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98-0000795

DEC 29 1997

97-MSD-291

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W., Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB) RECOMMENDATION 92-4 IMPLEMENTATION PLAN (IP), REVISION 2N, COMPLETION OF COMMITMENT 5.2.2.a, "PROVIDE A PROCEDURE FOR TRANSLATING TWRS TECHNICAL BASELINE DATA INTO PROJECT DESIGN SPECIFICATIONS"

As required by DNFSB Recommendation 92-4 IP, Revision 2N, Commitment 5.2.2.a, due December 31, 1997, enclosed is the "Level Two Specification Development Guide for the Tank Waste Remediation System." This procedure was transmitted through the liaison office to DNFSB technical staff on November 24, 1997.

RL has completed the action identified under this milestone and proposes closure of this commitment.

If you have questions regarding this matter, please contact me, or your staff may contact Jon Peschong, Management Systems Division, on (509) 376-9327.

Sincerely,

John D. Wagoner
Manager

MSD:DJF

Enclosure

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LEVEL 2 SPECIFICATION DEVELOPMENT GUIDE

FOR THE

TANK WASTE REMEDIATION SYSTEM

Prepared for the
Lockheed Martin Hanford Company
by
TRW

December 16, 1997

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CONTENTS

1.0 PURPOSE 1

2.0 SCOPE 1

3.0 DEFINITIONS 2

4.0 RESPONSIBILITIES 4

5.0 ACTIVITY DESCRIPTIONS 4
5.1 Level 2 - Type B Subsystem/Component Specifications Background 4
5.2 Level 2 - Type B Specification Development Annotated Flowchart Introduction/Notes 5
5.3 Level 2 Specification Development Guide Activity Descriptions 5
5.3.1 Screen Major Facility Specification Performance Requirements and Constraints for Subsystem/Component Applicability 5
5.3.2 Functional Analysis 6
5.3.3 Convert to Functional Requirements 6
5.3.4 Determine Performance Requirements 6
5.3.5 Identify Technology-Specific Constraints 6
5.3.6 Screen Constraint Set for Subsystem/Component Applicability . . . 7
5.3.7 Convert Subsystem/Component Constraints to Requirements 7
5.3.8 Subsystem/Component Alternative Analysis 7
5.3.9 Decision Action 8
5.3.10 Level 2 Subsystem/Component Interface Development 8
5.3.11 Analyze Subsystem/Component Reliability, Availability, and Maintainability 8
5.3.12 Determine any Peculiar Subsystem/Component Documentation Requirements 8
5.3.13 Subsystem/Component Logistics Requirements Analysis 9
5.3.14 Establish Subsystem/Component Verification Strategy/Requirements 9
5.3.15 Determine Verification Requirements Specific to Subsystem/Component 9
5.3.16 Identify Specific Tests and Conditions to Verify Specific Capabilities 10
5.3.17 Allocation Analysis to Subsystem/Component 10
5.3.18 Constraints Source List 10
5.3.19 Functions and Requirements (F&R) Source List 10
5.3.20 Specification Section 6.0 (Notes) Activity 11

CONTENTS (Continued)

6.0 REFERENCES . . . 11
6.1 Documents Cited . . . 11
6.2 Bibliography . . . 12

A.1.0 LEVEL 2 SPECIFICATION DEVELOPMENT ANNOTATED FLOWCHART INPUTS (NON-LEVEL 2 INFORMATION/DOCUMENTS) . . . 14
A.1.1 Major Facility Functional Flow Block Diagrams . . . 14
A.1.2 Major Facility Level 1 Alternative Generation Analysis . . . 14
A.1.3 Major Facility Level 1 Specifications . . . 14
A.1.4 System Assessment Report . . . 15
A.1.5 Waste Characteristics . . . 15
A.1.6 Previous Studies . . . 15
A.1.7 Standards/Requirements Identification Documents . . . 15
A.1.8 Major Facility Test Plans . . . 16
A.1.9 TWRS Verification and Validation Policy . . . 16
A.1.10 TWRS Logistics Support Strategy . . . 16

A.2.0 LEVEL 2 SPECIFICATION DEVELOPMENT ANNOTATED FLOWCHART INPUTS (LEVEL 2 INFORMATION/DOCUMENTS) . . . 16
A.2.1 Subsystem/Component Configuration Management Plan . . . 16
A.2.2 Government Furnished Property and Government Loaned Property Lists . . . 17

A.3.0 LEVEL 2 SPECIFICATION DEVELOPMENT ANNOTATED FLOWCHART OUTPUTS (INFORMATION/DOCUMENTS) . . . 17
A.3.1 Lower-Level Functional Flows . . . 17
A.3.2 Functional Descriptions . . . 17
A.3.3 Requirements Analysis . . . 17
A.3.4 Subsystem/Component Constraint Analysis Report . . . 17
A.3.5 Level 2 Subsystem/Component Alternative Generation Analysis . . . 18
A.3.6 Decision Document . . . 18
A.3.7 Update Major Facility Interface Control Documents . . . 18
A.3.8 Level 2 Subsystem/Component Interface Control Documents . . . 18
A.3.9 Subsystem/Component Reliability, Availability and Maintainability Report . . . 18
A.3.10 Subsystem/Logistics Support Analysis Report . . . 18
A.3.11 Functions and Requirements Traceability Document . . . 19

CONTENTS (Continued)

B.1.0 INPUT/OUTPUT SYMBOL (PARALLELOGRAM) 20

B.2.0 DOCUMENT SYMBOL (PRINT SYMBOL) 20

B.3.0 PROCESS SYMBOL (RECTANGLE) 20

B.4.0 CONNECTOR SYMBOL (SMALL CIRCLE) 20

B.5.0 LINE NODE (LINE DOT) 20

B.6.0 OFFPAGE CONNECTOR (HOME PLATE) 20

C.1.0 SCOPE 21
C.1.1 Description 21
C.1.2 Classification 21

C.2.0 APPLICABLE DOCUMENTS 21
C.2.1 U.S. Department of Energy Documents 21
C.2.2 Code of Federal Regulations 21
C.2.3 HNF Documents 22
C.2.4 Codes and Standards 22

C.3.0 REQUIREMENTS 22
C.3.1 Subsystem/Component Definition 22
C.3.1.1 Subsystem/Component Diagrams 22
C.3.1.2 Interface Definition 22
C.3.1.3 Major Component List 23
C.3.1.4 Government Furnished Property Lists 23
C.3.1.5 Government Loaned Property Lists 23
C.3.2 Characteristics 23
C.3.2.1 Performance Characteristics 23
C.3.2.2 Physical Characteristics 23
C.3.2.3 Reliability 24
C.3.2.4 Maintainability 24
C.3.2.5 Environmental Conditions 25
C.3.2.6 Transportability 25
C.3.3 Design and Construction 25
C.3.3.1 Materials, Processes, and Parts 25
C.3.3.2 Electromagnetic Radiation 25

C.3.3.3 Nameplates and Product Markings . . . 26
C.3.3.4 Workmanship . . . 26
C.3.3.5 Interchangeability . . . 26
C.3.3.6 Safety . . . 26
C.3.3.7 Human Performance/Human Engineering . . . 26
C.3.3.8 Decontamination and Decommissioning . . . 27
C.3.5 Logistics . . . 27
C.3.5.1 Maintenance . . . 27
C.3.5.2 Supply . . . 27
C.3.5.3 Facilities and Facility Equipment . . . 27
C.3.6 Personnel and training . . . 27
C.3.6.1 Personnel . . . 28
C.3.6.2 Training . . . 28
C.3.7 Characteristics of Subelements . . . 28
C.3.8 Precedence . . . 29

C.4.0 QUALITY ASSURANCE PROVISIONS . . . 29
C.4.1 General . . . 30
C.4.1.1 Responsibility . . . 30
C.4.1.2 Special Tests . . . 30
C.4.2 Quality Conformance Inspections . . . 30

C.5.0 PREPARATION FOR DELIVERY . . . 30

C.6.0 NOTES . . . 31

C.7.0 APPENDICES . . . 31

D.1.0 TECHNICAL BASELINE DEVELOPMENT PROCESS - MAJOR FACILITY LEVEL 1 SPECIFICATIONS DEVELOPMENT BACKGROUND . . . 32

D.2.0 SUBSYSTEM/COMPONENT DEFINITION PROCESS . . . 33

FIGURES

1. Level 2 Specification Development Annotated Flowchart (Draft) . . . 13

LIST OF TERMS

AGA	alternative generation analysis
Annotated Flowchart	Level 2 Specification Development Annotated Flowchart
F&R	functions and requirements
FFBD	functional flow block diagram
ICD	interface control document
Level 2 - Type B	Level 2
LSA	logistics support analysis
RAM	reliability, availability, and maintainability
S/RID	standards/requirements identification document
subsystems	subsystems/components
TBD	to be determined
TBL	technical baseline
TWR	Tank Waste Retrieval
TWRS	Tank Waste Remediation System

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TWRS LEVEL 2 SPECIFICATION DEVELOPMENT GUIDE

1.0 PURPOSE

The purpose of this guide is to provide the methodology for developing technically sound, traceable, and consistent Level 2 - Type B (Level 2) specifications for developing, modifying, or acquiring subsystems/components (subsystems) for the Tank Waste Remediation System (TWRS). This methodology uses data and information from the following existing sources:

- TWRS major facility Level 1 specifications
- Other TWRS major facility Level 1 information (e.g., functional flow block diagram [FFBDs] and alternative generation analysis [AGAs])
- Hanford Site information/documents
- TWRS Level 2 subsystem specific analysis.

The information in this guide is consistent with the technical baseline development process described in HNF-SD-WM-SEMP-002, *Tank Waste Remediation System Systems Engineering Management Plan,* and should be applied accordingly for development of TWRS Level 2 specifications. Although this guide defines the process for developing Level 2 specifications from Level 1 information, the process can be used to produce a more detailed second-tier, indentured Level 2 specification from information of another Level 2 architecture element. These second-tier, indentured Level 2 specifications will contain more detail and specificity than the parent Level 2 specification.

2.0 SCOPE

This guide includes all activities, required inputs, and process outputs necessary to produce a TWRS Level 2 specification, given a starting point of the TWRS major facility Level 1 specifications along with the associated TWRS major facility information produced while developing the major facility specifications. This guide will apply to the development of all TWRS subsystem specifications.

Guidance is organized by a detailed Level 2 Specification Development Annotated Flowchart (Annotated Flowchart) (Figure 1) and describes the necessary activities for producing the Level 2 specifications (Section 5.0). Attachments A, B, and C support Figure 1 with descriptions of the flowchart input/output, explanations of the flowchart symbols, and descriptions of Level 2 specification format and content.

A background discussion of the TWRS technical baseline (TBL) development process (above Level 2 specification development) is provided for reference in Attachment D, Section 1.0, Technical Baseline Development Process - Major Facility Level 1 Specifications Development Background. This guide does not provide detailed information on either TWRS TBL information, which is covered in other TWRS documents, or the TWRS major facility Level 1 specification development process. Rather, this guide is intended to provide a brief overview of upper-Level TWRS information to provide a set of initial conditions or a starting point from which the Level 2 specification development process can be expanded.

In addition, a brief outline in Attachment D (Section 2.0, Subsystem/Component Definition Process) shows how Level 2 specifications and other unique subsystem information/documents, such as a scoping document or statement of work, will be used to help define TWRS subsystems. This information is a general guide for helping the reader understand the application of Level 2 specifications. It is not a detailed guide on how to specifically define the TWRS subsystems.

3.0 DEFINITIONS

1. Alternative - A concept, design, hardware, software, procedure, personnel, infrastructure (individually or in combination). Used as an adjective only: Offering or expressing a choice between two or more things.

2. Alternative generation analysis (AGA) - A rigorous process by which design alternatives are identified, analyzed, and reported. Also referred to as either a tradeoff study or a trade study (see definition 14).

3. Architecture - A system, piece of equipment, or design that is being proposed to satisfy a given function, requirement, or set of requirements.

4. Constraint - Restriction or limitation that must be met. Used to screen alternative strategies and are always nontradeable by the designer (as opposed to requirements which are tradeable). Often imposed by federal and state laws and regulations (e.g., *Code of Federal Regulation*, U.S. Department of Energy Orders, U.S. Environmental Protection Agency regulations, Washington Administrative Codes).

5. Function - A specific action, activity, or process that achieves or supports the achievement of an objective (e.g., an operation that a system must perform to accomplish its mission).

6. Interface - System boundary across which material, data, or energy passes.

7. Objectives - Discrete, measurable events that, if accomplished, will contribute to achieving a goal.

8. Performance requirement - Quantitative and verifiable statements imposed on functions. Performance requirements indicate how well a particular function must be performed; are independent of architectural and design solutions; and are defined through an analysis that considers the function to be quantified and the appropriate upper-level requirements (both constraints and performance requirements).

9. Project - An organized set of activities within a mission or program that has firmly scheduled beginning, intermediate, and ending date milestones. Typically made up of technology-based activities, subprojects and supporting operations.

10. Requirement - How well the system needs to perform a function. The extent to which a function must be executed, generally measured in terms of quantity, quality, coverage, timelines, or safety. Requirements are always tradeable by the system designer.

11. System - A combination of related functions or equipment integrated into a single activity.

12. System Assessment Report - A report, in the author's chosen format, which provides an assessment of the current system or infrastructure. The report describes how the assessment was done, what the assessment showed, and what decisions where made as a result of the assessment.

13. Tank Waste Remediation System - An integrated solution for carrying out the specific functions associated with remediating tank waste.

14. Trade Study - (1) The process of comparing or trading the strengths and weaknesses of alternative approaches or attributes; (2) a feedback process for resolving inconsistencies among steps or levels; (3) the analysis of the ability of a design solution to meet its stated objectives as inputs are varied (see definition 2).

15. Verification - The method of proving that a particular design or architecture meets a given specification requirement.

4.0 RESPONSIBILITIES

The TWRS Tank Waste Retrieval (TWR) Division is primarily responsible for developing Level 2 specifications for subsystems, typically during the preconceptual or conceptual design phase. As such, in the case of lower-level TWR subsystems and this guide, the TWR Division will lead the Level 2 specification development. However, subsystem project (W-Project) individuals are and will be involved in preconceptual and conceptual design phase activities. Participation of these individuals in the development and production of TWRS Level 2 specifications will facilitate much needed integration among the upper-level TWRS organization, the upper-level TWR Division, and the lower-level TWR W-Projects. Also, in certain cases, it may be necessary and possible to turn over the main responsibility for Level 2 specification development to the individual W-Project and let the TWR Division act as consultant and contributor.

5.0 ACTIVITY DESCRIPTIONS

5.1 Level 2 - Type B Subsystem/Component Specifications Background

The TWRS Level 2 specification, in general, is similar in format to a TWRS Level 1 specification. Sections 1.0, 2.0, 4.0, 5.0, 6.0, and 7.0 of a Level 2 specification are general specification sections requiring specific subsystem information similar to that of a TWRS major facility Level 1 specification. Although Section 3.0 in both the major facility and the Level 2 specifications is set aside for placement of specification requirements, differences between the major facility and the Level 2 specifications occur in the Section 3.0 content area. Content differences between the two specifications, for the most part, occur in the constraint requirement areas (Sections 3.2 - 3.8). The differences are primarily because of different functional emphasis between the two levels of specifications, thus requiring different constraint sets and associated specification sections. Consult the Level 2 specification format/content information included in Attachment C for detailed information on these content differences as well as a general Level 2 specification format/content set-up.

5.2 Level 2 - Type B Specification Development Annotated Flowchart Introduction/Notes

The Annotated Flowchart (Figure 1) shows the required activities and other information/documents (inputs/outputs) needed for developing and producing a subsystem Level 2 specification. This guide shows the primary sources and/or methods for generating Level 2 specification section/subsection requirements. However, sources and/or methods, other than those shown, could also provide specification section/subsection requirements (see Figure 1, note 2).

The Annotated Flowchart (Figure 1) uses standard flowchart symbols to describe the intended process (Attachment B provides an explanation of Annotated Flowchart symbols). Level 2 specification development guide location numbers are included on each of the Annotated Flowchart processes indicating where in the guide text detailed information on the process can be located (5.3.X numbers [for the activities/analysis processes] in Section 5.3 and A.1.X, A.2.X, and A.3.X numbers [for the input/output processes] in Attachment A).

5.3 Level 2 Specification Development Guide Activity Descriptions

This section describes the activity/analysis blocks from the Annotated Flowchart (Figure 1) necessary to produce subsystem Level 2 specifications. All other Annotated Flowchart information (e.g., inputs/outputs) are included in Attachment A. HNF-IP-0842, *TWRS Administration Manual*, Volume IV, Section 3.2, Functions and Requirements Analysis and Allocation Procedure describes the functional analysis process in detail. This process is used in sub-sections 5.3.2 through 5.3.7. Traceability of requirements from the major facility specification to the Level 2 specification and to the second-tier, indentured Level 2 specifications will be maintained.

5.3.1 Screen Major Facility Specification Performance Requirements and Constraints for Subsystem/Component Applicability

Screen major facility specification requirements/constraints for their applicability to the subsystem architecture under consideration. Once a requirements set is determined and compiled, use it as an input for the Level 2 subsystem functional analysis activity.

5.3.2 Functional Analysis

Using major facility FFBDs, major facility Level 1 AGA results, the system assessment report (see Section 3.1, definition 12, or Attachment A, Input 1.4) and the set of applicable, screened major facility specification requirements from Section 5.3.1, perform a functional analysis to determine Level 2 subsystem functions. Functional analysis information produces lower-level (Level 2) functional flows and functional descriptions and will be converted to Level 2 functional requirements for use in developing Level 2 specification performance requirements.

5.3.3 Convert to Functional Requirements

Convert the Level 2 functional analysis information from Section 5.3.2 to Level 2 functional requirements. Use developed Level 2 functional requirements to produce Level 2 subsystem performance requirements.

5.3.4 Determine Performance Requirements

Produce required Level 2 subsystem performance requirements using Level 2 functional requirements, waste characteristics inputs, previous studies inputs, applicable Level 2 subsystem imposed requirement (constraint) set information, and Level 2 interface control document (ICD) information. Populate Level 2 specification, Section 3.1.2, Interface Definition (Level 2 interface input requirements), and Section 3.2.1, Performance Characteristics (Level 2 subsystem performance requirements [including Level 2 interface outputs]), from the defined Level 2 performance requirements (see Level 2 specification list in Figure 1). Also, use Level 2 performance requirement information in Level 2 AGA generation, allocation analysis for subsystem subelements, and Level 2 subsystem requirements analysis.

5.3.5 Identify Technology-Specific Constraints

Identify and document any imposed requirements (constraints) that are unique to the technology (or architecture) under consideration for the subsystem. The technology-specific constraint set will then be included in the total set of constraints screened to produce a Level 2 subsystem specific set of constraints and as input to the Level 2 AGA process.

5.3.6 Screen Constraint Set for Subsystem/Component Applicability

Screen a set of input constraints taken from the standards/requirements identification documents (S/RIDs), the major facility Level 1 specifications, and the identified technology-specific list in Section 5.3.5. Ascertain the applicability of those constraints to the subsystem being developed. The complete set of screened, applicable constraints will be converted into Level 2 specification requirements.

5.3.7 Convert Subsystem/Component Constraints to Requirements

Convert the Level 2 applicable constraint set into Level 2 specification requirements suitable for use in the subsystem Level 2 specifications. Use the Level 2 requirements to populate the applicable Level 2 subsystem specifications sections/subsections:

- 3.2.2 Physical Characteristics
- 3.2.5 Environmental Conditions
- 3.2.6 Transportability
- 3.3.1 Materials, Processes and Parts
- 3.3.2 Electromagnetic Radiation
- 3.3.3 Nameplates and Product Markings
- 3.3.4 Workmanship
- 3.3.5 Interchangeability
- 3.3.6 Safety
- 3.3.7 Human Engineering/Human Performance
- 3.3.8 Decontamination and Decommissioning
- 3.8 Precedence
- 5.0 Preparation for Delivery

Level 2 specification requirement information is also used to generate a subsystem constraint analysis report, which documents this set of Level 2 constraints, and for helping to produce performance requirements for the Level 2 subsystem specification.

5.3.8 Subsystem/Component Alternative Analysis

Identify and analyze Level 2 alternatives, making use Level 2 performance requirement information and any technology-specific constraints. Sometimes this process is also referred to as conducting Level 2 "trade studies." See HNF-IP-0842, *TWRS Administration Manual,* Volume IV, Section 3.3, Alternatives Generation and Analysis Procedure, for details on the process. Level 2 alternative analysis information and results will be documented as the Level 2 AGAs.

5.3.9 Decision Action

Conduct a decision process to chose a preferred subsystem alternative based on the information documented in the Level 2 AGAs. See HNF-IP-0842, *TWRS Administration Manual,* Volume IV, Section 2.7 Decision Management Procedure, for details on the decision process. Use the information from this decision action to produce a Level 2 alternative decision document, which will be used to help develop Level 2 ICDs as part of the subsystem logistics requirements analysis, and as part of the subsystem allocation analysis.

5.3.10 Level 2 Subsystem/Component Interface Development

Identify, define, and refine Level 2 subsystem interfaces using information from the Level 2 AGAs. See the HNF-IP-0842, *TWRS Administration Manual,* Volume IV, Section 2.8, Interface Control Procedure, for more information. Use the information from this activity to update applicable Level 1 major facility ICDs, as needed, and to produce Level 2 subsystem ICDs. Feed the updated Level 1 major facility ICD and the developed Level 2 ICD information into Level 2 subsystem specification, Section 3.1.2, Interface Definition (interface descriptions) (see Figure 1), and into the Level 2 performance requirements definition activity to produce actual interface (input/output) requirements.

5.3.11 Analyze Subsystem/Component Reliability, Availability, and Maintainability

Using Level 1 major facility reliability, availability, and maintainability (RAM) requirements and newly identified Level 2 specific RAM information, analyze the RAM data to produce Level 2 specification RAM requirements. For details on the RAM analysis process, procedures are being prepared on systems and cost effectiveness planning and analysis or life-cycle asset management implementation instructions for logistics support planning and analysis. Generate a subsystem RAM report to document the analysis and populate Level 2 specification RAM requirements (Section 3.2.3, Reliability, and Section 3.2.4, Maintainability [see Figure 1]) using the developed RAM requirements and information.

5.3.12 Determine any Peculiar Subsystem/Component Documentation Requirements

Develop, define, and produce Level 2 subsystem documentation requirements using Level 1 major facility specification documentation requirements and subsystem configuration plan information. Allocate these produced Level 2 subsystem specification requirements to the Level 2 specification, Section 3.4, Documentation.

5.3.13 Subsystem/Component Logistics Requirements Analysis

Using Level 2 AGA information, Level 1 major facility specification logistics requirements, and information from the TWRS logistics support strategy, perform a Level 2 subsystem logistics support requirements analysis. Review, define, and analyze logistics elements relating to the subsystem to produce applicable Level 2 logistics specification requirements. For details on the logistics requirements analysis process, procedures are being prepared on life-cycle asset management implementation instructions for logistics support planning and analysis. Levy developed logistics-type requirements into the applicable Level 2 specification logistics subsections as follows:

- 3.3.7 Human Engineering/Human Performance requirements
- 3.5.1 Maintenance Requirements
- 3.5.2 Supply Requirements
- 3.5.3 Facilities and Facilities Equipment Requirements
- 3.6.1 Personnel Requirements
- 3.6.2 Training Requirements

Document the results of this analysis in a subsystem logistics support analysis (LSA) report.

5.3.14 Establish Subsystem/Component Verification Strategy/Requirements

Develop a subsystem plan or strategy for testing or verifying the subsystem and its associated requirements, taking into consideration information contained in the TWRS verification and validation policy. Use the results of this activity to help develop actual Level 2 specification verification requirements.

5.3.15 Determine Verification Requirements Specific to Subsystem/Component

Using information from the Level 1 major facility test plans, Level 1 major facility specification verification requirements and the Level 2 verification strategy, define and produce Level 2 subsystem specification verification requirements. Allocate these verification requirements to the following Level 2 specifications sections/subsections:

- 4.0 Quality Assurance Provisions
- 4.1 General Testing Information
- 4.1.1 Testing Responsibilities
- 4.2 Quality Conformance Inspections

Also, use this verification requirement information as part of an analysis to identify any special subsystem testing is required.

5.3.16 Identify Specific Tests and Conditions to Verify Specific Capabilities

Analyze, identify, and document the Level 2 specification verification requirements from Section 5.3.15, Determine Verification Requirement Specific to Subsystem/Component, to ascertain whether a specific subsystem element (or associated requirement) requires any special tests to verify specific capabilities. Document and allocate these special test/verification requirements to the Level 2 specification, Section 4.1.2, Special Tests.

5.3.17 Allocation Analysis to Subsystem/Component

Analyze subsystem allocations for possible subelements if further subsystem breakdown is necessary for a better system definition. Identify, develop, and define these subelements using information from the Level 2 performance requirements and the Level 2 AGAs. See HNF-IP-0842, *TWRS Administration Manual,* Volume IV, Section 3.2, Functions and Requirements Analysis and Allocations Procedure, for more details on this activity. Document the allocations of these Level 2 subelements and their associated characteristics in the Level 2 specification, Section 3.7, Characteristics of Subelements. Using these subelement allocations and their characteristics, compile a Level 2 major component list and document it in Level 2 specification, Section 3.1.3, Major Components List.

5.3.18 Constraints Source List

Create a list of Level 2 subsystem source documents used in compiling the constraints applicable to the subsystem. Populate Section 2.0, Applicable Documents, of a Level 2 specification with those source documents on this list specifically identified in the text of a Level 2 specification requirement.

5.3.19 Functions and Requirements (F&R) Source List

Create a list of Level 2 subsystem source documents used in compiling the functions and requirements applicable to the subsystem. Populate Section 2.0, Applicable Documents, of a Level 2 specification with those source documents on this list specifically identified in the text of a Level 2 specification requirement.

5.3.20 Specification Section 6.0 (Notes) Activity

Create Section 6.0, Notes, of a Level 2 specification consisting of any required subsystem background information and/or instructions to the procurement official. Note: Section 6.0 for a Level 2 specification does not contain any requirements.

5.3.21 Specification Section 7.0 (Appendices) Activity

Create and produce a Level 2 specification, Section 7.0, Appendices, consisting of either information pertaining to special Level 2 specification topics and/or as documentation of lengthy requirements previously referenced in a Section 3.0 requirement of the Level 2 specification.

6.0 REFERENCES

6.1 Documents Cited

HNF-IP-0842, 1996, *TWRS Administration Manual, Alternatives Generation and Analysis Procedure*, Westinghouse Hanford Company, Richland, Washington.

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Level 2 Specification Development Annotated Flowchart

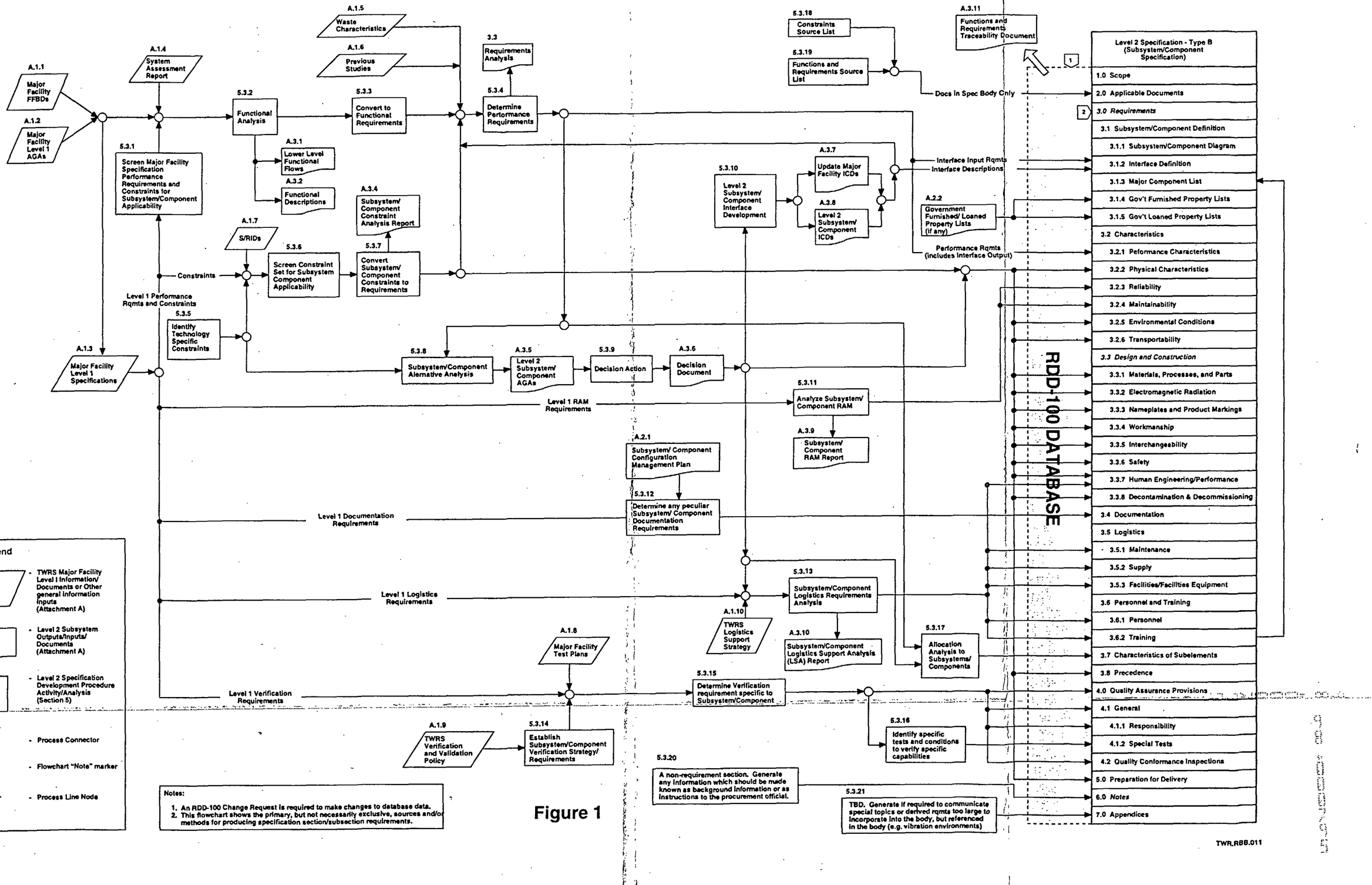

Figure 1

Figure 1. Level 2 Specification Development Annotated Flowchart

Attachment A

Level 2 Specification Development Annotated
Flowchart Input/Output Descriptions

This attachment describes preferred information to facilitate the development of Level 2 specifications. Where this information is not available, the specification author should develop a project strategy and communicate the need to Tank Waste Remediation System (TWRS) System Engineering and Integration (SE&I) or the Tank Waste Retrieval (TWR) Division.

A.1.0 LEVEL 2 SPECIFICATION DEVELOPMENT ANNOTATED FLOWCHART INPUTS (NON-LEVEL 2 INFORMATION/DOCUMENTS)

A.1.1 Major Facility Functional Flow Block Diagrams

Major facility functional flow block diagrams (FFBDs) are the FFBDs produced for use in developing the Level 1 major facility specifications and architectures and are used in helping to decompose the Level 1 functions and architectures into the required Level 2 functions and architectures. FFBDs are an input to the subsystem/component functional analysis.

A.1.2 Major Facility Level 1 Alternative Generation Analysis

Major facility Level 1 alternative generation analyses (AGAs) are the Level 1 AGA process studies conducted and produced in the development of the Level 1 major facility specifications and are used in helping to decompose Level 1 functions and architectures into Level 2 functions and architectures and to define project performance requirements. AGAs are an input to the subsystem/component functional analysis.

A.1.3 Major Facility Level 1 Specifications

Major facility Level 1 specifications are the first level TWRS specifications developed for the TWRS major facilities. The applicable requirements and constraints from the major facility specifications are used as one of the starting points for establishing Level 2 functional requirements, performance requirements, and constraints. Major facility Level 1 specifications are an input source for performing subsystem/component functional analysis, constraint screening process, reliability,

Attachment A (Cont'd)_

Level 2 Specification Development Annotated
Flowchart Input/Output Descriptions

availability, and maintainability (RAM) analysis, documentation analysis, logistics requirements analysis, verification requirements analysis, and the interface control document (ICD) process.

A.1.4 System Assessment Report

The system assessment report is a report on the condition of the existing system infrastructure that is used to determine system needs as well as any constraints on new projects. System assessment report format is chosen by its author. The report contains information indicating how the system was assessed, what the assessment found, and what decisions were made as a result of the assessment. The system assessment report is an input for the subsystem/component functional analysis.

A.1.5 Waste Characteristics

Waste characteristics include the physical makeup of the waste and the amount of waste that exists. Because both of these variables are constantly changing, it is important that waste characteristics are regularly reviewed for new and important data to be factored into the Level 2 specification development process. Waste characteristics are an input to help determine the subsystem/component performance requirements.

A.1.6 Previous Studies

Previous studies are any studies (site, TWRS, or other) or other documents that contain information pertinent to the subsystem/component under consideration or being developed. Previous studies are an input to help determine the subsystem/component performance requirements.

A.1.7 Standards/Requirements Identification Documents

Standards/requirements identification documents (S/RIDs) are all standards and requirements imposed on a system, program, or project from official sources such as the U.S. Department of Energy (DOE) orders, the *Code of Federal Regulations*, and the *Washington Administrative Code*. Pertinent S/RID information is analyzed for

Attachment A (Cont'd)_

Level 2 Specification Development Annotated
Flowchart Input/Output Descriptions

subsystem/component applicability and becomes part of the constraint set which undergoes a screening activity to produce the Level 2 Subsystem/component specification constraints.

A.1.8 Major Facility Test Plans

Test plans (e.g., test and evaluation plan, test and evaluation master plan) for the major facilities contain information pertinent to the subsystem/component under consideration or being developed. Applicable information contained in these major facility test plans is used as an input to the subsystem/component verification analysis process.

A.1.9 TWRS Verification and Validation Policy

The TWRS verification and validation policy is an upper-level policy that documents the verification and validation objectives, guidance philosophy, requirements, constraints, expectations, process management, integration, and compliance/acceptance philosophies. The policy is an input/information for the subsystem/component verification strategy which in turn will be used to help establish subsystem/component verification requirements for the Level 2 specification.

A.1.10 TWRS Logistics Support Strategy

The TWRS logistics support strategy is an upper-level strategy that documents the logistics policies, strategies, requirements, constraints and approach for the entire organization. The logistics support strategy is an input to the subsystem/component logistics requirement analysis activity.

A.2.0 LEVEL 2 SPECIFICATION DEVELOPMENT ANNOTATED FLOWCHART INPUTS (LEVEL 2 INFORMATION/DOCUMENTS)

A.2.1 Subsystem/Component Configuration Management Plan

This plan provides configuration control guidance and management instructions for subsystem/component information and documents. It is used as an input when performing unique subsystem/component documentation requirements analysis.

Attachment A (Cont'd)_

Level 2 Specification Development Annotated
Flowchart Input/Output Descriptions

A.2.2 Government Furnished Property and Government Loaned Property Lists

This is a list of all property furnished by the government for subsystem/component use as well as any property owned by government and on loan to the subsystem/component. The information from these lists is documented and levied to Level 2 Specification, Section 3.1.4, Government Furnished Property Lists, and Section 3.1.5, Government Loaned Property Lists.

A.3.0 LEVEL 2 SPECIFICATION DEVELOPMENT ANNOTATED FLOWCHART OUTPUTS (INFORMATION/DOCUMENTS)

A.3.1 Lower-Level Functional Flows

Lower-level functional flows are the documentation of Level 2 subsystem/component functional flows decomposed from the Level 1 functional flows as a result of the Level 2 subsystem/component functional analysis process.

A.3.2 Functional Descriptions

Functional descriptions are the documentation of the Level 2 subsystem/component text descriptions of the Level 2 functional flows results from the Level 2 functional analysis.

A.3.3 Requirements Analysis

Requirements analysis is the documentation of the Level 2 requirements analysis performed on the subsystem/component when determining the Level 2 Performance requirements from the Level 2 specification functional analysis, functional requirements, constraints, and ICDs.

A.3.4 Subsystem/Component Constraint Analysis Report

The Subsystem/Component Constraint analysis report documents those Level 2 constraints applicable to the subsystem/component and used in the Level 2 specification. The report results from the activity to convert the screened constraint set into specification requirements.

Attachment A (Cont'd)_

Level 2 Specification Development Annotated
Flowchart Input/Output Descriptions

A.3.5 Level 2 Subsystem/Component Alternative Generation Analysis

Level 2 subsystem/component AGAs are documented in reports that are used to determine an alternative decision action.

A.3.6 Decision Document

The decision document is a record of the AGA decision action activity. It includes the decision made on a "preferred" subsystem/component alternative, reasons for the decision and any other information required to support the decision. This information feeds the Level 2 interface development activity, the Level 2 logistics requirements analysis process, and the Level 2 subsystem/component allocation analysis.

A.3.7 Update Major Facility Interface Control Documents

Once the Level 2 interfaces are developed, it may be necessary to update existing Level 1 major facility ICDs because new or better-defined information about the interfaces is discovered. If necessary, major facility Level 1 interface updates will be documented.

A.3.8 Level 2 Subsystem/Component Interface Control Documents

These documents are records of the developed and defined Level 2 subsystem/component interfaces and associated interface requirements into an ICD.

A.3.9 Subsystem/Component Reliability, Availability and Maintainability Report

This report documents the Level 2 subsystem/component RAM analysis activity and RAM requirements.

A.3.10 Subsystem/Logistics Support Analysis Report

This report documents the Level 2 subsystem/component LSA process and logistics requirements.

Attachment A (Cont'd)_

Level 2 Specification Development Annotated
Flowchart Input/Output Descriptions

A.3.11 Functions and Requirements Traceability Document

The functions and requirements (F&R) traceability document is generated from the RDD-100™ database, which identifies either a derived or originating source for each Level 2 subsystem/component function and requirement.

Attachment B

Level 2 Specification Development Annotated Flowchart
Symbol Usage (Legend) Explanations

B.1.0 INPUT/OUTPUT SYMBOL (PARALLELOGRAM)

Upper-level Tank Waste Remediation System (TWRS) major facility information (functional flow block diagrams [FFBDs], alternative generation analyses [AGAs], and specification requirements) or general information (system assessment reports, previous studies, waste characteristics) required as inputs to the process are denoted by the input/output symbol (a parallelogram).

B.2.0 DOCUMENT SYMBOL (PRINT SYMBOL)

Subsystem outputs (subsystem/component reliability, availability, and maintainability [RAM] report, logistics support analysis [LSA] report, or AGAs) from the process as well as subsystem project documents (subsystem/component configuration management plan, subsystem/component government furnished/loaned property lists) required as inputs are denoted by the document symbol.

B.3.0 PROCESS SYMBOL (RECTANGLE)

Any activities or analyses (functional analysis, requirements analysis, or interface development) required for development of Level 2 specifications and any unique required Level 2 specification development guide information, Section 6.0, Notes, specification, Section 7.0 [Appendices] are denoted by a process symbol (a rectangle).

B.4.0 CONNECTOR SYMBOL (SMALL CIRCLE)

A connector symbol (small circle) is used to signify incoming or outgoing unique processes or information.

B.5.0 LINE NODE (LINE DOT)

A line node (dot) indicates an informational node that provides an information trace either to or from several different sources along a process flow line.

B.6.0 OFFPAGE CONNECTOR (HOME PLATE)

An offpage connector symbol is used to denote an annotated flowchart note of interest.

Attachment C

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.1.0 SCOPE

C.1.1 Description

This specification establishes the performance, design development, and test requirements for (insert the physical subsystem's/component's name and identifier). The purpose of this paragraph is to describe the subsystem/component that will be further detailed in the remainder of this specification. Describe what the subsystem/component is in this paragraph. This brief statement shall be sufficiently complete and comprehensive to describe generally the subsystem/component and material or process covered by the specification in terms that may be easily interpreted by manufacturers, contractors, etc. Do not list requirements that belong appropriately elsewhere in this specification.

C.1.2 Classification

Where a specification covers more than one category of a subsystem/component, designations of classification such as types, grades, classes, etc., shall be listed under this heading and shall be in accordance with accepted industry practice. When only one class of the subsystem/component is covered by this specification then the classification statement will be written in the scope paragraph and this section deleted. When the terms type, class, grade, composition, and style do not serve accurately to classify the differences, then other terms suitable for reference may be used such as color, form, weight, size temperature rating, etc.

C.2.0 APPLICABLE DOCUMENTS

List all and only those documents referenced in Section 3, 4, 5, and Appendixes of this specification and should include title and date or rev.

C.2.1 U.S. Department of Energy Documents

C.2.2 Code of Federal Regulations

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.2.3 HNF Documents

C.2.4 Codes and Standards

C.3.0 REQUIREMENTS

C.3.1 Subsystem/Component Definition

This paragraph will graphically portray the functions of the subsystem/component and the relationship of the subsystem/component to be developed to the remainder of the system. It shall identify (a) the major components of this subsystem/component and (b) the individual components that must be developed.

C.3.1.1 Subsystem/Component Diagrams

This paragraph will display the subsystem/component level functional schematics. This paragraph will cover the top-level functional flow diagrams of the subsystem/component and include diagrammatic presentations to the level required to identify all essential functions.

C.3.1.2 Interface Definition

This paragraph shall cover the functional and physical interfaces between (a) this subsystem and the other subsystems/components, and (b) the major components within this subsystem/component. The functional interfaces shall be specified in quantitative terms of input/output voltages, temperature ranges, loads, velocities, etc. Where interfaces differ because of a change in operational mode, the requirements shall be specified in a manner that identifies specific functional interface requirements for each different mode. Physical interface relationships shall be expressed in terms of dimensions with tolerances.

C.3.1.2.1 Functional Interfaces

C.3.1.2.2 Physical Interfaces

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.3.1.3 Major Component List

This paragraph shall include a complete list of all major components that comprise the subsystem/component.

C.3.1.4 Government Furnished Property Lists

This paragraph shall include a complete list of all government furnished property included in the subsystem/component design.

C.3.1.5 Government Loaned Property Lists

This paragraph shall include a complete list of all government loaned property in use by the subsystem/component.

C.3.2 Characteristics

C.3.2.1 Performance Characteristics

This paragraph shall state what the subsystem/component shall do, including upper and lower performance limits. Include considerations such as rates, velocities, pressure, etc., and quantitative criteria covering the endurance capabilities of the subsystem/component required to meet user needs under stipulated environmental and other conditions, including minimum total life expectancy. Indicate required mission duration and planned utilization rate.

C.3.2.2 Physical Characteristics

This paragraph shall include the following as applicable:

a. Weight limits of the subsystem/component

b. Dimensional and cube limitations, operator station layout, ingress, egress, and access for maintenance

c. Requirements for transport and storage, such as tiedowns, pallets, packaging, and containers

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

d. Durability factors to indicate degree of ruggedness

e. Health and safety criteria, including consideration of adverse explosive, mechanical, and biological effects. Included in these criteria are the adverse impacts of the subsystem/component or components thereof on facility personnel, the public, and the environment.

f. Security criteria

g. Command control requirements

h. Vulnerability factors including consideration of chemical, biological, and radiological operations, electromagnetic radiation, fire, and impact.

C.3.2.3 Reliability

Reliability shall be stated in quantitative terms, defining the conditions under which the requirements are to be met. Reliability requirements are normally expressed in terms of the required mean time between failure; i.e. 10,000 operating hours between failures. Reliability can also be expressed as a percentage availability; i.e., operational 90% of a time period, 90% of the time during transfers, etc.

C.3.2.4 Maintainability

This paragraph shall specify the quantitative maintainability requirements. The requirements shall apply to maintenance in the planned maintenance and support environment and shall be stated in quantitative terms. Examples are:

a. Time (e.g., mean and maximum downtime, reaction time, turnaround time, mean and maximum time to repair, mean time between maintenance actions)

b. Rate (e.g., maintenance manhours per operational hours, maintenance manhours per specific maintenance action, operational ready rate, frequency of preventive maintenance)

c. Maintenance complexity (e.g., number of people and skill levels, variety of support equipment).

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.3.2.5 Environmental Conditions

This paragraph shall include both induced and natural environmental conditions expected to be encountered by this subsystem/component during storage, shipment, and operation. It shall include such factors as climate, shock, vibration, noise, and noxious gases.

C.3.2.6 Transportability

This paragraph shall include requirements for transportability which are common to all components to permit receipt, deployment, and logistic support. Any subsystem/component which due to it functional or operational characteristics, will be unsuitable for normal transportation methods shall be identified.

C.3.3 Design and Construction

This paragraph shall specify minimum subsystem/component design and construction standards which have general applicability and are applicable to major classes of equipment or are applicable to particular design standards (e.g., nuclear air-handling systems, piping standards, etc.). To the maximum extent possible, these requirements shall be specified by reference to the established government and industry specifications and standards. Also included will be environmental standards to preclude adverse environmental impacts resulting from operation of the subsystem/component.

C.3.3.1 Materials, Processes, and Parts

This paragraph shall specify those subsystem/component-particular requirements governing use of materials, parts, and processes to be used in the design of the subsystem/component. It shall also provide information on which materials, processes, and parts that are not acceptable for use.

C.3.3.2 Electromagnetic Radiation

This paragraph shall contain requirements pertaining to electromagnetic radiation. It shall cover both the environment in which the subsystem/component operates as well as that which it generates.

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.3.3.3 Nameplates and Product Markings

This paragraph shall contain requirements for nameplates, part marking, serial and lot number marking, and all other identifying markings required for the subsystem/component and its subcomponent parts.

C.3.3.4 Workmanship

If development models of equipment are to be used during design, this paragraph shall contain the workmanship requirements for producing the models.

C.3.3.5 Interchangeability

This paragraph shall identify those components to be interchangeable and replaceable. Entries in this paragraph are for the purpose of establishing a condition of design.

C.3.3.6 Safety

This paragraph shall specify requirements to preclude or limit hazards to personnel and equipment. To the extent practicable, these requirements shall be imposed by citing established and recognized standards. Limiting safety characteristics peculiar to the subsystem/component due to hazards in assembly, disassembly, test, transport, storage, operation or maintenance shall be stated when covered neither by standard industrial or service practices. "Fail-safe" and emergency operating restrictions shall be included where applicable. These shall include interlocks and emergency standby circuits required to either prevent injury or provide for recovery of the subsystem/component in the event of failure.

C.3.3.7 Human Performance/Human Engineering

Human engineering requirements for the configuration of the subsystem/component should be specified herein and applicable documents included by reference. This paragraph should also specify any special or unique requirements.

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.3.3.8 Decontamination and Decommissioning

Decontamination and decommissioning requirements for the configuration of the subsystem/component should be specified herein and applicable documents included by reference. This paragraph should specify what disposal requirements the subsystem/component should be designed to satisfy (e.g., material restrictions, ability to clean sufficiently for disposal, etc.).

C.3.4 Documentation

This paragraph shall specify the plan for subsystem/component documentation such as specifications, drawings, technical manuals, test plans and procedures, installation instruction data.

C.3.5 Logistics

C.3.5.1 Maintenance

This paragraph shall include considerations such as use of multipurpose test equipment, use of module vs. part replacement, maintenance and repair cycles, accessibility and level of repairability.

C.3.5.2 Supply

This paragraph shall specify the impact of the subsystem/component on the supply system and the influence of the supply system on the subsystem/component design and use. Considerations shall include introduction of new components into the supply system, supply and resupply methods, distribution and location of subsystem/component stocks.

C.3.5.3 Facilities and Facility Equipment

This paragraph shall specify the impact of the subsystem/component on existing facilities and facility equipment. It also shall specify requirements for new facilities or ancillary equipment to support the subsystem/component.

C.3.6 Personnel and training

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

C.3.6.1 Personnel

This paragraph shall specify personnel requirements which must be integrated into the subsystem/component design. Requirements shall be specified in a positive sense, assuming that the numbers and skill levels of personnel will be made available. Requirements shall be the basis for determination of subsystem/component personnel training equipment/facility requirements.

C.3.6.2 Training

This paragraph shall consider:

a. Training requirements that will be generated by new equipment to include, if possible, the concept of how training should be accomplished; e.g., school, unit, or contractor training

b. Estimates of quantities of equipment being developed that will be required solely for training purposes

c. The need to develop associated training devices, including types required. Prepare actual detailed statements of requirements for characteristics of training devices

d. Training time and locations available for effective training programs.

C.3.7 Characteristics of Subelements

This paragraph shall include a subparagraph for each major component/subelements listed in paragraph 3.1.3. In stating requirements for the various major components/subelements, it should be recognized that verification may necessarily need to be accomplished following the delivery, installation, and checkout of the parts constituting the major components/subelements. The functional relationship may be such that verification of requirements specified for a major component/subelement can only be accomplished when the units, assemblies, or parts which comprise the major component/subelement are assembled into the subsystem/component. For each major component/subelement, a separate

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

paragraph shall be prepared specifying the performance and physical characteristics.

C.3.8 Precedence

This paragraph shall either specify the order of precedence of requirements or assign weights to indicate the relative importance of characteristics and other requirements. These include requirements allocated from subsystem/component requirements and requirements that are peculiar to the major component/subelement and cannot be directly referenced to subsystem/component requirements. It shall also establish the order of precedence of this specification relative to the referenced documents.

C.4.0 QUALITY ASSURANCE PROVISIONS

Requirements for formal tests/verifications of subsystem/component performance and design characteristics and operability shall be specified in this paragraph. Test/verifications specified herein shall include subsystem/component design evaluation and operational capability verification. Subparagraphs under this section shall include:

a. Reliability testing with respect to subsystem/component and subcomponent reliability. Requirements shall be specified for collection and recording of data during all testing which is to be part of the reliability analysis.

b. Engineering evaluation and test requirements to the level of detail necessary to define the extent of the test program and the objectives of the tests. The specific elements to be included in the test shall be specified. If data generated during the progress of tests specified herein is to be recognized as formal verification that specified requirements in Section 3 of the specification have been satisfied, the test objectives shall so state.

c. Qualification testing of the subsystem/component and critical subcomponents.

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

d. Installation testing and checkout, such as continuity checking, interface mating, major component operation in the installed environment, support equipment compatibility, and documentation verification.

e. Formal test verification of performance characteristics to demonstrate that subsystem/component requirements in Section 3 of the specification have been satisfied.

C.4.1 General

This paragraph shall discuss the philosophy of testing, location for performance of tests, and other information related to subsystem/component testing not covered elsewhere.

C.4.1.1 Responsibility

This paragraph shall assign responsibilities for performance of tests to each agency, government or contractor, as applicable.

C.4.1.2 Special Tests

This paragraph is optional in the development specification, and when used, would generally cover testing requirements for qualification evaluation for selection of parts, components, or equipments to be used in the system.

C.4.2 Quality Conformance Inspections

This paragraph shall cover, or reference, test and inspection requirements necessary to determine if all requirements of Section 3 of the specification have been achieved. Insofar as practical, tests shall be arranged in a logical order for sequential performance.

C.5.0 PREPARATION FOR DELIVERY

This section shall provide guidance for the preparation of equipment for delivery. Such guidance will be peculiar to the subsystem/component being specified and other than standard practice. It shall include specific

Attachment C (Cont'd)

Level 2 - Type B Subsystem/Component
Specification Format/Content

requirements to incorporate such nonstandard practices in appropriate subsystem/component descriptions. It may impose requirements to comply with standard practices by referencing appropriate official specifications and standards.

C.6.0 NOTES

The contents of this section are not contractually binding. This is a nonrequirements section. Any information which should be made known as background information or as instructions to the procurement official may be include herein.

C.7.0 APPENDICES

This section of the specification shall contain requirements which are contractually a part of the specification but which, for convenience in specification maintenance, are incorporated herein because they are too large to incorporate into the main body of the specification (e.g., vibration environments). Can also be used to communicate special topics in the same manner. The special topic or large derived requirements listed here must be referenced in the main body of the specification.

Attachment D

Level 2 Specification Development
Background Information

D.1.0 TECHNICAL BASELINE DEVELOPMENT PROCESS - MAJOR FACILITY LEVEL 1 SPECIFICATIONS DEVELOPMENT BACKGROUND

The starting point for the development process of lower-level (Level 2) Tank Waste Remediation System (TWRS) specifications is the major facility Level 1 specifications. To produce these major facility specifications, TWRS first claimed ownership of nine major facilities and a first-level subcomponent of another major facility (the Canister Storage Building [CSB]) on the Hanford Site Architecture Tree. This collection of major facilities, the CSB subcomponent, and identified interfaces are the necessary and sufficient set of architectures needed to accomplish the TWRS mission as described in the TWRS Mission Analysis Report. TWRS major facility-level functions and functional flow block diagrams (FFBDs) were derived from the Hanford Site Functional Hierarchal Breakdown. Existing TWRS requirements (including some with items to be determined) and newly identified requirements were analyzed, resulting in a set of performance requirements needed to satisfy these major facility-level functions. Also, imposed requirement sets (constraints) from the site, from standards/requirements identification documents, and from the TWRS Mission Analysis Report were analyzed for their applicability to each of the major facilities and levied where appropriate. From these identified major facility-level performance requirements and applicable, levied constraint sets, the Level 1 major facility specifications were developed and produced. The technical baseline development process work done to produce the TWRS major facility Level 1 specifications, information from the specifications, and other associated Hanford Site information will be used as initial input conditions to describe the TWRS Level 2 specification development process detailed in this guide.

Attachment D (Cont'd)

Level 2 Specification Development
Background Information

D.2.0 SUBSYSTEM/COMPONENT DEFINITION PROCESS

Level 2 subsystem specifications are but one portion of development and definition of a TWRS subsystem. Other subsystem information, used in conjunction with these specifications, all contribute to help develop and define the TWRS subsystem W-Projects. TWRS subsystem documents such as a scoping document or a statement of work are invaluable tools in both defining new subsystems and validating existing TWRS lower-level subsystem W-Projects. Upper-level TWRS documents/information such as major facility FFBDs, major facility specifications, major facility alternative generation analyses, TWRS major facility architectures, and existing system assessment reports are also of use in the subsystem development/definition process. Costing information, additional assessment reports, need reports, and schedules will also contribute to defining and developing new TWRS subsystems and validation and/or modification of existing TWRS subsystem W-Projects. The purpose of this guide is not to go into a detailed description of the TWRS subsystem definition process, but rather summarize what types of information/documentation will be used so as to help understand what role the Level 2 specifications play in this process and their importance to the process as a whole.

Attachment D (Cont'd)

Level 2 Specification Development
Background Information

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