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

J. J. Holmes

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

J. J. Holmes

ABSTRACT

The formalized methodology of Systems Engineering is being applied to the Hanford Cleanup effort. Systems Engineering is a prescriptive process consisting of steps that span the entirety of the cleanup effort including program strategy development, system design, acquisition and verification, and deployment of the system to achieve the desired mission objectives. The initial steps in application of Systems Engineering to the cleanup effort include top-level mission analysis, functional breakdown, requirements analysis, and measures of effectiveness development for the selection of specific designs or functional architectures.

The Hanford Cleanup mission analysis was performed by senior executives from Westinghouse Hanford Company, Pacific Northwest Laboratory, Kaiser Engineers Hanford, Boeing Computer Services, Richland, and Hanford Environmental Health Foundation. The executive mission analysis produced a mission statement, scope statement, and a problem statement, and defined the initial state and desired end state. This mission analysis work was further developed by a "capstone" team which produce a top-level functional analysis defining all appropriate functional relationships. The Capstone Team also specified a top-level set of requirements, constraints, and measures of effectiveness.

This report documents the top-level mission analysis, functional analysis, and requirements analysis for the cleanup effort. Systems Engineering is a hierarchical process in which detail becomes apparent only after sufficient analysis. Functional analyses are described to Level 2 to show the connection between the initial functional decompositions and the more detailed functional analysis to follow.

The material described above is just the initial part of the Systems Engineering process. Development of design alternatives and architectures, design selection and optimization, detailed design, product definition and organization, system acquisition, verification, and deployment, all remain to be completed.

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERMC	Environmental Restoration Management Contract
FR	Federal Register
IDEFO	Input Computer Automated Manufacturing Definition
MIL-STD	U.S. Department of Defense Military Standard
PL	Public Law
RCW	Revised Code of Washington
RDD	Requirements Driven Design
SE	System Engineering
SEN	Secretary of Energy Notice
Tri-Party Agreement	<i>Hanford Federal Facility Agreement and Consent Order</i>
TWRS	Tank Waste Remediation System
USC	United States Code
WIPP	Waste Isolation Pilot Project

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1.0 INTRODUCTION

The Systems Engineering (SE) approach to defining work content and organization is being introduced to the Hanford Site cleanup effort as an initiative to substantially improve mission performance. Systems Engineering methodology evolved mostly from the U.S. Department of Defense (DOD) where its application to weapons system development, procurement, and verification is well known. This approach also has been used for planning and conducting the National Aeronautics and Space Administration activities which stretched the envelope of human experience to the moon and beyond. During the last few years, SE has been extended to applications beyond its original base such as improvements to business systems; the design and production of complex computer equipment; and advances in the nuclear industry, at the Yucca Mt. repository, and in the Nuclear Regulatory Commission regulatory process.

1.1 OBJECTIVE

This report documents the top-level SE mission analysis, functions analysis, and requirements analysis for the Hanford Site cleanup mission. Because SE is an iterative process, this document will be continuously updated as the mission evolves. This first issue will be subject to change as lower-level work is conducted or primary system architecture is changed as a result of public involvement, NEPA processes, or changes in DOE/HQ direction.

1.2 SYSTEMS ENGINEERING FUNCTIONS AND REQUIREMENTS DEFINED

The U.S. Department of Defense (DOD) Military Standard (MIL-STD) 499B (MIL-STD 1993) describes the application of the SE process as follows:

"The System Engineering process is applied iteratively ... to translate the stated problems into design requirements providing an integrated solution consisting of people, products, and processes that provides a capability to satisfy customer needs. Problems are normally expressed in terms of needs for new developments and modifications or, as deficiencies in operating, supporting, or providing training for already-fielded items. Performance-based requirements and alternative solutions to problems are iteratively defined and refined. .... Selection of preferred solutions is based on cost, schedule, performance and risk."

Additionally, MIL-STD 499B also specifies the requirements for the SE process:

"The performing activity shall employ the systems engineering process of requirements analysis, functional analysis/allocation, synthesis, and systems analysis and control progressively throughout the effort to achieve contractual objectives and to define requirements, designs, and solutions for the system life cycle."

Requirements analysis is described as follows:

"The performing activity shall analyze customer needs, objectives, and requirements in the context of customer missions, utilization environments, and identified systems characteristics to determine functional and performance requirements for each primary function."

Functional analysis is described as:

"Identified functional requirements shall be analyzed to determine the lower level functions to accomplish the parent mission. All specified usage modes shall be included in the analysis. Functional requirements shall be arranged so that lower level functional requirements are recognized as part of higher level requirements. When time is critical to performance or sequencing of functions, a time line analysis shall be conducted. Functional requirements shall be logically sequenced; with input, output, and functional interface requirements defined; and be traceable from beginning to end conditions and across their interfaces."

1.3 SYSTEMS ENGINEERING PROCESSES FOR THE HANFORD MISSION

The U.S. Department of Energy (DOE) management environment is substantially different than that of DOD. As a result, the principles of MIL STD 499B may not be directly applicable to the cleanup mission. DOE Order 4700.1 describes a SE process appropriate for well-defined projects, but not for overall high-level program strategy or architecture development.

The SE approaches specified above must be modified to be useful to the design and delivery of the cleanup effort. Work described in this report reflects the overall intent of MIL STD 499B and DOE Order 4700.1 but not the specific detail.

The methodology adapted to Hanford Site cleanup defines mission requirements, guides selection of design solutions, and defines system deliverables, acquisition, verification, and integration. The mission requirements work consists of mission analysis, functional analysis, external requirements analysis, and measures of effectiveness development. Design solution and definition includes development of system alternatives, evaluation and selection of these alternatives, and detailed design of selected alternatives. The acquisition, verification, and integration phase includes all operations, procurement of systems elements, construction projects, quality assurance, configuration management, interface management, and optimization.

2.0 TOP-LEVEL HANFORD CLEANUP MISSION ANALYSIS

SE activities were initiated using an Executive Workshop consisting of high-level management personnel from Westinghouse Hanford Company, Kaiser Engineers Hanford, Battelle Pacific Northwest Laboratory, and Hanford Environmental Health Foundation. The workshop was followed by a 2-mo long workshop of executive-level delegates aimed at verification of the executive-level work and extension to lower levels of detail. This group was designated as the "Capstone Group."

The Executive Workshop/Capstone Group activities produced a mission statement, input state definition, desired final state definition, scope statement, problem statement and mission external interface definition. Subsequent review by Hanford Site contractor and DOE Richland Operations Office (RL) senior management was used to establish a Hanford Site consensus on the mission analysis. Specifics follow.

2.1 HANFORD CLEANUP MISSION STATEMENT

At the Hanford Strategic Quality Planning Board meeting of 12/9-10/93, a new mission statement for all Hanford work was defined as:

"The Hanford Mission is to clean up the site, provide scientific and technological excellence to meet global needs, and to partner in the economic diversification of the region."

This mission statement defines three separate, but related, missions for Hanford. This document is focused uniquely on the Cleanup Mission. SE, for the remaining two missions, will be the focus of efforts to come later.

This mission statement for the Cleanup work is:

"The waste management and environmental restoration mission is to clean up the Hanford Site, protect the health and safety of the public and our workers, protect the environment, and provide beneficial use of land and other resources while serving as the DOE model for environmental restoration. Site cleanup will be in accordance with the *Hanford Federal Facility Agreement and Consent Order* (also known as the Tri-Party Agreement) (Ecology et al. 1990), other agreements, and will be in compliance with all applicable federal, state, and local laws. The stakeholders will be active participants in the decision processes including establishing priorities, determining end states, and developing a consistent set of rules, regulations, and laws. The work will be leveraged with providing positive, lasting economic impact in the region. Effectiveness, efficiency, and discipline in all mission activities will enable us to achieve our vision and mission in a continuous and substantive manner."

2.2 THE HANFORD CLEANUP MISSION SCOPE STATEMENT

The waste management and environmental restoration mission is to mitigate environmental, safety, and health risks and brings the Site into compliance with applicable laws. It makes Hanford Site land and other resources (including excess facilities and infrastructure) available for other uses by treating, storing, and disposing of waste and other materials where necessary. It also will support determination of appropriate future uses for the Hanford Site's land by varied outside stakeholder groups, and does not preclude other government missions.

The mission includes the following: (1) management and transition of all materials and facilities from the Hanford Site's former mission; (2) treatment and preparation of waste and other materials for shipment off site; (3) assimilation and disposition of nuclear materials; (4) disassembly and disposal of existing facilities; (5) development and deployment of the infrastructure necessary to support the cleanup mission, (6) closure of waste sites; and (7) postclosure monitoring in accordance with regulatory requirements.

The mission will contribute to the economic transition of the region by mitigating adverse impacts from workforce fluctuations, transferring technology, and by making Hanford Site land and other resources available for new uses.

Obtaining public acceptance is considered essential to mission completion.

2.3 THE HANFORD CLEANUP MISSION INITIAL STATE

2.3.1 Health/Environmental Legacy From Former Missions

The legacy from the Hanford Site's former missions poses unacceptable current and future risks to the public, workers, and environment.

Hanford Site's legacy includes contaminated land, groundwater, and facilities from prior uses; deteriorating facilities and infrastructure that pose potential threats to the Hanford Site's workforce; ongoing releases of materials to the environment (some controlled and some uncontrolled) through multiple pathways, including to the Columbia River; and large inventories of stored and disposed radioactive wastes, nuclear materials, and other hazardous wastes, including some wastes that are not well characterized, thus leading to safety issues and uncertainties in the selection of appropriate processing approaches.

2.3.2 Regulatory Noncompliance

Portions of the Site's operations do not comply with applicable regulations.

Cleanup and operation of the Hanford Site is subject to regulation by numerous federal, state, local and regional authorities. The Tri-Party Agreement (Ecology et al. 1990) and other compliance agreements were formed in recognition of the fact that full regulatory compliance does not now exist. The Tri-Party Agreement enables Site operations to continue, and establishes enforceable commitments for bringing the Site into compliance with the regulations. Compliance is complicated by the complexity of wastes and other materials including large quantities of mixed radioactive and hazardous constituents and quantities of nuclear materials that are not classified as wastes.

2.3.3 Restricted Land

Past uses of the Hanford Site restricts land usage and limits land available for other socially beneficial uses.

The Site consists of 1,450 km² (560 mi²) of land of which roughly 10 percent has been occupied by past mission activities. These activities have resulted in contamination of about 518 km² (200 mi²) of underlying groundwater and more than 1,000 separate contaminated sites. The Site also contains contaminated facilities, stored nuclear materials, and previously disposed radioactive and hazardous materials.

2.3.4 Public Distrust

There is a lack of public trust of activities carried out at the Hanford Site.

The secrecy surrounding the Hanford Site's past production mission has lead to general mistrust by the public of the DOE's current activities at the Site. The complexity of the technical activities and the potential risk associated with these activities further heighten public attention and concern. The DOE's traditional decision-making processes have not effectively involved the public. Effective public involvement, however, is essential to making cleanup progress.

2.3.5 Dependent Local Economy

The local and regional economy is highly dependent upon federal funding of activities at the Hanford Site.

Hanford Site work activity and employment comprise a substantial portion of the direct economic activity in the Tri-Cities (communities of Richland, Kennewick, and Pasco). Other businesses and local infrastructure (e.g., schools) are highly susceptible to fluctuations in Hanford Site employment levels. The Hanford Site budget constitutes a majority of the regions economic base.

2.3.6 Insufficient Plan and Control

The Hanford Site lacks a comprehensive plan for controlling cleanup actions.

The whole cleanup job has not been fully specified. The endpoints for the mission have not been defined and agreed upon, and the methods or approaches for carrying out the mission have not been fully defined. Such a plan is needed to guide and control cleanup activity. The Tri-Party Agreement (Ecology et al. 1990) drives cleanup and resource allocation but is not a complete plan for all mission activities.

2.3.7 Continued Waste\Material Receipt

The Hanford Site continues to receive waste and other materials from offsite sources and provides waste management services, including disposal, for those materials.

Until national policy changes dictate otherwise, the Hanford Site will provide waste management services for the rest of the DOE complex and related activities (e.g., nuclear submarine compartments). The Hanford Site's expected role in a new national policy is yet to be articulated.

2.3.8 Existing Site Infrastructure

The Hanford Site does not presently possess the full set of capabilities as identified below to efficiently and completely carry out this mission.

1. **Workforce.** There is an existing, multi-contractor, 16,000-person highly-skilled workforce that faces an unprecedented technical challenge. Extensive training will be needed to meet mission needs. Not only is there a need to retrain staff, but a new mix of skills is required to efficiently and effectively carry out the mission.
2. **Technology.** Appropriate and adequate technical solutions to all cleanup problems do not presently exist. Technology development programs are underway outside of the Hanford Site, but these are not perceived to be adequate to meet the needs.
3. **Physical Infrastructure.** Much of the Hanford Site's physical infrastructure is aging and deteriorating. Also, waste storage, treatment, and related support services (e.g., analytical laboratories) will need to be upgraded or expanded to support the mission.

2.4 HANFORD CLEANUP MISSION DESIRED END STATES

2.4.1 Acceptable Risk

Risks to the public, workers, and environment have been reduced to acceptable levels.

Future risks from the Site are consistent with its designed end uses. These will include any actions needed to control access to and use of the former Site (e.g., its land and resources, including groundwater). At the end state, the public must feel confident of end state safety and accept the end state conditions. As such, residual risks must be well characterized and clearly communicated to the public.

2.4.2 Regulatory Compliance Achieved

Compliance with appropriate safety and environmental regulations must be achieved and accepted by stakeholders.

A prerequisite condition for achieving our end state is that the site's final condition be accepted by all regulatory agencies including the Environmental Protection Agency and Washington State. There should be no outstanding compliance issues. Also, we know "how clean is clean," and all appropriate institutional guidelines (e.g., orders and requirements) are in place.

2.4.3 Dispositioned Legacy Materials

Legacy materials, facilities, and wastes (including cleanup byproducts and infrastructure) have been permanently dispositioned consistent with land use plans and applicable regulations.

The whole cleanup job is complete. All legacy materials have been dispositioned in accordance with requirements. The problem hasn't simply moved from one place to another or one point in time to another. Radioactive and hazardous materials are safely managed (e.g., stored, treated, recycled, disposed, or shipped) on the minimum required land area.

2.4.4 Excess Land Transferred

Land and other resources have been transferred for other socially beneficial uses.

Land and other resources are recovered and returned for beneficial uses (e.g., caretaker, dual use infrastructure, and other Hanford Site missions).

2.4.5 Public Acceptance

Public trust and acceptance is obtained.

A prerequisite for successful completion of the cleanup mission is obtaining public trust. This trust is essential to gaining the broad public acceptance needed to close the site. Embedded in this end state is the information supplied to the public on progress, planning, and unusual events during mission implementation.

2.4.6 Transitioned Economy

Resources (e.g., technology, people, expertise) developed and used during cleanup have been leveraged to enhance the economic viability of the regional economy.

Cleanup resources will have been expended in a manner to support independence of the local/private sector economy. This can be achieved through development of public/private sector partnerships, transfer of technologies for use elsewhere, etc. Also, expenditure of these resources should, where possible, provide national and international benefit by making technology and expertise broadly available.

2.5 HANFORD CLEANUP MISSION RESOURCES

Mission resources include budget (funding) to conduct the mission, public involvement to guide design selections and resource allocations toward compatibility with the various public groups, such offsite resources as technical assistance from federal laboratories, and unsolicited proposals to privatize cleanup activities, or to use or transfer excess mission resources.

2.6 EXTERNAL HANFORD CLEANUP MISSION REQUIREMENTS/CONSTRAINTS

External entities are organizations, institutes, systems, or people that have an effect on, or attended by, or communicate with the cleanup mission.

External mission requirements consist of appropriate laws, regulations, orders, and policy as described in Section 5.0. Constraints, i.e., technical direction from external authority, also may restrict choices on cleanup technologies/endpoints. Direction from DOE/HQ is also considered as an external control.

2.7 THE HANFORD CLEANUP MISSION PROBLEM STATEMENT

Nuclear and chemical waste materials are stored at the Hanford Site under unacceptable conditions. These materials must be transformed to a physical state that meets all regulatory requirements and stakeholder expectations. Various natural resources such as soils, groundwater, flora and fauna contaminated as a result of previous Hanford Site activities must be

transformed to an acceptable condition. Further contamination of natural resources during cleanup activities must be avoided. Facilities no longer in use must comply with the regulations or be committed to usage outside the mission scope. Unused land and natural resources which meet institutional release requirements should be transferred to other governmental agencies or be released to private use.

Cleanup activities must have a sound technical base that reflect the national need to reduce the deficit. Cleanup planning must include efforts to resolve conflicting or uncertain regulations, disparate stakeholder values, and resolution of treaty rights issues, while emphasizing risk-based technical solutions. Trust among the DOE, contractors, and stakeholders also must be improved to reach consensus on cleanup goals and methods.

Human resources, facilities, and infrastructure improvements are required to complete the mission. Resources must be managed to achieve maximum productivity and accountability as the mission progresses. The Technology Development Program provides many useful technologies for Hanford Site cleanup, but additional Site-specific technologies, which balance performance requirements with resource availability, must be developed to meet mission goals.

Hanford Site culture must be transformed from a "can't do," zero risk approach to a "can do," graded approach to risk taking. Enthusiasm for using highly innovative technical and management methods needs to replace a reluctance to embrace such concepts.

The local and regional economy should not be negatively affected by infusion of cleanup funds. Personnel employed in cleanup activities need a sound transition to new employment opportunities as the mission evolves and reaches completion.

2.8 INTERFACES WITH EXTERNAL ENTITIES

Primary interfaces outside the mission area include actual physical interfaces, regulatory agencies; state and local governments; the Native American Nations; DOE headquarters; federal entities, which send waste and nuclear materials to the Hanford Site; DOE laboratories; and the other missions being conducted at the Site.

2.8.1 Physical Interfaces

Primary physical interfaces exist for the transportation of stabilized waste, for the Waste Isolation Pilot Project (WIPP), the planned high-level waste repository at Yucca mountain in Nevada, the hazardous waste disposal facility at Arlington, Oregon, and various waste incineration facilities. Interfaces also exist with the transportation infrastructure needed for waste shipment and for the importation of raw materials.

2.8.2 Regulatory Agencies

A working interactive interface with the regulatory agencies is essential in the clarification, modification and reformulation of rules and regulations that specify cleanup requirements.

2.8.3 State and Local Governments and Confederated Tribes

Washington State, county and local entities effect both requirements and constraints on cleanup activities through the Tri-Party Agreement (Ecology et al. 1990), which also includes the DOE and U.S. Environmental Protection Agency (EPA). The state of Oregon and the confederated Tribes also contribute to the cleanup decision-making process.

2.8.4 DOE Headquarters

DOE headquarters provides the primary interface with Congress, OMB, and administration policy and provides the budget authority for funding Hanford Site cleanup work. DOE/HQ also provides integration with other DOE sites, and other Federal governmental agencies.

2.8.5 DOE Laboratories

DOE laboratories provide some of the technologies and expertise needed for Hanford Site cleanup. The cleanup mission, in turn, provides guidance concerning technology development needs to the outside laboratories.

2.8.6 Government Agencies Sending Waste or Nuclear Materials to the Hanford Site

Agencies sending waste to the Hanford Site must meet Site acceptance criteria and schedule requirements. The national effort to establish policy for disposition of excess defense materials also will impose constraints on the Hanford Site approach to nuclear material disposition.

2.8.7 Other Hanford Missions

Cleanup activities must be conducted in a manner that minimizes impacts to other Hanford Site activities such as PNL and Laser Interferometric Gravitational Observatory.

3.0 TOP-LEVEL FUNCTIONAL ANALYSIS (LEVEL ONE)

Top-Level Functional Analysis was performed by the Capstone Group using the IDEF methodology (DeMarco 1979) and RDD-100 (ALC 19XX) documentation software and reflects the approach described in MIL-STD 499B for functional analysis.

Procedures for functional analysis in the cleanup mission will be defined in the Hanford Cleanup Mission *Systems Engineering Manual* (WHC-CM-X-X). Functions are defined as the transformations needed to change the input condition to the desired output condition. At the highest level, functions are strategic in nature and largely guide the development of lower level decompositions. At the lowest level the functions provide sufficient description of "what needs to be done" to define the specific scopes of projects programs, or work efforts.

Every function either provides a transformation to one of the desired end states or produces a requirement, resource, or input to another function. Each function also will be allocated an appropriate fraction of the requirements, which control the function and resources needed to perform the function.

When the functional analysis is complete, a full specification of all transformations, with associated requirements and resources needed to complete the mission completion, will be available. The top-level functions are defined using the information developed in the Executive Workshop and Capstone Group input, and the desired state, scope, and mission and problem statements.

This report describes the top-level functions and requirements only. The hierarchy of functions is identified with a numeric system. First level functions are numbered 1.0, 2.0, 3.0 ...; second level functions are 1.1, 1.2, 1.3,...2.1, 2.2 ...; third level are 1.1.1, 1.1.2 ....., 2.1.1 ... Each function is defined only when all initial conditions, final conditions, internal requirements, and resources are known. The function is actually defined by the input/output conditions rather than the functional description or title.

All functions and functional relationships are provided in the IDEF diagrams in Addendum 1 to the second level.

3.1 TOP-LEVEL FUNCTIONS DEFINED

The five top-level functions were defined by grouping all input (i.e., initial state) statements into five related groups and constructing five functions that produced the desired end state or became resources for other top-level functions. The five related groups were collected as follows:

1. All the inputs that require a physical change to complete the mission, namely,
  - HEALTH/ENVIRONMENTAL LEGACY FROM FORMER MISSIONS
  - REGULATORY NONCOMPLIANCE

- CONTINUED WASTE\MATERIAL RECEIPT
- 2. The inputs associated with post-mission economic activity, namely,
  - RESTRICTED LAND
  - DEPENDENT LOCAL ECONOMY
- 3. The PUBLIC DISTRUST input
- 4. The EXISTING SITE INFRASTRUCTURE input
- 5 The INSUFFICIENT PLAN AND CONTROL input.

Only three end states exist at the mission completion. Two of the final outputs are resources used to conduct the mission rather than mission end states. The desired end states were grouped as follows:

1. End states resulting from physical change, namely,
  - ACCEPTABLE RISK
  - REGULATORY COMPLIANCE ACHIEVED
  - DISPOSITIONED LEGACY MATERIALS

Since those end states are closely related, they were further grouped into a single end state call "Dispositioned Legacy."

2. End states associated with post-mission economic activity, namely,
  - EXCESS LAND TRANSFERRED
  - LESS DEPENDENT LOCAL ECONOMY
3. The PUBLIC ACCEPTANCE end state.

3.2 THE TOP-LEVEL TRANSFORMATION FUNCTIONS DEFINED

The top-level (Level 1) transformation functions, which are needed to transform the initial state to the desired end state, consist of straightforward descriptions of "what must be done" to transition from input to output.

3.2.1 Manage Program (1.0)

The input state INSUFFICIENT PLAN AND CONTROL is transformed to the desired management system by the following function:

The MANAGE PROGRAM function provides all program planning, management direction, evaluation, and the management system. This function does not directly contribute to the final state but provides the management needed to

conduct the mission. The function includes specification of management policies and procedures, configuration management, scheduling, allocation of all resources, definition of performance criteria, and resolution of regulatory problems.

3.2.2 Acquire Mission Essential Capabilities (2.0)

The lack of capability to complete the mission is transformed by the following function:

The ACQUIRE MISSION ESSENTIAL CAPABILITIES function provides all new intellectual and physical resources. This includes personnel, consultants, services, supplies, equipment, construction projects, and subcontracts of all kinds.

3.2.3 Obtain Public Acceptance (3.0)

PUBLIC DISTRUST is transferred to PUBLIC ACCEPTANCE by the following function:

The OBTAIN PUBLIC ACCEPTANCE function provides all the public interactions needed to complete the mission including public relations, reviews of all plans and priorities, as needed to minimize potential conflicts between the stakeholder interests and mission activities.

3.2.4 Remedy Unsafe and Unacceptable Conditions (4.0)

All physical site deficiencies are transformed to their desired end states by the following function:

The REMEDY UNSAFE AND UNACCEPTABLE CONDITIONS function provides the physical changes needed to complete the function and provides the safe and efficient operation of all facilities. Included within this function are environmental restoration of buildings, facilities, groundwater, and soils, treatment of waste materials, interim storage of various materials, disposition of low-level waste, packaging and shipment of hazardous, transuranic, mixed, and high-level waste, retrieval of wastes for disposition, regulatory compliance actions, and disposition of new imported wastes and materials.

3.2.5 Transition Resources For Beneficial Use (5.0)

The TRANSITION RESOURCES FOR BENEFICIAL USE function provides for the disposal of excess land, materials and personnel; recycling of material, facilities, equipment and personnel to uses within the mission; and smooth economic transition to a viable local economy as the cleanup mission winds down.

3.3 FUNCTIONAL INTERFACES DEFINED

The input/output for each level one function is provided below.

3.3.1 Manage Program

Inputs include the following:

- a. The INSUFFICIENT PLAN AND CONTROL initial condition from the Hanford initial state definition
- b. *Program needs/information* from all other first level functions.

Resources include the following:

- a. *Budget* (funding) to conduct the mission from the DOE customer.
- b. *Public values* to the program planning process from the OBTAIN PUBLIC ACCEPTANCE function.

Requirements include the following:

- a. *External Requirements* including all laws, regulations, orders, and policies that control design solutions or operations.
- b. *External Constraints* including all system constraints imposed by agreements or policy decisions made by the customer or appropriate legal authority.
- c. *Mission Direction* from DOE-HQ.

Outputs include the following:

- a. *Institutional information* includes license and permit applications and supporting information, etc.
- b. *Defined work packages* and other resources to all functions.
- c. *Mission requirements* to all functions.
- d. *Direction and control* to all functions.
- e. *Cleanup Program Information* consisting of program plans for review, comment and information, progress information, and resource allocation information to the OBTAIN PUBLIC TRUST function for public review and information.
- f. *Allocated Resources* including budget to all functions.

The total of these outputs produce the efficient management system required to correct the initial conditions relating to Insufficient Plan and Control.

3.3.2 Acquire Mission Essential Resources Capabilities

Inputs for this function include the following:

- a. The condition of EXISTING SITE INFRASTRUCTURE from the Hanford initial state concept that insufficient capability exists to conduct the mission with respect to WORK FORCE, TECHNOLOGY, and PHYSICAL INFRASTRUCTURE. Physical infrastructure includes lack of adequate processing facilities, equipment, civil support, and multi-user technical support.
- b. The component of DEPENDENT LOCAL ECONOMY associated with local acquisition of materials, services, contractors, etc. and development of transferable technologies in concert with local firms which contribute to, or need new technologies.

Resources include:

- a. *Allocated resources* from MANAGE PROGRAM (1.0).
- b. *Offsite resources* from other federal laboratories and facilities.
- c. *Unsolicited proposals* to conduct Hanford Cleanup activities in the private sector.
- d. *Resources redirected for mission* by TRANSITION RESOURCES FOR BENEFICIAL USE (5.0).

Requirements include:

- a. *Mission requirements* from MANAGE PROGRAM (1.0).
- b. *Defined work packages* from MANAGE PROGRAM (1.0).
- c. *Direction and control* from MANAGE PROGRAM (1.0).

Outputs for this function include:

- a. A contribution to TRANSITIONED ECONOMY resulting from stimulation of local economy or by use of private services and facilities.
- b. *Transferrable technology* to TRANSITION RESOURCES FOR BENEFICIAL USE (5.0).
- c. *Mission essential capabilities* in the form of all physical resources, manpower, technology, infrastructure, expertise required by all the other functions to conduct their submissions.
- d. *Mission essential capabilities/needs information* in terms of financial and schedular requirements; acquisition progress information to the MANAGE PROGRAM (1.0) function.

3.3.3 Obtain Public Acceptance

Inputs for this function include:

- a. PUBLIC DISTRUST from the Hanford initial state.
- b. *Cleanup program information* from the MANAGE PROGRAM (1.0) consisting of program plans for review, comment and information; progress information, and resource allocation information.

Resources include:

- a. *Mission Essential Capabilities* from PROVIDE MISSION ESSENTIAL CAPABILITIES (2.0).
- b. *Allocated Resources* from MANAGE PROGRAM (1.0).
- c. *Public Interactions* from offsite consisting of involvement with stakeholder groups, Native American Tribes, and the public at large. This involvement provides feedback on values systems, cleanup plans, resource allocation, and public information work.

Requirements include:

- a. *Direction and Control* from MANAGE PROGRAM (1.0).
- b. *Mission Requirements* from MANAGE PROGRAM (1.0).
- c. *Defined Work Packages* from MANAGE PROGRAM (1.0).

Outputs for this function include:

- a. *Public information* to entities outside the mission consisting of press releases, position papers, educational matter, policy, strategy, etc.
- b. *Public Needs/Information* to the PROGRAM MANAGEMENT function.
- c. PUBLIC ACCEPTANCE of the cleanup work being conducted at Hanford Site and general agreement that appropriate end points are attained. This output satisfies the desired Hanford Site desired state requirement embedded in PUBLIC ACCEPTANCE. This output also provides *public values* to the program planning work embedded in the PROVIDE MANAGEMENT (1.0) function.
- d. *Public Values* consisting of value sets to guide systems design, feedback on plans, feedback on resource allocation, requirements applications, program progress, and program priorities.

3.3.4 Remedy Unsafe And Unacceptable Conditions

Inputs to this function include:

- a. All components of Hanford initial states HEALTH/ENVIRONMENTAL LEGACY FROM FORMER MISSIONS AND REGULATORY NONCOMPLIANCES, including equipment and facilities from past missions; nuclear fuels, nuclear materials, and refined isotopes, waste materials located in waste tanks; and solid waste materials in various forms including previously buried wastes and stored solid wastes, all groundwater, contaminated soils, deactivated facilities, etc.
- b. All newly received wastes and nuclear materials from Hanford initial state CONTINUED WASTE\MATERIAL RECEIPT.
- c. All unused land from Hanford initial state RESTRICTED LAND that require remediation for release or reuse.

Resources include:

- a. *Mission essential capabilities* from ACQUIRE MISSION ESSENTIAL CAPABILITIES (2.0).
- b. *Allocated Resource* from MANAGE PROGRAM (1.0).

Requirements include:

- a. *Mission requirements* from MANAGE PROGRAM (1.0).
- b. *Defined work packages* from MANAGE PROGRAM (1.0).
- c. *Direction and control* from MANAGE PROGRAM (1.0).
- d. *Transfer Agreements* from functions (5.0) which identify equipment, facilities, supplies, and raw materials to be transferred to new uses inside or outside the cleanup mission.

Outputs from this function include:

- a. *Dispositioned legacy*; all wastes and nuclear materials dispositioned consistent with all regulations, policies and public preferences which satisfy the Hanford Site desired states ACCEPTABLE RISK, REGULATORY COMPLIANCE ACHIEVED, and DISPOSITIONED LEGACY MATERIALS.
- b. *Transferable Resources* consisting of valuable technologies, materials, and equipment, and infrastructure as an input to TRANSITION RESOURCES FOR BENEFICIAL USE (5.0).
- c. *Remedy Needs/Information* consisting of progress and program evaluation information to MANAGE PROGRAM (1.0) to assist program formulation, reporting and resource allocation.

- d. *Identification of potentially transferable resources* which consists of excess inventory information to TRANSITION RESOURCES FOR BENEFICIAL USE (5.0).

3.3.5 Transition Resources for Beneficial Uses

Inputs to this function include:

- a. *Transferable Resources* consisting of valuable and redeployable resources from REMEDY UNSAFE AND UNACCEPTABLE CONDITIONS (4.0) and transferable technology from ACQUIRE MISSION ESSENTIAL CAPABILITY (2.0).
- b. The DEPENDENT LOCAL ECONOMY input from the Hanford initial state.
- c. The *Administratively Restricted lands* component of the initial state RESTRICTED LANDS.

Resources include:

- a. *Mission essential capabilities* from ACQUIRE MISSION ESSENTIAL CAPABILITIES (2.0).
- b. *Allocated resources* from MANAGE PROGRAM (1.0).
- c. Potential user interest in resources from outside the mission consisting of *unsolicited proposals to use or ownership*.

Requirements include:

- a. *Direction and control* from MANAGE PROGRAM (1.0).
- b. Mission Requirements from MANAGE PROGRAM (1.0).
- c. *Defined work packages* from MANAGE PROGRAM (1.0).

Outputs for this function include:

- a. *Transfer Agreements* consisting of identification of resources to be used in building the local economy as an input to REMEDY UNSAFE AND UNACCEPTABLE CONDITIONS (4.0) which essentially causes transferrable items to be removed from the "disposal" list to the transfer list.
- b. *Excess land transferred* consisting of transfer of unused land and other resources for alternate use which satisfies the desired state EXCESS LAND TRANSFERRED.
- c. *Transitioned economy* by support to the local economy by means of technology transfer to local business, lease of facilities, training of staff, or selling resources. This output satisfies desired end state ECONOMIC TRANSITION.

- d. *Resource transition needs/information* consisting of program formulation, progress, evaluation, and resource requirements information to PROVIDE PROGRAM MANAGEMENT (1.0).
- e. *Resources redirected for mission.* This output is an input to ACQUIRE MISSION ESSENTIAL RESOURCES (2.0).

4.0 DEFINITION OF SECOND-LEVEL FUNCTIONS AND INTERFACES

Second-level functions further define level-one functions and provide the platform needed to extend the functional analysis to successively lower levels. All inputs, requirements, resources, and outputs directed to the parent function must be accounted for in the collection of lower-level functions supporting the parent.

4.1 LEVEL-TWO FUNCTION DETAIL

4.1.1 The Manage Program

The MANAGE PROGRAM (1.0) function consists of six subfunctions.

The ESTABLISH MANAGEMENT SYSTEM (1.1) function defines 11 procedures, policies, reporting, configuration, and SE, needed to manage the program. This function encompasses all routine management areas such as total quality, quality assurance, personnel management, legal services, fiscal control, prime contracts, etc. This function also develops the organizational structure, evaluates the efficiency of the management work and develops appropriate corrective actions.

The PERFORM SYSTEMS ENGINEERING (1.2) function performs SE activities for the mission.

The FORMULATE PROGRAM (1.3) function converts the SE product tree into an executable set of programs consisting of schedules, budgets and priorities and produces all program descriptive information.

The DIRECT PROGRAM (1.4) function assigns the work activities defined above to the performing entity along with budget, work definition and other necessary resources.

The EVALUATE PROGRAM (1.5) function evaluates progress, quality, and efficiency of assigned work activities, reports to appropriate authority, and recommends corrective action.

The HELP REINVENT GOVERNMENT (1.6) function reviews requirements, policies, and directives for mission effectiveness, determines high payoff candidates for revision, change, or elimination, and actively pursues the desired change.

4.1.2 Acquire Mission Essentials

The ACQUIRE MISSION ESSENTIAL RESOURCES (2.0) function consists of six subfunctions.

The FORMULATE ACQUISITION STRATEGY FOR MISSION ESSENTIAL CAPABILITIES (2.1) function screens incoming acquisition needs with respect to opportunities for consolidation or assignment to a full service, non-Hanford Site contractor. Opportunities identified are provided to the Manage Program function for reprogramming.

The PROVIDE EXPERTISE (2.2) function provides new personnel, retrain existing professional personnel for new assignments outside their usual discipline, provides expert consultants, and acquires off-site expert services of all types.

The PROVIDE TECHNOLOGIES (2.3) function provides all needed new technologies not currently available on-site, obtains needed technology from the Technology Development Program, and provides the technology interface to all appropriate entities.

The PROVIDE INFRASTRUCTURE, FACILITIES, EQUIPMENT, AND SUPPLIES (2.4) function produces all facilities, equipment, software and related items needed by all work activities.

The PROVIDES ESSENTIAL INFORMATION FUNCTION (2.5) supplies the entire effort with access to various offsite databases, proprietary commercial data, and offsite expert systems and allows wide and facile access to internally generated information used in Cleanup Mission activities.

The PROVIDE INTEGRATED INDEPENDENT SERVICES (2.6) function delivers integrated service contracts of all types including ERMCS, specialty services like laundry, steam supply, etc, to other related integrated efforts.

4.1.3 Obtain Public Trust and Acceptance

The OBTAIN PUBLIC TRUST AND ACCEPTANCE (3.0) function consists of four subfunctions.

This function is still under development. Functions listed below are only approximations of what can be expected as the work unfolds.

The IDENTIFY ACTIVITIES MOST MEANINGFUL TO PUBLIC INVOLVEMENT (3.1) function defines areas of high interest to the various public sectors (sometimes called publics).

The IDENTIFY NEEDS (3.2) function defines areas where the cleanup mission needs public involvement.

The IDENTIFY PUBLICS (3.3) function classifies the public into associated groups with common outlooks and needs.

The ELIMINATE ADVERSARIAL RELATIONSHIPS (3.4) function conducts those activities requiring public input and fills the need for public interaction with respect to public expectations, needs and information.

4.1.4 Remedy Unsafe and Unacceptable

The REMEDY UNSAFE AND UNACCEPTABLE (4.0) function contains seven sub-functions.

The DEACTIVATE FACILITIES (4.1) function contains the safe operation of all facilities until further operation is no longer mission essential. The primary output is eventual facility conversion to a state where transfer to the function 4.4 can take place.

The REMEDY TANK WASTE (4.2) function is directed to removal, treatment, and disposition of highly radioactive wastes located in tanks around the Hanford Site. Emphasis is on the 177 waste storage tanks located on the 200 Area plateau. This function also contains newly generated liquid/slurry wastes from operating facilities and other Hanford Site sources as well as all High Level waste in tanks other than the 177 waste tanks.

The REMEDY SOLID WASTE (4.3) function is charged with disposition of buried wastes and solid waste materials generated during past missions as well as solid wastes generated during the cleanup mission.

The REMEDY/RESTORE SITES, FACILITIES, AND GROUND WATER (4.4) function restores sites, deactivated facilities, ground water, and related items to an acceptable state. This function includes restoration of chemically contaminated lands, and removal or disposition of buildings, fission reactors, chemical processing plants, infrastructure, etc. This function includes new as well as legacy items.

The MANAGE AQUEOUS WASTES (4.5) function disposes of hazardous aqueous liquids, low level aqueous wastes, and liquid effluents being generated as a result of continued plant operations and ongoing cleanup activities.

The CORRECT UNSAFE INFRASTRUCTURE CONDITIONS (4.6) function has a dual purpose, namely to correct all unsafe or non-compliant conditions as well as operation of all the services and facilities not identified with the programs or integrated cleanup activities. Infrastructure includes such items as roads, utilities, transportation, office buildings,

The STORE, TREAT, AND DISPOSITION OF SPECIAL NUCLEAR MATERIAL/NUCLEAR MATERIAL/NUCLEAR FUEL (4.7) function converts currently non-compliant and physically degrading SNM/nuclear material (NM)/nuclear fuel (NF) materials storage facilities into a robust, safe and compliant condition.

4.1.5 Transition Resources for Beneficial Use

The TRANSITION RESOURCES FOR BENEFICIAL USE (5.0) function consists of three Functions:

The DETERMINE BENEFICIAL USES OF RESOURCES (5.1) function determines which resources are candidates for use outside the mission, seeks "customers" to receive the resources, and establishes agreements to actually transfer specific items, as well as personnel.

The TRANSFER OWNERSHIP OF RESOURCES OUTSIDE OF MISSION (5.2) function produces an actual change in ownership of excess mission resource to an owner outside the mission. This function includes resource upgrade and covers buildings, equipment, land, raw materials, as well as personnel.

The TRANSFER RESOURCES FOR USE OUTSIDE THE MISSION (5.3) function provides for use of excess mission resources to an outside user without actually transferring ownership.

5.0 EXTERNAL SYSTEMS REQUIREMENTS

The Hanford Mission Systems Engineering systems analysis approach defines external requirements as physical limits on the system design solutions imposed from authority outside the mission itself. These requirements must be allocated (accounted for) to the physical designs selected to deliver the mission. At present, requirements allocation to the high-level functions are of little value because of the strategic nature of the design choices at high-functional levels. However the external requirements must be considered in the development of high-level strategies to eliminate potential conflicts.

External requirements cover a broad range of activities and the complete list of all mission requirements will be identified as the system architecture and detail designs are developed. Some of these requirements are included in the following sections.

5.1 PUBLIC LAW

Public Laws (PL) are federal legislative statutory laws, published in chronological order, that are generated by a specific session of Congress. Some of the PLs that are expected to be a portion of the Site requirements list include:

- PL 101-189 (Sec 3156) National Defense Authorization Report in connection with the permanent closure of Dept of Energy Defense Nuclear Facilities.
- PL 101-510 (Sec 3137) Safety Measures for Waste Tanks at Hanford Nuclear Reservation.

- PL 102-484 (Sec 3161) National Defense Authorization Act for Fiscal Year 1993 - Department of Energy work force Restructure Plan.

5.2 UNITED STATES CODE

The United States Code (USC) comprises all laws of a general and permanent nature under arrangement of official code of laws of the United States and are arranged according to subject matter. Some of the USCs that are expected to be a portion of the Site requirements list include:

- 16 USC 1531 et seq. Endangered Species Act
- 25 USC 3001 et seq. Native American Graves Protection and Repatriation Act
- 33 USC 1251 et seq. Clean Water Act
- 42 USC 1996 et seq. American Indian Religious Freedom Act of 1978
- 42 USC 2011 et seq. Atomic Energy Act
- 42 USC 4321 et seq. National Environmental Policy Act
- 42 USC 5801 et seq. Energy Reorganization Act of 1974
- 42 USC 6901 et seq. Resource Conservation and Recovery Act of 1976
- 42 USC 7101 et seq. Department of Energy Organization Act
- 42 USC 7401 et seq. Air Pollution Prevention and Control (Clean Air Act)
- 42 USC 9601 et seq. Comprehensive Environmental Response, Compensation, and Liability Act of 1980
- 42 USC 10101 et seq. Nuclear Waste Policy Act
- 49 USC 1802 et seq. Hazardous Materials Transportation Act.

5.3 FEDERAL REGISTER

The Federal Register (FR) provides uniform system for making available to the public regulations and legal notices issues by federal agencies. These include, but are not limited to, proposed and final federal agency regulations, federal agency policies, documents required to be published by an act of Congress and other federal agency documents of public interest.

The complete list of FRs pertinent to Hanford Site cleanup is too extensive to list here. Three of the most direct FRs follow:

- 46 FR 42237 Responses to Environmental Standards
- 52 FR 2923 Superfund Implementation
- 52 FR 12449 Final Environmental Impact Statement for the Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington: Decision of Records.

5.4 CODE OF FEDERAL REGULATIONS

The Code of Federal Regulations (CFR) is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. CFRs that are expected to be on the Site requirements list include the following:

- 10 CFR 71: Packaging and Transportation of Radioactive Material
- 10 CFR 961: Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Radioactive Waste
- 10 CFR 1021: Compliance with the National Environmental Policy Act
- 29 CFR 1910: Occupational Safety and Health Administration
- 40 CFR 58: Ambient Air Quality Surveillance
- 40 CFR 60: Standards of Performance for New Stationary Sources
- 40 CFR 61: National Emission Standard for Hazardous Air Pollutants; Standards for Radionuclides
- 40 CFR 124: Procedures for Decision Making
- 40 CFR 191: Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High Level and Transuranic Radioactive Waste
- 40 CFR 192: Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings
- 40 CFR 260: Hazardous Waste Management System
- 40 CFR 261: Identification and Listing of Hazardous Waste
- 40 CFR 262: Standards Applicable to Generators of Hazardous Waste

- 40 CFR 264: Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
- 40 CFR 265: Interim Status Standards for Owner and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
- 40 CFR 268: Land Disposal Restrictions
- 40 CFR 300: National Oil and Hazardous Substances Pollution Contingency Plan (CERCLA)
- 40 CFR 1500-1508: Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act
- 43 CFR 11: Natural Resource Damage Assessments
- 49 CFR 173: Shippers-General Requirements for Shipments and Packaging.

5.5 HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER. 89-10, REV. 1

The agreement between DOE, the EPA, and the Washington State Department of Ecology is known as the Tri-Party Agreement (Ecology et al. 1990). The Tri-Party Agreement identifies milestones that quantify actions toward Hanford Site compliance with the *Resource Conservation and Recovery Act of 1976*, the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, and the *Washington State Hazardous Waste Management Act*. The DOE will have addressed all aspects of the Hanford Site contamination with no other federal or state actions required at the completion of the Tri-Party Agreement Action Plan.

5.6 WASHINGTON ADMINISTRATIVE CODE

The Washington Administrative Code is a codification of the general and permanent rules published in the Washington State Register by the agencies of the State of Washington. Some of the WACs that are expected to be on the requirements list include:

- WAC 173-201a Water Quality Standards for Waters of the State of Washington
- WAC 173-303 Dangerous Waste Regulations
- WAC 173-304 Minimum Functional Standards for Solid Waste Handling
- WAC 173-340 Model Toxics Control Act - Clean Up

- WAC 173-480 Washington Ambient Air Quality Standards and Emission Limits for Radionuclides
- WAC 246-247 Radiation Protection-Air Emissions
- WAC 246-249 Radioactive Waste-Use of the Commercial Site
- WAC 402-24 Washington Standard for Protection Against Radiation
- WAC 446-50 Transportation of Hazardous Materials.

5.7 REVISED CODE OF WASHINGTON

The Revised Code of Washington (RCW) comprises all laws of a general and permanent nature under arrangement of official code of laws of the state of Washington and are arranged according to subject matter. Some of the RCWs that are expected to be a portion of the final site requirements list follow:

- 36.58 RCW Washington Solid Waste Disposal
- 43.21C RCW Washington State Environmental Policy Act
- 43.200 RCW Washington Radioactive Waste Act
- 49.17 RCW Washington Industrial Safety and Health Act
- 70.94 RCW Washington Clean Air Act
- 70.96 RCW Washington Underground Storage Tanks
- 70.105 RCW Hazardous Waste Management Act
- 90.42 RCW Washington Water Resource Management
- 90.48 RCW Washington Water Pollution Control Act.

5.8 EXECUTIVE ORDER (EO-XXXX)

An Executive Order (EO) is an order or regulation issued by the President, or administrative authority, that can have the effect of law if published in the Federal Register. Some of the EOs that are expected to be a portion of the site requirements list include the following:

- EO-12316 Responses to Environmental Standards; Aug. 14, 1981; 46 FR 42237
- EO-12580 Superfund Implementation; Feb 23, 1987; 52 FR 2923.

5.9 SECRETARY OF ENERGY NOTICES (SEN-XX-XX)

A Secretary of Energy Notice (SEN) is a routine method to convey DOE direction on processes and procedures which control operations, design, procurements, etc. The final site requirements list is expected to include the following SEN:

- SEN-35-91 Nuclear Safety Policy.

5.10 U.S. DEPARTMENT OF ENERGY ORDERS (DOE ORDER XXXX.X)

DOE orders are permanent or long-lasting directives stating permanent policy or establishing standards of operation. Some of the DOE orders that are expected to be a portion of the site requirements list follow:

- DOE Order 5400.1 General Environmental Protection Program
- DOE Order 5400.2A Environmental Compliance Issue Coordination
- DOE Order 5400.3 Hazardous and Radioactive Mixed Waste Program
- DOE Order 5400.4 Comprehensive Environmental Response, Compensation, and Liability Act Requirements
- DOE Order 5400.5 Radiation Protection of the Public and the Environment
- DOE Order 5440.1E National Environmental Policy Act Compliance Program
- DOE Order 5480.4 Environmental Protection, Safety and Health Protection Standards
- DOE Order 5480.11 Radiation Protection for Occupational Workers
- DOE Order 5484.1 Environmental Protection, Safety and Health Protection Information Reporting Requirements
- DOE Order 5700.6C Quality Assurance
- DOE Order 5820.2A Radioactive Waste Management.

5.11 U.S. DEPARTMENT OF ENERGY NOTICES (DOE/XX-XXXX XX.XX-X)

DOE Notices are one-time or short-term (less than 1 yr) instructions or information. Notices provide immediate dissemination until information can be incorporated into an order. DOE Notices of importance include the following:

- DOE/RL-90-27, Rev. 1 Evaluation and Selection of Borosilicate Glass as the Waste Form for the Hanford High-Level Radioactive Waste
- DOE/RW-0351P, Rev. 0 Waste Acceptance System Requirements Document
- DOE/WIPP-069, Rev. 4 Waste Acceptance Criteria for the Waste Isolation Pilot Plant.

5.12 CODES AND STANDARDS

Codes and Standards are national or international consensus documents written and critiqued by technical specialists versed in the field of interest. Usually these standards are generated by professional societies such as the American Society of Mechanical Engineers (ASME) or American Society of Testing Materials. A standard that is expected to be a portion of the final site requirements list follows:

- ASME NQA-1-1989 Ed.   Quality Assurance Program for Nuclear Facilities.

5.13 U.S. DEPARTMENT OF ENERGY ENVIRONMENTAL MANAGEMENT POLICY

Finally, Performance Guidelines formulated by the Assistant Secretary for Environmental Management or by the Secretary of Energy will be assimilated into the SE process as requirements. An example of this requirement is the following six points the Assistant Secretary recently announced to improve the performance of the entire Environmental Management effort:

1. Address the Urgent Risks
2. Assure Worker Safety
3. Be Outcome Oriented, Get Tangible Results
4. Establish a System that is In Control, Managerially and Financially
5. Focus Technology Development Efforts
6. Establish Stronger Partnerships Between the DOE and its Stakeholders.

6.0 HANFORD CLEANUP MISSION CONSTRAINTS

Constraints are limits on design choices that are not the result of law, policy, or outside interfaces. When applied to alternative selection, these constraints must be satisfied by all viable design alternatives. Constraints defined by the Executive Workshop and Capstone Group follow.

1. Design solutions must inherently improve the safety posture of the Site with respect to subsequent operations.
2. Only cost effective design solutions will be considered.
3. Stakeholder interests must be included in alternative definition and selection.

4. Successful alternatives must be capable of resulting in, or contributing to, the rapid progress needed to sustain mission momentum and support.
5. The cleanup work must not adversely affect other ongoing or projected Hanford Site missions.

Other constraints may be assigned to the mission from other authorities. For example, sections of the Tri-Party Agreement closely constrain alternative choice in the Tank Waste area as the Tri-Party Agreement defines the use of a vitreous matrix to stabilize low-level tank waste and eliminates cementitious grout as an acceptable low-level waste form (Ecology et al. 1990)

7.0 MEASURES OF MISSION EFFECTIVENESS

Measures of effectiveness provide a quantitative reference to assess design alternatives with respect to mission end state definitions. Measures of effectiveness for the overall mission defined by the Capstone Group are listed below:

1. Degree and rate of reduction in worker risk
2. Degree and rate of risk reduction to the public and environment
3. Rate of transition to compliance with all laws and regulation
4. Degree and rate of placing waste in a final disposition form
5. Demonstrated improvement in public acceptance of Hanford Site cleanup activities
6. Degree and rate of the transition of the local and regional economy to post-cleanup mission viability.

8.0 DEFINITION OF PHYSICAL INPUTS

Definition of the physical items that require change to meet the desired end state include the following: (1) waste materials, (2) contaminated soils and groundwater, (3) contaminated equipment, (4) contaminated facilities structures, and (5) contaminated infrastructure. The *Hanford Strategic Analysis Study* (Pajunen 1993) specifies the type, character, and location of these physical inputs. The *Hanford Strategic Analysis Study* will provide the basis for quantitative definition of physical inputs to the appropriate physical transformation functions.

Allocation of the physical inputs to the individual functions can be conducted only after appropriate high-level functional architectures are clarified.

9.0 PHYSICAL DESIRED END STATE SPECIFICATION

The physical desired end state specification is defined in some cases by the specific laws governing environmental restoration. In situations not specifically covered by law, the end state will be defined by technical feasibility, negotiation with regulators, negotiation with stakeholders, or successful legislative initiative. Function 1.6 is, in part, aimed at resolution of uncertainty of end state specification.

10.0 LOWER-LEVEL FUNCTIONAL ANALYSIS

Lower-level functional decompositions will be documented at a later date as an addendum to II of this report. The appendix will cover all cleanup mission functions not included as part of the Environmental Restoration (ER) or Tank Waste Remediation System (TWRS) programmatic functional analysis.

The TWRS and ER programmatic functional analyses are fully integrated with the sitewide functional breakout but will contain some overlap because of a pre-existing programmatic scope that includes areas, which, from a sitewide perspective, should logically be placed elsewhere. An example of this overlap is the appearance of Cesium/Strontium capsules in Function 4.2 because of the TWRS scope, and appearing again in Function 4.3, solid waste. The overlap is acceptable in that functional analysis needs only to be sufficient and complete to be successful.

The functional breakout of the TWRS management system requires further integration as it is not yet fully matched to the Site system.

11.0 REFERENCES

1. MIL-STD, 1993, *Systems Engineering*, Draft Military Standard, MIL-STD-499B, (September 7, 1993).
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3. ALC, 19XX, *RDD-100/SD System Designer Overview*, PN 100036/93, Ascent Logic Corporation, San Jose, California.
4. WHC-CM-X-X, *Systems Engineering Manual (Draft)*, Westinghouse Hanford Company, Richland, Washington.
5. Pajunen, A. L., et al., 1993, *Hanford Strategic Analysis Study*, WHC-EP-0549, Westinghouse Hanford Company, Richland, Washington.
6. Ecology, EPA, and DOE, 1990, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U. S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

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ADDENDUM 1

IDEF DIAGRAMS FOR THE HANFORD CLEANUP MISSION

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Function Hierarchy

Hanford Site Systems Engineering

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