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Systems Engineering Functions and Requirements for the Hanford Cleanup Mission: First Issue

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**SYSTEMS ENGINEERING FUNCTIONS AND REQUIREMENTS
FOR THE HANFORD CLEANUP MISSION: FIRST ISSUE**

SUMMARY

This addendum provides additional information, in the form of Functional Flow Block Diagrams (FFBD), concerning the systems engineering functional analysis for the Hanford cleanup mission. Details of the mission analysis including mission statement, scope, problem statement, initial state definition, and final state definition are provided in the parent document¹. The results of the functional analysis as depicted in Integrated Definition language notation (IDEF0) diagrams are provided in Addendum 2 to the parent document.

The FFBDs provided herein cover the total Hanford cleanup mission and depict the decomposition of functions to a reasonable level for understanding (generally level 3 or 4). Functional definitions are contained in Section 3.0 of Addendum 2 to the parent document. Specific programs such as the Tank Waste Remediation System and Environmental Restoration, whose IDEF0 diagrams were presented as part of their specific baseline documentation and not included in Addendum 2, have their FFBDs included in this addendum.

The information contained in this addendum will remain tied to the overall Hanford cleanup mission through the top-level ("Capstone") functional analysis so that a complete, top-to-bottom functional documentation set always exists for all mission activities. This linkage is accomplished through the use of the Requirements Driven Design (RDD-100²) design tool.

Through the use of RDD-100², this addendum supports and is traceable to the information presented in Addendum 2 to the parent document.

¹Holmes, J. J., 1994, *Systems Engineering Functions and Requirements for the Hanford Cleanup Mission: First Issue*, WHC-EP-0722, Rev. 0, Westinghouse Hanford Company, Richland Washington.

²RDD-100² is a trademark of Ascent Logic Corporation.

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1.0 FUNCTIONAL FLOW BLOCK DIAGRAMS

Functional flow block diagrams (FFBD) are developed as an integral part of the functional analysis of a system. FFBDs are employed as a mechanism for portraying system design requirements in a pictorial manner, illustrating the hierarchy of system functions, their possible sequences, alternative (path) selection processes, concurrencies, and functional interfaces. These diagrams are developed for all levels of the system down to a level necessary to establish the needs of the system in terms of hardware, software, facilities, personnel, and data. The top level shows gross operational functions while the lower levels represent progressive expansions of the individual functions of the preceding level.

The enclosed FFBDs were developed with the Requirements Driven Design (RDD-100*) System as part of the Hanford Sitewide systems engineering activities. These diagrams were developed following definition of the functional relationships by the domain expert working groups as part of the "Capstone" effort. This effort was documented in the IDEFs contained in Addendum 2. The FFBDs presented herein represent a separate but consistent view of the system as presented in Addendum 2.

The "AND" connections utilized in the figures as an input to two or more functions indicate that both functions may start simultaneously. When utilized to join the output of two or more functions, it indicates that all connected functions must be completed before the process can continue.

The "OR" connections utilized in the figures to connect two or more inputs to a function indicate that any of the inputs may be utilized to start the function. When utilized to join the output of two or more functions, it indicates that only one of the connected functions must be completed before the process can continue.

Figure 1-1 depicts the top level (level 0) FFBD as consisting of the level 1 functions (1) Manage Program, (2) Acquire Mission Essential Capabilities, (3) Obtain Public Acceptance, (4) Remedy Unsafe and Unacceptable Conditions, and (5) Transition Resources for Beneficial Use. Function (4) is shown as further decomposed to its next level functions of (4.1) Deactivate Facilities, (4.2) Remediate Tank Waste, (4.3) Remedy Solid Waste, (4.4) Remedy/Restore Sites, Facilities, & Ground Water, (4.5) Manage Aqueous Wastes, (4.6) Correct Unsafe Infrastructure Conditions, and (4.7) Store, Treat, and Disposition SNM/NM/NF Materials.

Figures 1-2, 1-4 through 1-6, and 1-15 depict the FFBDs for the decomposition of the level 1 functions (1) Manage Program, (2) Acquire Mission Essential Capabilities, (3) Obtain Public Acceptance, and (5) Transition Resources for Beneficial Use. In Figure 1-3, a separate page has been utilized to more clearly present the decomposition of the level 2 function (1.1) Establish Management System to its lower level constituents.

Figures 1-7, and 1-9 through 1-14 depict the FFBDs for each of the level 2 functions (4.1) Deactivate Facilities, (4.2) Remediate Tank Waste, (4.3) Remedy Solid Waste, (4.4) Remedy/Restore Sites, Facilities, & Ground Water, (4.5) Manage Aqueous Wastes, (4.6) Correct Unsafe Infrastructure Conditions, and (4.7) Store, Treat, and Disposition SNM/NM/NF Materials, decomposed to their respective lower level functions. In Figure 1-8, a separate page has been utilized to more clearly present the decomposition of the level 3 function (4.1.1) Deactivate Facilities With Special Nuclear Materials & Nuclear Materials (Type 1 Facility).

Figure 1-1. Clean Up Hanford.

Exit Loop: Provides functional interface to
 1.2 System Engineering
 1.8 Help Relevant Government

Figure 1-3. Establish Management System (Scenario).

Figure 1-4. Acquire Mission Essential Capabilities (Scenario).

Figure 1-5. Obtain Public Acceptance (Scenario).

Figure 1-6. Remedy Unsafe and Unacceptable Conditions.

Figure 1-7. Deactivate Facilities
(Scenario).

DESCRIPTION: Machines With Special Nuclear Material & Nuclear Material (1' pp) 1' Ctry)

Figure 1-8. Deactivate Facilities with Special Nuclear Materials (Scenario).

Figure 1-9. Remediate Tank Waste (Scenario).

Figure 1-10. Remedy Solid Waste (Scenario).

Figure 1-11. Remedy/Restore Sites, Facilities, and Groundwater (Scenario).

4
Remedy Unsafe And
Unacceptable
Conditions

AND

4.5.1
Maintain Aqueous
Waste Safety and
Compliance Envelope
SDD

4.5.2
Develop Aqueous
Waste Disposition Plan
SDD

Receive/Transport Aqueous Waste

4.5.3.1
Process Generator
Aqueous Waste
Transfer Request
SDD

4.5.3.2
Schedule Aqueous
Waste Transfers
SDD

4.5.3.3
Transfer Aqueous
Waste
SDD

4.5.3.4
Store Transferred
Aqueous Waste
SDD

Figure 1-12. Manage Aqueous Waste (Scenario).

This diagram depicts the functional representation for correcting a generic unsafe infrastructure condition. This generic representation is applicable to the following specific infrastructure conditions.

- Energy - Electricity, Steam, Gas
- Transportation - Bus, Truck, Barge, etc.
- Fabrication Shops
- Office Space
- Telecommunications - Telephone, Radio, Microwave, etc.
- Water System
- Sanitary Waste System
- Solid Waste Disposal
- Storage Facilities
- Emergency Facilities - Fire, First Aid, Ambulance, etc.
- Training Facilities

Figure 1-13. Correct Unsafe Infrastructure Conditions (Scenario).

Figure 1-14. Store, Treat, and Disposition
Special Nuclear Materials, Nuclear
Materials, Nuclear Fuel Materials
(Scenario).

Figure 1-15. Transition Resources for Beneficial Use (Scenario).

2.0 DETAILED FUNCTIONAL FLOW BLOCK DIAGRAMS

Figures 2-1 through 2-71 depict the FFBDs for each level 0, 1, 2, and 3 function individually decomposed to the next level.

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Figure 2-1. Clean Up Hanford.

Figure 2-2. Manage Program.

Figure 2-3. Establish Management System.

Figure 2-4. Evaluate Value Added.

Figure 2-5. Define Management System.

Figure 2-6. Implement Management System.

Figure 2-7. Maintain Management System.

Figure 2-8. Formulate Program.

Figure 2-9. Formulate Program Baseline.

Figure 2-10. Obtain Funding.

Figure 2-11. Direct Program.

Figure 2-12. Implement Program Baseline.

Figure 2-13. Evaluate Program.

Figure 2-14. Status Program.

Figure 2-15. Analyze Status Information.

Figure 2-16. Conduct Audits and Assessments.

Figure 2-17. Acquire Mission Essential Capabilities.

Figure 2-18. Formulate Acquisition Strategy for Mission Essential Capabilities.

Figure 2-19. Provide Expertise.

Figure 2-20. Import Expertise.

Figure 2-21. Develop Expertise.

Figure 2-22. Retain Expertise.

Figure 2-23. Provide Technology.

Figure 2-24. Provide Facilities, Equipment, Infrastructure, and Supplies.

Figure 2-25. Provide Projects.

Figure 2-26. Provide Equipment.

Figure 2-27. Provide Essential Information.

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Figure 2-41. Remedy Solid Waste.

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Figure 2-45. Determine Solid Waste Disposition Requirements.

Figure 2-46. Disposition Solid Waste.

Figure 2-47. Manage Aqueous Wastes.

Figure 2-48. Maintain Aqueous Waste Safety and Compliance Envelope.

Figure 2-49. Develop Aqueous Waste Disposition Plan.

Figure 2-50. Receive/Transport Aqueous Waste.

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Figure 2-51. Treat Aqueous Waste.

Figure 2-52. Disposition Aqueous Waste.

Figure 2-53. Correct Unsafe Infrastructure Conditions.

Figure 2-54. Store, Treat, and Disposition Special Nuclear Materials, Nuclear Materials, Nuclear Fuels Materials.

Figure 2-55. Maintain Safety and Security Envelope (Special Nuclear Materials, Nuclear Materials, Nuclear Fuels Materials).

Figure 2-56. Control Special Nuclear Materials, Nuclear Materials, and Nuclear Fuels Functions.

Figure 2-57. Handle Incoming Materials.

Figure 2-58. Store Materials.

Figure 2-59. Transfer Outgoing Materials for Disposition.

Figure 2-60. Transition Resources for Beneficial Use.

Figure 2-61. Determine Beneficial Uses of Resources.

Figure 2-62. Inventory Resources.

Figure 2-63. Define and Rank Alternative Potential Uses.

Figure 2-64. Identify Potential Users.

Figure 2-65. Confirm Market.

Figure 2-66. Select Preferred Disposition.

Figure 2-67. Transfer Ownership of Resources Outside of Mission.

Figure 2-68. Transfer Resources for Use Outside of Mission.

Figure 2-69. Modify/Upgrade Resources.

Figure 2-70. Establish Conditions for New Use.

Figure 2-71. Transfer Resource for New Use.

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