is the sponsoring TFC manager or designee.

- **System Functional Review**. A system functional review is held before initiation of preliminary design. The objective of a system functional review is to verify that customer requirements have been translated into system-specific performance requirements, that technology demonstration plans are complete, that critical technologies are assessed and risks identified, and that a system concept satisfying the requirements has been developed. The project manager is responsible for organizing the review and presenting the information to the review authority. The review authority for the system functional review is the sponsoring TFC manager or designee.

- **Detailed Design Review**. A detailed design review is held before the start of construction. The objective of the detailed design review is to demonstrate that the detailed design is complete, performs the functions and satisfies the requirements, and that the system is ready for fabrication, construction, and/or procurement as appropriate. The project manager is responsible for organizing the review and presenting the information to the review authority. The review authority for the detailed design review is the Technical Operations Vice President.

- **Operational Startup Review**. An operational startup review is held before new SSCs are turned over to Tank Waste Operations for use. This review verifies that (1) the SSCs are functional, (2) the physical configuration matches the drawings, and (3) the operations and maintenance (O&M) technical data are suitable. This review complies with the requirements of HNF-IP-0842, Volume I, Section 1.2, "Readiness Review Process," and HNF-IP-0842, Volume IV, Section 3.12, "Acceptance of Structures, Systems, and Components for Beneficial Use" (CHG 2000). This review is planned in accordance with HNF-IP-0842, Volume I, Section 1.3, "Integration of Operational Readiness and Readiness Assessment Review Planning in the Project Life Cycle" (CHG 2000). On successful completion of this review, the SSCs are turned over to Operations for use. The review authority is the Tank Waste Operations Vice President.

2.3.7 Technical Performance Measurement

The TFC develops and tracks key technical performance measures. Technical performance measures are significant technical parameters that provide insight into and reveal trends in the progress of the project toward achieving mission technical goals. The TFC uses technical performance measures to achieve the following:

- Gain insight into the maturity of the engineering design
- Identify key parameters for testing and evaluation
- Provide management insight into the overall project, decision, and risk management.

The HNF-IP-0842, Volume IV, Section 2.4 "Technical Performance Measurement" (CHG 2000), contains additional information on the implementation of technical performance measurements.

This page intentionally left blank.

3.0 SYSTEMS ENGINEERING PROCESS

This section provides (1) the details of how systems engineering is applied to the development of the TFC technical baseline, (2) the required systems engineering analyses, and (3) an outline of how the requirements baseline is used to define projects. This section also describes how testing and evaluation is performed by the TFC and provides a table that lists major technical documents.

The TFC employs the systems engineering process throughout the effort to define requirements, designs, and solutions that achieve program objectives. The systems engineering process is applied iteratively as many times as needed to develop the solutions to the level of detail appropriate to the specific life-cycle phase. Feedback within this process includes lessons learned in accordance with HNF-IP-0842, Volume X, Section 2.3, "Lessons Learned Policy and Program Description" (CHG 2000).

The systems engineering process and the *Integrated Environment, Safety and Health Management System* (CHG 2000) are mutually supporting. Both seek to provide approved processes that allow work to be planned and executed around requirements at all levels. The RPP ISMS program is designed to protect the safety, health, and well-being of RPP employees by defining the work scope, analyzing hazards, developing/implementing controls, performing work within the controls, and providing feedback. Hazards are controlled within the requirements defined by the TFC contract (CHG 1999) and WHC-SD-MP-SRID-001, Rev. 2, *High Level Waste Storage Tank Farms/242-A Evaporator Standards/Requirements Identification Document* (Milliken 1999). For example, Technical Operations, Tank Waste Operations, and Project Delivery ensure that all process configuration, design, and operational changes that may affect criticality safety during normal or off-normal conditions are documented and reviewed. The criticality safety representative is notified of changes. Hazards are analyzed and corrective actions incorporated into design and/or criticality prevention specifications. Operations are conducted within the scope of approved criticality prevention specifications, and feedback is provided.

3.1 SYSTEMS ENGINEERING PROCESS OVERVIEW

Figure 4 is a graphical representation of the TFC systems engineering model. The process includes five functional steps: (1) define need and scope, (2) define what needs to be done (functions) and develop how well it must be done (requirements), (3) develop alternatives and evaluate existing system, (4) analyze and select alternatives, and (5) verify that the result meets the need (test). The output is an operational system that satisfies the needs. This process is consistent with the guidance in DOE Order 430.1A and the associated Good Practice Guides (*Critical Decision Criteria*, GPG-FM-002; *Project Execution and Engineering Management Planning*, GPG-FM-010; *Project Reviews*, GPG-FM-015) and with commercial practices such as EIA-632 (EIA 1999).

The steps of the systems engineering process are performed sequentially to define the physical products, production processes, and SSCs. The process is applied iteratively until the definition reaches a level of detail at which the requirements for elements of the system can be clearly specified for construction or procurement. The steps of the process go on simultaneously for different elements of the system and at different levels of detail depending on the priorities of the program, the level of complexity and risk associated with the products, production processes, SSC being developed, and the life-cycle phase of development for the SSC.

3.2 SYSTEMS ENGINEERING PROCESS APPLICATION TO THE TANK FARM CONTRACTOR

This section defines the systems engineering process that is being applied by the TFC. The technical baseline evolves as projects move through the life-cycle phases and the system is configured for evolving missions. Ongoing operations and projects are reviewed and updated on the basis of the evolving technical baseline. Expanded activities (e.g., new projects) to address the retrieval and disposal mission are developed on the basis of the existing operational baseline. The composition of these baselines is identified in Section 3.7. The technical data (e.g., drawings, operations manuals) that define the tank farms and related infrastructure form the operational baseline. The existing operational baseline is modified as necessary to establish the TFC portions of the RPP Privatization Phase 1, Phase 2, and Closure systems.

The systems engineering process establishes the requirements baseline for major facilities allocated to the TFC. These facilities are identified in the *River Protection Project-Mission Analysis Report* (MAR) (ORP 2000) and are listed in Table 1. The major facilities are the top level of the TFC architecture tree, HNF-4208, *Tank Waste Remediation System Architecture Tree* (Peck 1999). These major facilities interface with the Privatization Contractor's facilities (i.e., Low-Activity Waste [LAW]/High-Level Waste [HLW] Plant [Privatization Phase 1], LAW Treatment Facility [Privatization Phase 2], and HLW Treatment Facility [Privatization Phase 2]). Similarly, RPP major facilities must interface with other Hanford Site facilities. Major facility requirements are the basis for developing a requirements baseline for the subsystems and components.

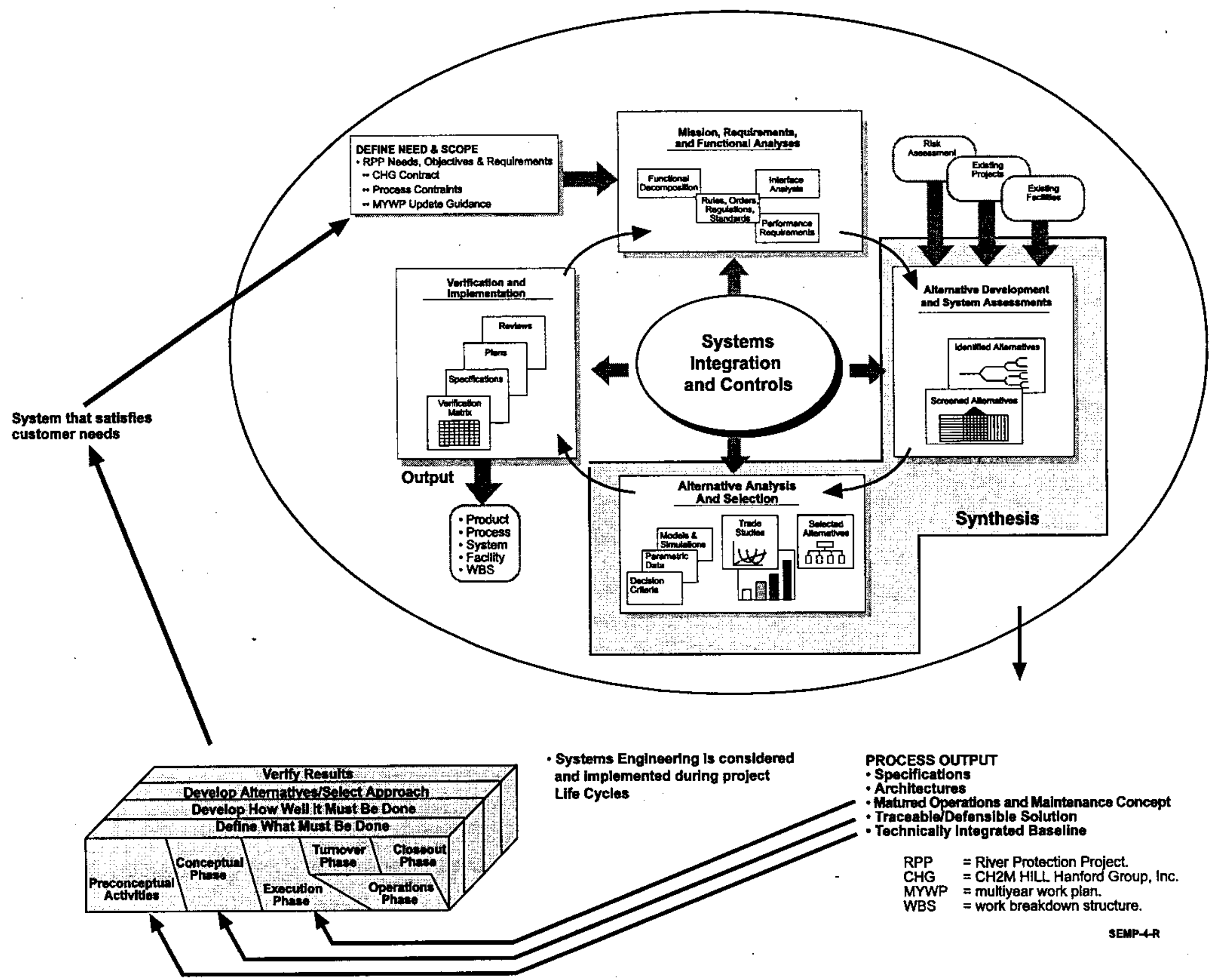
Table 1. Tank Farm Contractor Major Facilities by Privatization Phase.

Phase 1	Phase 2	Closure
• Tank Farm System[a] • Canister Storage Building[d] • ILAW Disposal System • Central Plateau Infrastructure[d]	• Tank Farm System[b] • Canister Storage Building[d] • ILAW Disposal System • Central Plateau Infrastructure[d] • IHLW Storage System, Part 2	• Tank Farm System[c] • Canister Storage Building[c,e] • ILAW Disposal System[c] • Central Plateau Infrastructure[d] • Phase 1 HLW/LAW Plant[c,e] IHLW Storage System[c]

[a]These systems are evolutions of the current system.
[b]These systems are evolutions of the Phase 1 systems bearing the same name.
[c]These systems represent an evolution to a closed, monitored state.
[d]The Tank Farm Contractor is responsible only for the River Protection Project portions of these major facilities.
[e]These facilities are decontaminated and decommissioned at the end of their beneficial life.

HLW = high-level waste.
IHLW = immobilized high-level waste.
ILAW = immobilized low-activity waste.
LAW = low-activity waste.

Figure 4. Systems Engineering Process.



The following constraints influence systems engineering definition:

1. DOE/RL-96-92, *Hanford Strategic Plan* (RL 1996a), which outlines the goals for Hanford Site cleanup

2. 62 FR 8693, "Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, Washington," and the associated, "Record of Decision Hanford Comprehensive Land Use Plan Environmental Impact Statement, DOE/EIS-0222D," (64 FR 61615), which outline an approved strategy for retrieval, treatment, and disposal of tank waste in phases

3. The DOE acquisition strategy for the RPP, which includes privatization of the immobilization facilities (RL contract with BNFL Inc., *TWRS Privatization*, Contract DE-AC06-RL13308 [RL 1998])

4. The timelines imposed on the RPP by the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1996) and the DOE

5. The constraints imposed on the Hanford Site by regulations contained in the *Code of Federal Regulations*, *Washington Administrative Code*, and DOE orders

6. Contract between CH2M Hill Hanford Group, Inc., and the U. S. Department of Energy Richland Operations Office, Contract DE-AC-06-99RL14047 (CHG 1999)

7. The legacy RPP physical system including tank waste

8. Projects in the design and construction phases that modify the existing system.

Specific requirements with respect to the first five constraints were imposed by contract (CHG 1999). The last two constraints influence how systems engineering principles are applied to generate requirements. With these eight constraints as given, an RPP technical baseline development strategy was developed with the following tenets.

- Focus technical baseline development on the RPP Privatization Phase 1 operations. Technical baseline development to support the balance of mission systems (Privatization Phase 2 and Closure) is conducted when necessary information is available to support system development.

- The technical baseline is developed by means of a top-down systems engineering process that takes into account the existing RPP systems and ongoing upgrade projects. This process is integrated with bottom-up planning. Existing systems then are modified or supplemented with new systems to fulfill defined functions and requirements.

- The existing projects continue while the top-down process is being developed. It is a priority to keep these projects progressing to ensure Privatization Phase 1 waste feed delivery on schedule. Reviews, baseline comparisons, and analyses are conducted in the interim to manage risks. Reviews and baseline comparisons are conducted as additional information becomes available and as projects move through their life-cycle phases.

In addition, development of the technical baseline emphasizes cost effectiveness while balancing performance requirements and schedule constraints. Considerations include the following:

- Benefits of flexibility and expansion as applicable to other mission areas and phases
- Benefits of standardizing components
- Validation and verification methods that ensure, on the basis of requirements and cost effectiveness, that the system satisfies the mission need.

This strategy is implemented as illustrated in Figure 5. This figure illustrates how upper-tier constraints are analyzed by ORP and the applicable RPP needs, objectives, and requirements are allocated to the TFC . The contract, the existing system capability and conditions, and the existing project design requirements then feed systems engineering analysis to establish a requirements baseline. The strategy concludes with the integrated operational system.

Figure 6 provides an overview of how this systems engineering analysis proceeds. Decisions are made during the systems engineering analysis about which portions of the existing system are used as is, which are modified, and what new SSCs are needed. These decisions, together with the requirements baseline, are used to define projects (project definition details are provided in Section 3.3). The project definition activity leads to validation and/or modification of existing project scope and requirements and to launching new projects. This model then is applied to support phased completion of the RPP for Privatization Phase 1, Phase 2, and Closure.

Figure 7 provides an example of the application of this process to the development of the Level 1 and Level 2 specifications required for waste feed delivery.

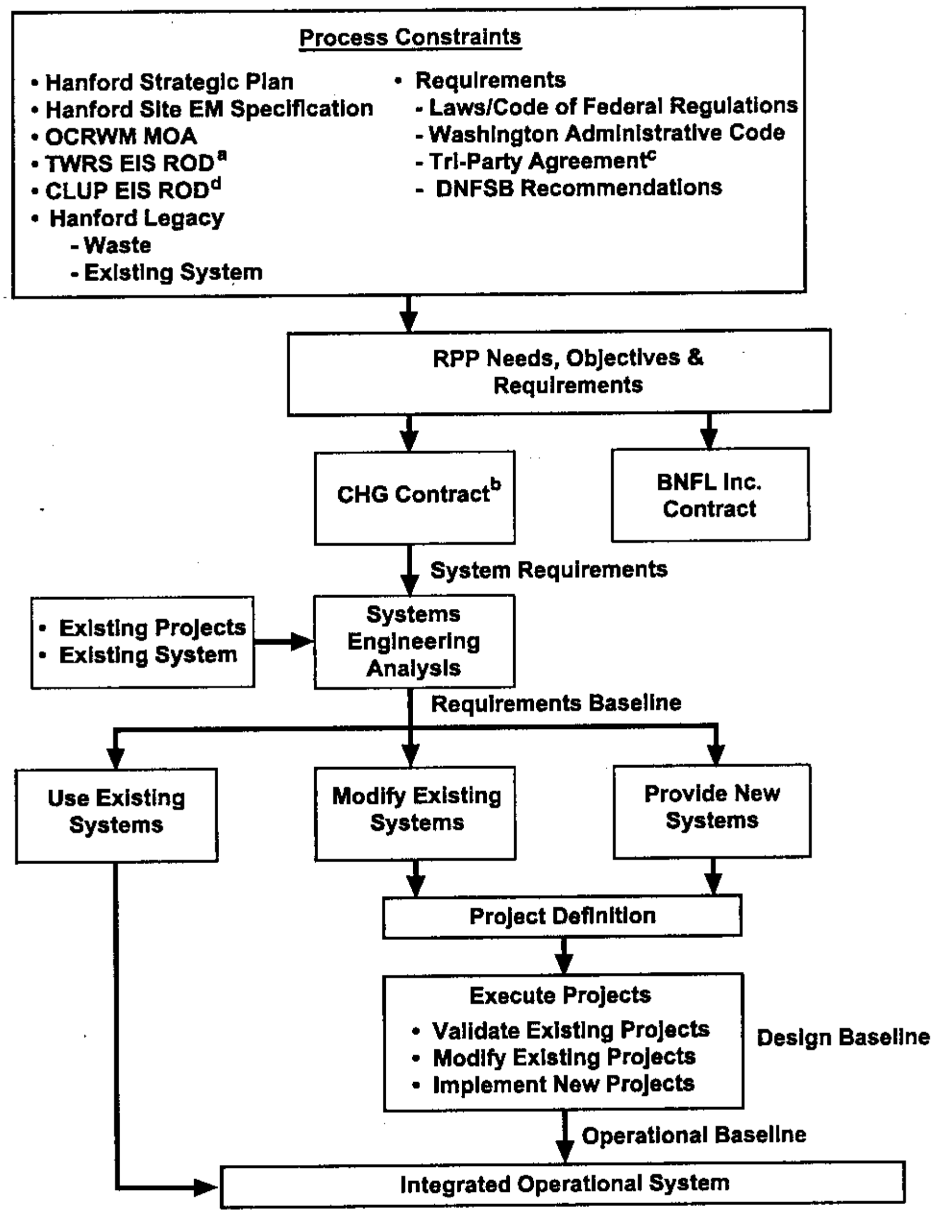
3.2.1 Mission Analysis

The MAR (ORP 2000) provides the starting point for functions and requirements development. The ORP allocates applicable RPP needs, objectives and requirements from the MAR to TFC through the contract.

3.2.2 Functional Analysis

Functional analysis determines which actions a production process and/or SSC must perform and the sequence of those activities to achieve the mission. This analysis is performed in accordance with HNF-IP-0842, Volume IV, Section 3.2, "Functions and Requirements Analysis Allocation and Development of Level 1 and 2 Specifications" (CHG 2000). The starting points for major facility functional analyses are documented by the MAR (ORP 2000). These functions are broken down into lower-level functions that more clearly and completely define major facility functional behavior. The results are translated into system requirements and recorded in Level 1 specifications (refer to Section 3.2.7 for specification definitions).

Figure 5. Tank Farms Contractor Technical Baseline Development Strategy.



CHG = CH2M Hill Hanford Group, Inc.
DOE = U.S. Department of Energy
EIS = Environmental Impact Statement
MOA = Memorandum of Agreement
OCRWM = Office of Civilian Radioactive Waste Management
ROD = Record of Decision
RPP = River Protection Project
SEN = Secretary of Energy Notice
TWRS = Tank Waste Remediation System
CLUP = Comprehensive Land Use Plan
DNFSB = Defense Nuclear Facilities Safety Board

[a] DOE, 1997, *Record of Decision (ROD) on the Final Environmental Impact Statement for the Tank Waste Remediation System*, U.S. Department of Energy, Washington D.C., February 26.

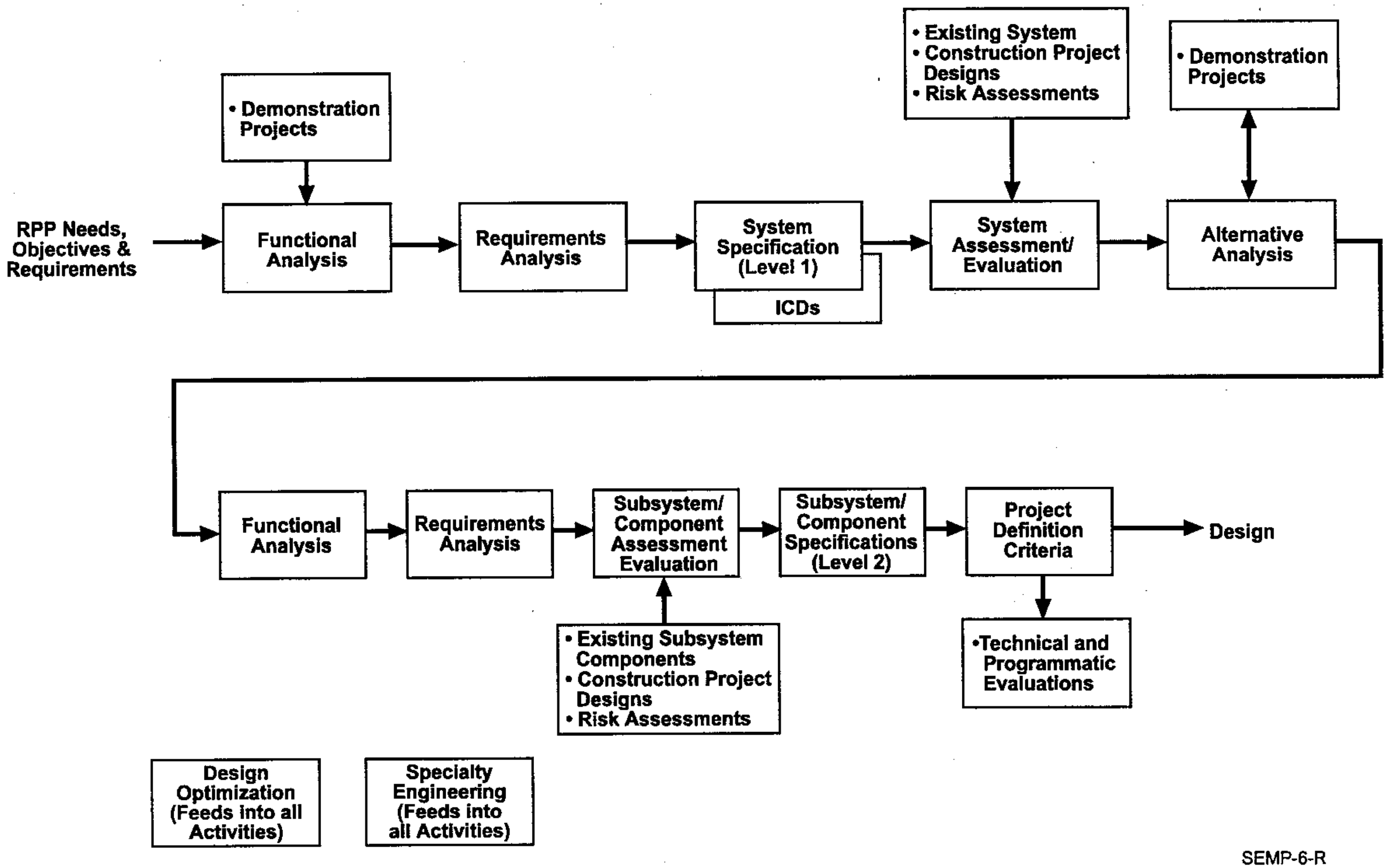
[b] RL, 1999, CH2M Hill Hanford Group, Inc. DE-AC06-99RL14047.

[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, Olympia, Washington.

[d] DOE 1999, Record of Decision (ROD) Hanford Comprehensive Land Use Plan EIS, November, 1999.

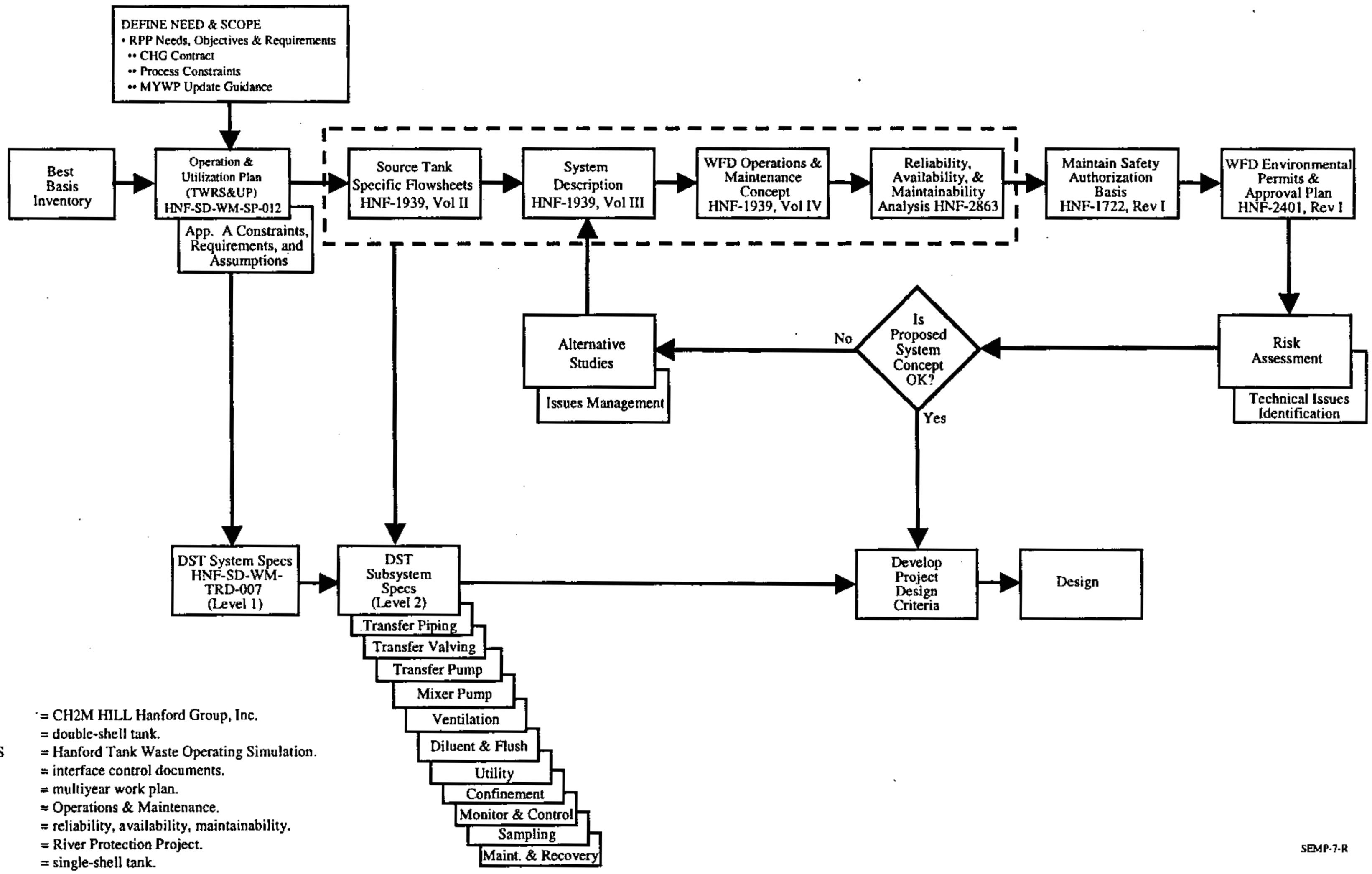
SEMP-5-R

Figure 6. System Engineering Analysis Overview.



RPP = River Protection Project.
ICD = interface control document.

Figure 7. Retrieval Engineering Work Flow for Waste Feed Delivery.



CHG = CH2M HILL Hanford Group, Inc.
DST = double-shell tank.
HTWOS = Hanford Tank Waste Operating Simulation.
ICDs = interface control documents.
MYWP = multiyear work plan.
O&M = Operations & Maintenance.
RAM = reliability, availability, maintainability.
RPP = River Protection Project.
SST = single-shell tank.
TWRSO&UP = TWRS Operation & Utilization Plan.
WFD = Waste Feed Delivery.

Functional analyses below the major facility level follow development of the relevant Level 1 specification(s) and the subsequent system assessment. These analyses break down the functions allocated to major facilities to arrive at subsystem and component functions. This next breakdown is used to generate Level 2 specifications. Results of functional analyses are translated into the IRMS. Functional analyses continue until needed specifications are developed.

3.2.3 Requirements Analysis

Requirements analyses are conducted to develop verifiable statements of how well the production processes and SSCs must perform the functions to complete the mission. There are four such analyses: performance requirements analysis, requirements allocation, specialty engineering (see Section 3.2.6), and interface analysis. Requirements analyses are performed in accordance with HNF-IP-0842, Volume IV, Section 3.2 (CHG 2000). The requirements derived are allocated to the functions defined during functional analysis. Requirements analyses and implementing decisions are documented in referenceable reports that provide requirements traceability. Analytical details, including equations, graphs, and flowsheets, are included in these reports as appropriate. The results are allocated to appropriate functions and recorded in the IRMS.

Performance requirements analysis can be achieved through a combination of analytical techniques such as time-line analysis, queuing models, chemistry models, mass/energy balance, and several other means of applying scientific and engineering principles. For example, the Hanford Tank Waste Operation Simulator model is a tool for analyzing waste stream volume and composition issues. Operations and maintenance related requirements are based on the analysis and strategy in an operations and maintenance concept (refer to HNF-IP-0842, Volume IV, Section 2.15, "Operations and Maintenance Planning Process Procedure" [CHG 2000]). In some cases, determination of performance requirements requires testing. When such cases are identified, a demonstration project is defined.

Requirements allocation is the assignment of functions and requirements to the architecture tree (Peck 1999) for the purpose of producing specifications for systems, subsystems or logical groupings of architecture elements. The major facility (system) requirements are documented in Level 1 specifications (see Section 3.2.7). Functions and requirements developed during lower-level analyses are allocated to specific subsystems and components. The results of these allocations are used to generate Level 2 specifications.

Interface analysis establishes requirements for the interfaces between physical SSCs. For major facilities, interface analysis coincides with performance requirements analysis. Specific major facility interface analysis starts with interfaces identified in Internal Correspondence 73600-97-PSS-001, "Identification and control of TWRS Interfaces" (Schaus 1998) and in the Privatization Contractor ICDs. For subsystems and components, interface analyses commence following AGA and requirements allocation. The ICDs are generated to document and control these requirements. The ICDs are controlled as prescribed in Section 2.3.2.

3.2.4 System Assessments/Evaluations

The extent to which the existing system is able to perform the mission must be determined. The determination is based on analytical and/or physical assessments of the system. An analytical assessment evaluates the current system waste-feed capability (as recorded in its operational baseline data) and modifications planned by specified existing projects against the requirements of Level 1 specifications. Follow-on assessments of a specific SSC may be performed subsequently.

Physical assessment adds information of actual system operability and physical conditions to identify degraded or unsafe SSCs. These analyses and results are documented in systems assessment/evaluation reports. Decisions made from this activity focus alternatives analysis and specification development on the areas where new and modified SSCs are needed.

3.2.5 Alternative Analysis and Selection (Synthesis)

Where new equipment is needed to perform system functions (e.g., waste retrieval), an evaluation of alternative system technologies and configurations (i.e., architectures) is needed. Potential solutions are evaluated in accordance with HNF-IP-0842, Volume IV, Section 3.3, "Alternative Generation and Analysis" (CHG 2000). The AGA studies compare competing system architectures against constraints, requirements, and applicable factors selected by the decision maker in accordance with HNF-IP-0842, Volume IV, Section 2.7 (CHG 2000). The AGA studies are used to analyze alternatives and optimize the system (see Section 3.4 regarding design optimization). The complexity of AGAs varies with the complexity of the decision being made. Some AGAs are expected to be very simple (completed within hours), while others may be extensive. The AGAs are documented in formal reports. The HNF-IP-0842, Volume IV, Section 2.7, (CHG 2000) is used to document the selected alternative.

Selection of appropriate technologies may require testing. In cases where risk warrants, a technology development or demonstration project may be required to prove capability. The result of the tests or demonstrations is integrated into the AGA to support the decision process.

3.2.6 Specialty Engineering Analysis and Integration

Specialty engineering participation on program/project planning, requirements development, design development, testing, and turnover provides the continuity between life-cycle phases. Input from specialty engineering disciplines early in the program/project development ensures that necessary and sufficient requirements are considered and integrated in time to result in a system that meets mission requirements with minimum redesign and rework. Program and project managers plan for, and obtain, the appropriate engineering support required for their work. In addition to project and process engineering, the following disciplines are used in design baseline development as specified in HNF-1947, *Tank Waste Remediation System Engineering Plan* (Rifaey 1998) and subsequent operational baseline development. Specialty engineering analysis results are documented and traceable.

Specialty engineering disciplines include the following:

- Human systems integration
- Reliability, availability, and maintainability (RAM)
- Operations and maintenance analysis
- Environmental, safety, and health
- Quality
- Regulatory compliance
- Producibility
- Value engineering
- Standardization
- Facility startup
- Construction
- Decontamination and decommissioning
- Hazard analysis
- Nuclear safety
- Criticality safety.

3.2.7 Specification Development

Level 1 (i.e., system) specifications are generated in a prioritized manner for the major facilities identified in Table 1. Level 2 (i.e., subsystem, component) specifications are generated for applicable SSCs in accordance with HNF-IP-0842, Volume IV, Section 3.2, "Functions and Requirements Analysis and Allocation and Development of Level 1 and 2 Specifications" (CHG 2000). The specific Level 2 specifications that are generated are determined as a result of decisions made on the basis of the system assessment and alternatives analysis. Specifications are controlled in accordance with configuration management (see Section 2.3.1).

3.3 CONSTRUCTION PROJECT DEFINITION

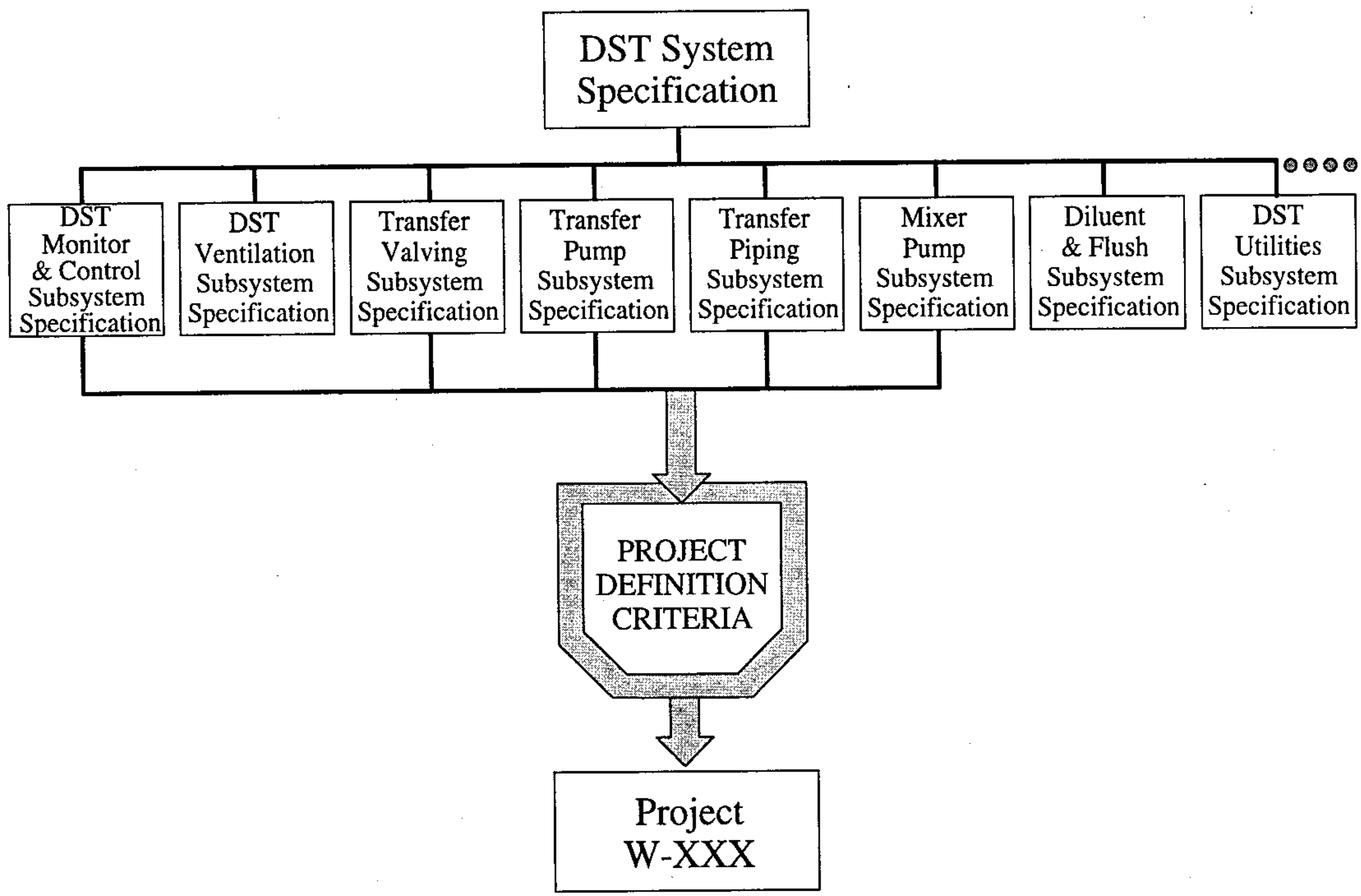
An activity is required to package the acquisition of new and modified SSCs into discrete projects. This activity evaluates technical, work scope, synergy, cost, schedule, and business factors to define construction projects. The results of this activity are the validation of existing projects, modification of existing projects, and definition of new projects.

A project receives its functions and requirements from allocated specifications. An example of this process is illustrated in Figure 8. Each project is given the following items to establish its scope:

- Specifications for the required SSCs. A Level 1 specification may provide the scope for a project if the SSCs can be managed, designed, and deployed as a discrete unit. Level 2 specifications are required for SSCs that need further breakdown.

- The associated ICDs.

Figure 8. Specification Allocation to Projects.



DST = double-shell tank

SEMP-8-R

- Project definition criteria documenting the quantities and locations of the SSCs are provided in accordance with HNF-IP-0842, Volume IV, Section 2.17, "Project Definition Criteria Document Guidance" (CHG 2000). The project definition criteria document is maintained by the program throughout the project life cycle.

A core-requirements planning matrix for an operational-readiness-review is prepared in accordance with HNF-IP-0842, Volume I, Section 1.3 (CHG 2000).

Projects initiated in this manner do not need a separate project mission analysis. New projects are formed and a team assigned when the above package has been assembled. The project team works with the program to determine CD-1 scope and responsibility. The project organization assumes lead responsibility at the start of conceptual design for completion of the remaining project phases.

3.4 DESIGN BASELINE DEVELOPMENT

The design baseline development starts with the preparation of the conceptual design and the technical baseline document. Projects develop design baselines for the SSCs within their scope in accordance with HNF-1947 (Rifaey 1998). The process for baseline development and the required documents that form the design baselines are in accordance with this plan. Existing projects base their designs on the combination of their existing requirements documents and/or on those additional requirements baseline documents required in their project-specific systems engineering planning. Newly formed projects base their design baselines on the project definition data as outlined in Section 3.3.

Design optimization is performed to determine the most cost-effective solution for a given system need and to balance requirements across multiple activities. The TFC integrates the results of its activities and performance of design optimization studies as required to ensure a balanced system. When an AGA is needed, it is managed by means of the decision management process specified in Section 2.3.4. The decision maker establishes the decision criteria and attributes to be analyzed and compared. The attributes may include the following:

- Technical feasibility/maturity and effectiveness
- Safety
- Environmental impact
- Cultural impact
- System effectiveness
- Risk
- Reliability, availability, and maintainability
- Life-cycle cost
- Schedule
- Operability impacts
- Other specialty engineering.

These factors are tailored to support the specific area of evaluation or optimization.

3.5 PHYSICAL SYSTEM TESTING AND EVALUATION

Test and evaluation activities are necessary to ensure that (1) design solutions comply with specified requirements, (2) delivered or constructed systems comply with approved design drawings and construction/procurement specifications, (3) systems are properly installed and integrated into existing systems, (4) procedures are consistent and compatible with equipment/systems as constructed, (5) systems operate safely on turnover, and (6) the operational system continues to operate as designed throughout its intended life. The Testing and Evaluation Process is defined in HNF-2029, *River Protection Project Testing and Evaluation Management Plan* (TEMP) (Wilson 1999).

3.6 INTEGRATED LOGISTICS SUPPORT

This discipline determines what is needed to support system operations and maintenance. The evaluation is performed for each major facility and SSC. Because it is important to deliver waste on time to the vendors, logistics support evaluation considers the entire system, not just for those SSCs being developed. Support concepts are generated for new and modified SSCs during the project conceptual-design phase. Each of these concepts considers the operations and maintenance concept, RAM requirements, and the existing support infrastructure.

The analysis for these concepts addresses the following areas:

- Staffing requirements for operations and maintenance
- Maintenance requirements
- Support equipment needs
- Supply support (spares)
- Technical data requirements for operations and maintenance
- Training requirements for operations and maintenance
- Computer resources required to support maintenance and logistics databases
- Additional maintenance facility requirements
- Packaging, handling, storage, and transportation requirements for SSCs and spares.

3.7 MAJOR TECHNICAL DOCUMENTS

Table 2 identifies the major technical documents used in the development of the technical baseline. The table points to the SEMP section that describes the document development, identifies the appropriate baseline (if applicable), provides a description of each document's purpose and use, and identifies plan and/or procedure reference.

Table 2. Major Technical Documents. (5 Sheets)

Document	SEMP Process Reference Section	TFC Baseline Category	Purpose/Use	Plan/Procedure
MAR (ORP 2000)	3.2.1	NA	Establishes the purpose and top-level requirements for a system. It is used as the starting point for systems analysis and other work. The MAR contains RPP data assigned by the site analyses, including major facilities definitions, requirements, functions, and interfaces. There is to be one MAR for the RPP.	NA
O&M concept document	3.2.6	NA	Summarizes operation and maintenance concept(s). This document supports requirements development, design, and specialty analyses.	HNF-IP-0842, Volume IV, Section 2.15 (CHG 2000)
Requirements analysis reports	3.2.3	NA	Contain the detailed analyses used to derive system requirements. May contain flowsheets, calculations, outputs from computer models, and other data used to derive a specified system requirement. These documents provide requirement traceability and defensibility. The *Tank Waste Remediation System Operation and Utilization Plan to support Waste Feed Delivery* (Kirkbride 2000) is an example of a requirements analysis report.	HNF-IP-0842 Volume IV, Section 3.2 (CHG 2000)
System assessment reports	3.2.4	NA	Contain detailed performance analysis and condition assessments of the existing system (or a specific SSC being assessed). Contains calculations, computer model outputs, maintenance record reviews, results of physical inspections/tests, risk assessments, trades, and other data used to substantiate the decision to use existing systems, modify/replace existing systems, or provide new SSCs.	HNF-IP-0842 Volume IV, Section 3.2 (CHG 1999)
AGA reports	3.2.5	NA	Contain detailed analysis of alternative technologies and system configurations, evaluating each against a predetermined set of decision criteria. Contain calculations and system layout relevant to the study, cost analyses, and other types of analyses relevant to the decision criteria selected. May contain recommendations for the preferred solution. This document is used by the decision board to select which technologies and system configurations to develop further.	HNF-IP-0842, Volume IV, Section 3.3 (CHG 1999)

Table 2. Major Technical Documents. (5 Sheets)

Document	SEMP Process Reference Section	TFC Baseline Category	Purpose/Use	Plan/Procedure
Decision documents	2.3.4, 3.2.3, 3.4	Requirements baseline	Identify the selected alternative based on an AGA, system assessment, or trade study. Includes rationale for the decisions made.	HNF-IP-0842, Volume IV, Section 2.7 (CHG 2000)
ICDs	2.3.2 and 3.2.3	Requirements baseline	Contain requirements and agreements about specific physical interfaces between SSCs, including major facilities. They repeat values called out in specifications and contain drawing data when mature. (They do NOT specify organizational interfaces.) These documents are used to manage interfaces between items in design and/or with existing SSCs. Parties responsible for providing the interfacing SSCs are held accountable to the requirements in the relevant ICD.	HNF-IP-0842, Volume IV, Section 2.8 (CHG 2000)
Specialty engineering analysis reports	3.2.6	NA	Contain analysis required to convert specialty engineering requirements into design requirements. May contain calculations, outputs from computer models, and other data used to substantiate a specified requirement. These documents provide requirement traceability and defensibility.	None specified
Level 1 specifications	3.2.7	Requirements baseline	Contain system-level requirements for a specific major facility. Requirements include functions, performance levels, time factors, system environments, RAM, safety, human factors, logistics, and many others. Also contain a requirements verification matrix used to determine the means of system design verification. These documents provide the basis for system assessment and modeling.	HNF-IP-0842, Volume IV, Section 3.2 (CHG 2000)
Level 2 specifications	3.2.7	Requirements baseline	Contain design requirements for a specific subsystem or component. Requirements include functions, performance levels, time factors, system environments, RAM, safety, human factors, logistics, and many others. Also contains a requirements verification matrix that is used to determine the means of system design verification. These documents provide the basis for projects to perform design.	HNF-IP-0842, Volume IV, Section 3.2 (CHG 2000)

Table 2. Major Technical Documents. (5 Sheets)

Document	SEMP Process Reference Section	TFC Baseline Category	Purpose/Use	Plan/Procedure
Project definition criteria document	3.3	Requirements baseline	Defines project scope by identifying specific SSCs that the project develops and constructs. It specifies the location and identifies the points of interface for each SSC with adjoining systems.	HNF-IP-0842 Volume IV, Section 2.17 (CHG 2000)
Core requirements planning matrix	3.3	NA	Identifies and integrates the products necessary to successfully complete operational readiness review.	HNF-IP-0842 Volume 1, Section 1.3 (CHG 2000)
Test and Evaluation Plan	3.5	Requirements baseline	Documents the project-level testing and evaluation plans including verification methods, locations, management approach, and schedule.	HNF-2029
Master equipment list	3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Identifies all the SSC equipment items and associated design media	See Rifaey (1998) and procedures
Conceptual Design	3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Establishes capital project scope, schedule, and cost baseline for validation	See Rifaey (1998) and RPP-PRO-1999
Technical Baseline Document	3.4	Design Baseline	Technical alignment between ORP and the TFC regarding project scope, high-level performance and acceptance criteria.	RPP-PRO-1999
Flowsheets	3.4 reference to the Engineering Plan (Rifaey 1998)	Design Baseline	Provide detailed process flows and technical design basis to guide development of drawings and specifications	See Rifaey (1998) and procedures
Design drawings	3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Specify the physical geometry, material, and manufacturing requirements for SSCs. They are used for fabrication and construction of SSCs and their parts.	See Rifaey (1998) and procedures
Design analysis reports	3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Document the design calculations and other analyses that were used to arrive at a given design. This document provides traceability of design and may be used to demonstrate analytically how the design complies with the specification.	See Rifaey (1998) and procedures

Table 2. Major Technical Documents. (5 Sheets)

Document	SEMP Process Reference Section	TFC Baseline Category	Purpose/Use	Plan/Procedure
Requirements verification reports	3.5 reference to TEMP (Wilson 1999)	Design baseline	Compile into a single source the evidence that a given SSC design complies with the requirements of the associated design specification. Verification method, activities, and results are documented. Often such a report points to series of design analysis reports and test reports to show compliance.	See TEMP (Wilson 1999) and procedures
Test procedures	3.5 reference to the TEMP (Wilson 1999)	Design baseline	Document the specific SSC test procedures required to verify SSC suitability at various stages of development. Reference the SEMP, Section 3.5, for the major test categories for which this document is required.	See TEMP (Wilson 1999) and procedures
Test reports	3.5 reference to TEMP (Wilson 1999)	Design baseline	Document the results of tests performed for the purposes listed in the SEMP, Section 3.5.	See TEMP (Wilson 1999) and procedures
Interface control drawings	3.2.3, 3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Document the physical geometry, materials, manufacturing methods, and other related information for interfaces between SSCs. These drawings are used to document specific design interface agreements between the designers of both sides of the interface.	See Rifaey (1998) and procedures
Construction specifications	3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Specify SSC construction requirements (e.g., product delivery, handling and storage, execution of work, types of materials, acceptance criteria, workmanship, documentation requirements). They are used to communicate requirements to a construction contractor.	See Rifaey (1998) and procedures
Procurement specifications	3.4 reference to the Engineering Plan (Rifaey 1998)	Design baseline	Specify requirements for procurement of items or services.	See Rifaey (1998) and procedures
As-built drawings	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	Specify the physical geometry, material, and other salient information about the installed configuration of SSCs. They are used for management and modification of SSCs and their parts.	See Rifaey (1998) and procedures
Operations manuals/ procedures	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	Specify how the system is operated in each of its operational modes and for responding to off-normal conditions.	See Rifaey (1998) and procedures

Table 2. Major Technical Documents. (5 Sheets)

Document	SEMP Process Reference Section	TFC Baseline Category	Purpose/Use	Plan/Procedure
Safety equipment list	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	Identifies specific operations and maintenance SSCs that are designated as important to safety. It is used to manage safety-class equipment and as reference to safety and authorization-basis documents.	See Rifaey (1998) and HNF-IP-0842, Volume IV, Section 5.2
Maintenance manuals/ procedures	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	Specify specific methods for system calibration, troubleshooting, and maintenance. These documents cover both on-equipment and off-equipment maintenance.	See Rifaey (1998) and procedures
Training certification	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	Documents that operators, craftsmen, and technicians have been trained to a minimum level of proficiency in SSC operation and maintenance activities and related skills. Also documents that management, engineers, and other professional staff have been trained and certified as necessary to maintain proficiency in specialized professional areas.	See Rifaey (1998), and procedures
Licenses and permits	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	Establish the agreements with oversight authorities for operating SSCs. SSCs are not operated beyond the requirements of these documents.	See Rifaey (1998), and procedures
Lessons learned	3.0	Operational Baseline	Enhance performance and integration by the open exchange of lessons learned from good working practices, cost savings initiatives, and recurrence of negative experiences.	HNF-IP-0842, Volume X, Section 2.3
Authorization Basis Documents	3.4 reference to the Engineering Plan (Rifaey 1998)	Operational baseline	The authorization basis describes aspects of facility design basis and operational requirements relied on by DOE to authorize operation.	HNF-IP-0842, Volume IV, Sections 5.4, 5.6, and 5.10

AGA = alternative generation and analysis.
DOE = U. S. Department of Energy.
ICD = interface control document.
MAR = *Tank Waste Remediation System Mission Analysis Report.*
O&M = operations and maintenance.
RAM = reliability, availability, and maintainability.
RPP = River Protection Project.
SSC = structure, systems, and components.
SEMP = *Systems Engineering Management Plan.*
TEMP = *Testing and Evaluation Plan.*
TFC = Tank Farm Contractor.

This page intentionally left blank.

4.0 GLOSSARY

Architecture. The physical structures, systems, and components (SSC) selected to perform River Protection Project (RPP) activities. Architecture is selected through an analysis of alternative solutions and selection of the design approach that best meets decision criteria.

Architecture Tree. A hierarchical representation of the design solutions selected to achieve the mission.

Baseline, Design. The technical information that defines the processes and SSC necessary for the safe operation and delivery of products.

Baseline, Integrated. A baseline composed of the project's technical, work scope, schedule, and cost baselines. This baseline excludes management plans (administrative process documents).

Baseline, Operational. The equipment, facilities, materials, staff qualifications, and technical information that defines the conduct of operations and maintenance of SSC.

Baseline, Requirements. The technical information that defines the customer's expectations, constraints, required products, and mission boundaries. It includes contractual requirements as well as contractor-generated or -derived requirements.

Baseline, Technical. The set of equipment, facilities, materials, staff qualifications, and enabling documentation needed to startup and complete mission objectives. It comprises the following segments: Requirements Baseline, Design Baseline, and Operational Baseline.

Configuration Management. A management process for establishing and maintaining consistency of a product's performance, functional, and physical attributes with its requirements, design, and operational information throughout its life.

Constraint. A restriction, limit, or regulation imposed on a product, project, or process (e.g., an externally imposed mandatory restriction, limitation, or requirement) by agencies and organizations (e.g., the U.S. Congress, U.S. Environmental Protection Agency, Washington State Department of Ecology, and other regulatory agencies) and DOE orders, Secretary of Energy Notices, and other regulatory documents. A type of requirement or design feature that cannot be traded off.

Design Requirements. The requirements set provided to the product realization team with the detailed information enabling the design process or a "make/buy" decision.

Enabling Assumption. Engineering estimate, typically a credible, nonvalidated requirement or architecture selection, to address technical or programmatic uncertainties so that related activities can continue and where the uncertainties cannot be resolved in time to support the program schedule.

Function. A task, action, or activity performed to achieve a desired outcome (e.g., an operation that a system must perform to accomplish its mission).

Interface Control Document (ICD). A document representing a design agreement between interfacing hardware or software systems that fully defines the interface.

Interface Requirement. A necessary function input that is defined at the system boundary across which material, data, or energy passes.

Logistics. The planning, implementation, and coordination of the maintenance and support activities for a system.

Major Facility. The elements of the top-level Hanford Site architecture

Office of River Protection. The U. S. Department of Energy (DOE) Field Office chartered with managing DOE's River Protection Project.

Performance Requirement. The extent to which a mission or function must be executed; generally measured in terms of quantity, quality, coverage, timeliness, or readiness.

Privatization Contractor. The privatization contractor, BNFL Inc., is responsible for the design construction, and operations of the tank waste treatment facility in support of the River Protection Project.

Program. The River Protection Project organization that is financially responsible for major mission elements and that establishes strategy.

Project. The discrete work within the larger River Protection Project that is a temporary endeavor undertaken to create a unique product or service.. A unique subset comprises construction projects such as line items that have constraints because of capital funding and reporting requirements to the U.S. Congress.

Requirement: A statement of how well a product must perform in quantitative terms and the environment in which it must operate; the extent to which the mission or function must be executed.

River Protection Project. The River Protection Project stores, retrieves, treats, and disposes of Hanford's Tank Waste.

Specification. (1) A document prepared to support acquisition and life-cycle management that clearly and accurately describes essential technical requirements and verification procedures for items, materials, and services. (2) A statement of a set of requirements to be satisfied by a product, material, or process indicating, whenever appropriate, the procedure by which it may be determined whether the requirements given are satisfied.

Specification, Level 1. System-level specifications written for the River Protection Project major facilities. They are used to provide a consistent source for performance requirements and constraints.

Specification, Level 2. A specification used as the "design-to" specification for a specific end item being developed/designed.

Specification Tree. The hierarchical depiction of the specifications needed (planned or existing) for River Protection Project systems development.

Synthesis. The translation of functions and requirements into possible integrated solutions (resources and techniques) satisfying basic input requirements. System element alternatives that satisfy allocated performance requirements are generated; preferred system element solutions that satisfy internal and external physical interfaces are selected; system concepts, preliminary designs, and detailed designs are completed as a function of the development phase; and system elements are integrated into a physical architecture.

Structure, Systems, and Components (SSC). Elements that constitute the total operating system. It does not imply any particular indenture, but rather is used as a general term for elements. Safety SSC are a subset of these SSC.

Systems Engineering. Systems Engineering is a graded approach to define and apply proven methods that are consistent with commercial practices for engineering a system to define and control the technical basis.

Systems Engineering Management. Organizing and directing tasks, activities, and performances related to the technical baseline work, defining the systems engineering process, ensuring that the process is followed, reviewing technical results, and making strategic technical decisions based on those results for the system under development.

Tank Farm Contractor. The Tank Farm Contractor, CH2M HILL Hanford Group, Inc., is responsible for performing the planning and operations necessary for tank waste storage, retrieval, feed delivery, and disposal or shipment in support of the River Protection Project.

Technical Performance Measurement. The assessment process that estimates and tracks essential technical parameters to provide visibility of actual versus planned performance, provide early detection and prediction of problems, and support assessment of the effect of proposed changes.

Test and Evaluation. The complete set of activities that verify that end products meet customer requirements. Test and evaluation includes (1) reviews and analysis performed during the design process; (2) inspection activities during manufacturing and construction; and (3) testing performed during design, manufacturing, construction, turnover activities, River Protection Project management planning, operation and maintenance of storage tanks, waste retrieval, separation, immobilization (private contractors), storage disposal, and closure.

Validation. (1) Confirmation by examination that requirements are well formulated and usable for the intended use. (2) A demonstration that a predictive model and its mathematical expression adequately reflect reality. Validation usually consists of comparing the results of the applied mathematical expression to measured results from the system being modeled (or from similar or identical systems) and showing that any differences were expected and/or within acceptable error.

Verification. Confirmation by examination and provision of objective evidence that the specified requirements to which an end product was designed, built, coded, or assembled have been fulfilled.

5.0 REFERENCES

Federal Register

62 FR 8693, 1997, "Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, Washington," *Federal Register*, Vol. 62, pp. 8693-8704 (February 26).

64 FR 61615, 1996, "Record of Decision Hanford Comprehensive Land Use Plan Environmental Impact Statement, DOE/EIS-0222D," *Federal Register*, Vol. 64, p.61615ff (November 12).

Good Practice Guides

GPG-FM-002, *Critical Decision Criteria*, Life Cycle Asset Management, Good Practice Guide, U.S. Department of Energy, Washington, D.C.

GPG-FM-010, *Project Execution and Engineering Management Planning*, Life Cycle Asset Management, Good Practice Guide, U.S. Department of Energy, Washington, D.C.

GPG-FM-015, *Project Reviews*, Life Cycle Asset Management, Good Practice Guide, U.S. Department of Energy, Washington, D.C.

U.S. Department of Energy Orders

DOE Order 430.1A, *Life Cycle Asset Management*, U.S. Department of Energy, Washington, D.C.

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

Project Hanford Management System

RPP-PRO-123, 1999, *The Material Request/Purchase Requisition/Contract Requisition Process*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PRO-186, 1999, *Preparing a Statement of Work for Services*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PRO-1819, 1999, *PHMC Engineering Requirements*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PRO-1997, 2000, *Construction Program Overview*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PRO-1998, 1999, *Construction Program Pre-Conceptual Activity*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PRO-1999, 2000, *Construction Program Conceptual Phase*, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-PRO-2000, 2000, *Construction Program Execution Phase*, CH2M HILL Hanford Group, Inc., Richland, Washington

Documents

CHG, 2000, *Integrated Environment, Safety and Health Management System Description for the Tank Farm Contractor*, RPP-MP-003, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

CHG, 2000, *RPP Administration*, HNF-IP-0842, CH2M HILL Hanford Group, Inc., Richland, Washington.

- Volume I, Section 1.2, "Readiness Review Process"
- Volume I, Section 1.3, "Integration of Operational Readiness and Readiness Assessment Review Planning in the Project Life Cycle"
- Volume IV, Section 2.4, "Technical Performance Measurement"
- Volume IV, Section 2.6, "Risk Management"
- Volume IV, Section 2.7, "Decision Management"
- Volume IV, Section 2.8, "Interface Control"
- Volume IV, Section 2.14, "Systems Engineering Maturity Assessment and Compliance Guide"
- Volume IV, Section 2.15, "Operations and Maintenance Planning Process Procedure"
- Volume IV, Section 2.17, "Project Definition Criteria Document Guidance"
- Volume IV, Section 3.1, "Mission Analysis"
- Volume IV, Section 3.2, "Functions and Requirements Analysis Allocation and Development of Level 1 and 2 Specifications"
- Volume IV, Section 3.3, "Alternative Generation and Analysis"
- Volume IV, Section 3.12, "Acceptance of Structures, Systems, and Components for Beneficial Use"
- Volume IV, Section 5.2, "Safety Equipment Lists"
- Volume IV, Section 5.4, "Unreviewed Safety Questions"
- Volume IV, Section 5.6, "Authorization Basis Facility Compliance Matrix"
- Volume IV, Section 5.10, "Authorization Basis Document Process"
- Volume VIII, Section 1.1, "Baseline Change Control"
- Volume VIII, Section 3.1, "Configuration Management Implementation."
- Volume X, Section 2.3, " Lessons Learned Policy and Program Description"

Diediker, J. A., 2000, *Technical Baseline Summary Description for the Tank Farm Contractor*, HNF-1901, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.

Ecology, EPA, and DOE, 1996, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EIA, 1999, *Processes for Engineering a System*, EIA-632, Electronic Industries Alliance, Arlington, Virginia.

Halverson, T. G., 2000, *Draft Project Execution Plan for the Tank Farm Contractor*, RPP-6017, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

Kirkbride, R. A., 2000, *Tank Farm Contractor Operation and Utilization Plan*, HNF-SD-WM-SP-012, Rev. 2, Numatec Hanford Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

Milliken, N., 1999, *Tank Waste Remediation System Standards/Requirements Identification Document*, WHC-SD-MP-SRID-001, Rev. 2, Lockheed Martin Hanford Corporation, Richland, Washington.

ORP, 1999, *CH2M HILL Hanford Group, Inc., Contract*, Contract No. DE-AC06-99RL14047, U.S. Department of Energy, Office of River Protection, Richland, Washington.

ORP, 2000, *River Protection Project - Mission Analysis Report,* DOE/ORP-2000-10, U.S. Department of Energy, Office of River Protection, Richland, Washington.

Peck, L. G., 1999, *Tank Waste Remediation System Architecture Tree*, HNF-4208, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

Rifaey, S. H., 1998, *Tank Waste Remediation System Engineering Plan*, HNF-1947, Rev. 0, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

RL, 1996a, *Hanford Strategic Plan*, DOE/RL 96-92, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

RL, 1996b, *Project Hanford Management Contract*, Contract No. DE-AC06-96RL13200, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

RL, 1998, *TWRS Privatization,* Contract DE-AC06-RL13308, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Schaus, P. S., 1998, "Identification and Control of TWRS Interfaces," (Internal Correspondence 73600-97-PS-001, to R. D. Wojtasek, January 7), Lockheed Martin Hanford Corporation, Washington.

Weir, W. R., 2000, *Configuration Management Plan for the Tank Farm Contractor*, HNF-1900, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

Wilson, C. E., 1999, *River Protection Project Testing and Evaluation Management Plan,* HNF-2029, Rev. 1, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

This page intentionally left blank.

DISTRIBUTION SHEET

To Distribution	From Engineering Config & Process	Page of 1
Project Title/Work Order Configuration Managment Plan for the Tank Farm Contractor		Date 4/20/00
		EDT No.
		ECN No. 6600802

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
DOE Public Reading Room	H2-53	X			
Hanford Technical Library	P8-55	X			
Central Files	B1-07	X			
Document Processing Center	A3-94	X			
ER Hamm	R1-31	X			
WR Weir	R1-31	X			

A-6000-135 (10/97)