Approved: 7-09-99

APPENDIX A
Technical Basis and Considerations for DOE M 435.1-1

U.S. DEPARTMENT OF ENERGY

Distribution:
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TABLE OF CONTENTS

TECHNICAL BASIS AND CONSIDERATIONS

TABLE OF CONTENTS (cont.)

TECHNICAL BASIS AND CONSIDERATIONS

1.0 INTRODUCTION

This section outlines and summarizes the methodology used by the Department of Energy in revising its Order on radioactive waste management. The purpose of this appendix is to establish the technical basis of the order revision process and of each of the requirements included in the revised radioactive waste management order. The Department of Energy revised the Order on radioactive waste management for several reasons:

- After thorough technical reviews and analyses, both the Department of Energy and the Defense Nuclear Facilities Safety Board concluded that the existing Order, 5820.2A, did not adequately address the Department's radioactive waste management and disposal practices.

- There have been significant advances in radioactive waste management practices and changes within the Department of Energy since the Order was issued in 1988.

- Risk based and performance-based requirements are a prudent and necessary component of DOE's new directives system.

- Opportunities for stakeholder involvement, a key element of DOE decision making, needed to be provided.

- The technical basis for the Department's radioactive waste management requirements and guidance needed to be documented.

The revised Order, designated *DOE O 435.1*, establishes the requirements for management of radioactive waste consistent with the Department's *Atomic Energy Act* responsibilities to provide for radiological protection from DOE operations. The scope of DOE O 435.1 includes: (1) high-level waste, including closure of high-level waste tank systems and management of associated incidental wastes; (2) transuranic waste, including safe treatment, storage, and characterization/ certification to support disposal at the Waste Isolation Pilot Plant; and (3) low-level waste, with attention to disposal and the impacts of interacting source terms on projected public dose. The revised Order does not contain requirements for the decontamination or decommissioning of radioactively contaminated facilities. Those requirements are incorporated in a revision of DOE O 430.1A, *Life-Cycle Asset Management*. Additionally, the requirements for the management of spent nuclear fuel are not contained in this Order. The hazards analysis performed to identify requirements for high-level waste did not address the functions associated with management of spent nuclear fuel. Thus the requirements contained in DOE M 435.1-1 do not apply to this DOE-managed spent nuclear fuel.

2.0 BACKGROUND

DOE 5820.2A, Radioactive Waste Management, was issued by the Department of Energy in September 1988. As early as 1990, the Department began analyzing, assessing, and reviewing the implementability of the Order on radioactive waste management, 5820.2A. Most DOE Orders are scheduled for review every two years to determine whether they should be continued, revised, or canceled. The policy of the Department of Energy is to use a consistent and effective management system for the development, communication, implementation, and periodic review of its Orders. Objectives in revising a DOE Order include providing more effective program direction, accountability, and performance assurance. In 1991, the Department initiated efforts to revise DOE 5820.2A.

During this initial revision effort, the Defense Nuclear Facilities Safety Board (DNFSB) also began examining low-level waste management within the defense nuclear complex, including the Department's low-level management program and practices in terms of its past, present, and future operations. In September 1994, the DNFSB issued Recommendation 94-2, *Conformance with Safety Standards at Department of Energy Low-Level Nuclear Waste and Disposal Sites*, which identified problems with the Department's radioactive waste management specific to low-level waste.

The DNFSB's findings, as reported to DOE in Recommendation 94-2, were that: (1) DOE had not kept pace with the evolution of commercial practices for waste disposal; (2) that six years after the issuance of DOE 5820.2A, the performance assessment process had not been completed for any of DOE's low-level waste disposal facilities; (3) that the performance assessments excluded waste buried prior to September 1988 and interacting source terms; (4) that there was considerable uncertainty in the DOE projections of low-level waste volumes; (5) that DOE needed additional requirements standards, or guidance on LLW Management; and (6) that DOE needed to improve its modeling and predictive capability for assessing radionuclide migration, enhancing stability of buried waste forms, deterring intrusion, and inhibiting migration of radionuclides.

In May 1995, a revision to 5820.2A (draft DOE 5820.2B) was issued for review by DOE and the DNFSB staff. The draft revised DOE 5820.2B was an extensive, detailed set of requirements. However, the relationship of the requirements to guidance within the Order and the technical basis for each was not clear. When distributed for review, the draft revision drew 1,500 comments from within DOE and the Defense Nuclear Facilities Safety Board. DNFSB staff identified 41 significant safety concerns and eight additional observations which they determined could adversely affect the safety of DOE's management of its radioactive waste and/or which conflicted with commitments made by DOE in response to other DNFSB Recommendations, including 94-2. Based on the DNFSB's concerns and those raised by the numerous comments on the draft Order, a significant number of issues were raised internally within DOE. As a result, the Office of

Environmental Management (EM) committed to a new approach to revising the radioactive waste management Order, and also committed to issuing a draft of the revised Order.

DOE objectives in revising the Order included: (1) incorporate DOE commitments in response to 94-2 and other DNFSB Recommendations into the Order; (2) develop a clear and sound technical basis for the requirements and guidance; (3) incorporate considerations of risk, including the processes being developed under DOE's Integrated Safety Management System; (4) develop less prescriptive and more performance-based requirements; (5) address stakeholder concerns; and (6) address other emerging considerations, such as the movement toward external regulation, legislation requiring the adoption of industry consensus standards, and DOE's ongoing efforts to delegate decision-making and managerial controls from Headquarters to the Field Office level.

The Department's approach for revising the Order on radioactive waste management involved:

- Undertaking a systematic review of DOE's radioactive waste management activities to identify and evaluate the functions and activities necessary to manage radioactive waste effectively;

- Assessing the hazards posed by performing the functions and activities;

- Identifying the regulatory requirements and guidance to mitigate identified hazards and manage waste effectively; and

- Establishing and documenting the technical basis for the requirements and guidance.

The revised DOE radioactive Waste Management Order, as DOE O 435.1, with its accompanying Contractor Requirements Document, Manual, and Guidance Documents governs the management of DOE's radioactive wastes: high-level waste, transuranic waste, low-level waste, and the radioactive component of mixed waste. The process of developing these documents recorded the technical basis for the general requirements common to all radioactive waste, and the waste-type specific requirements. The overall Order revision process is summarized below. Functions maps, crosswalk tables, and technical bases for waste type specific requirements are included in this Appendix.

3.0 ORDER REVISION TEAM ORGANIZATION

3.1 Order Revision Team

DOE drew on the technical expertise of its Headquarters and Field staff and contractors to assist in the analysis radioactive of waste management functions and development of requirements. Four subteams were formed, one to address each waste type, and one to address the Order's

general requirements. The revision of the Order relied on a broad spectrum of relevant talent within and beyond DOE. Many of the team members who contributed to the response to the DNFSB Recommendation 94-2 on low-level waste were recruited for this effort because of their extensive experience in the operation and regulation of radioactive waste management activities. The expertise of the DOE National Program Managers for radioactive waste types were tapped. Also, representatives from each DOE site assisted through frequent participation via conference calls, meetings, workshops, and document reviews.

The Organization Chart in Figure 4-1 reflects both the structure of the Order Revision Team and the relationships among the Team, the Executive Committee, line management, and the Senior Review Panel.

3.2 Executive Committee

The Executive Committee provided direction on major policy issues and ensured that all programmatic issues regarding the Order revision were addressed in an integrated fashion. The Committee consist upper level management representatives from the following DOE Environmental Management offices: Office of the Assistant Secretary (EM-1); Office of the Principal Deputy Assistant Secretary (EM-2); Office of Safety and Health (EM-4); Office of Management and Evaluation (EM-10); Office of Planning, Policy and Budget (EM-20); Office of Waste Management (EM-30); Office of Environmental Restoration (EM-40); Office of Science and Technology (EM-50); Office of Nuclear Material and Facility Stabilization (EM-60); and Office of Site Operations (EM-70).

3.3 Senior Review Panel

A Senior Review Panel was established to review and provide independent technical advice and comment on the technical issues, analytical approaches, conclusions, and other activities performed for revising of the Order. The Panel consisted of top-level experts from outside DOE in the field of radioactive waste management. The expertise of the Senior Review Panel and the perspectives of each member is shown in Table 3-1.

FIGURE 3-1. Organization Chart

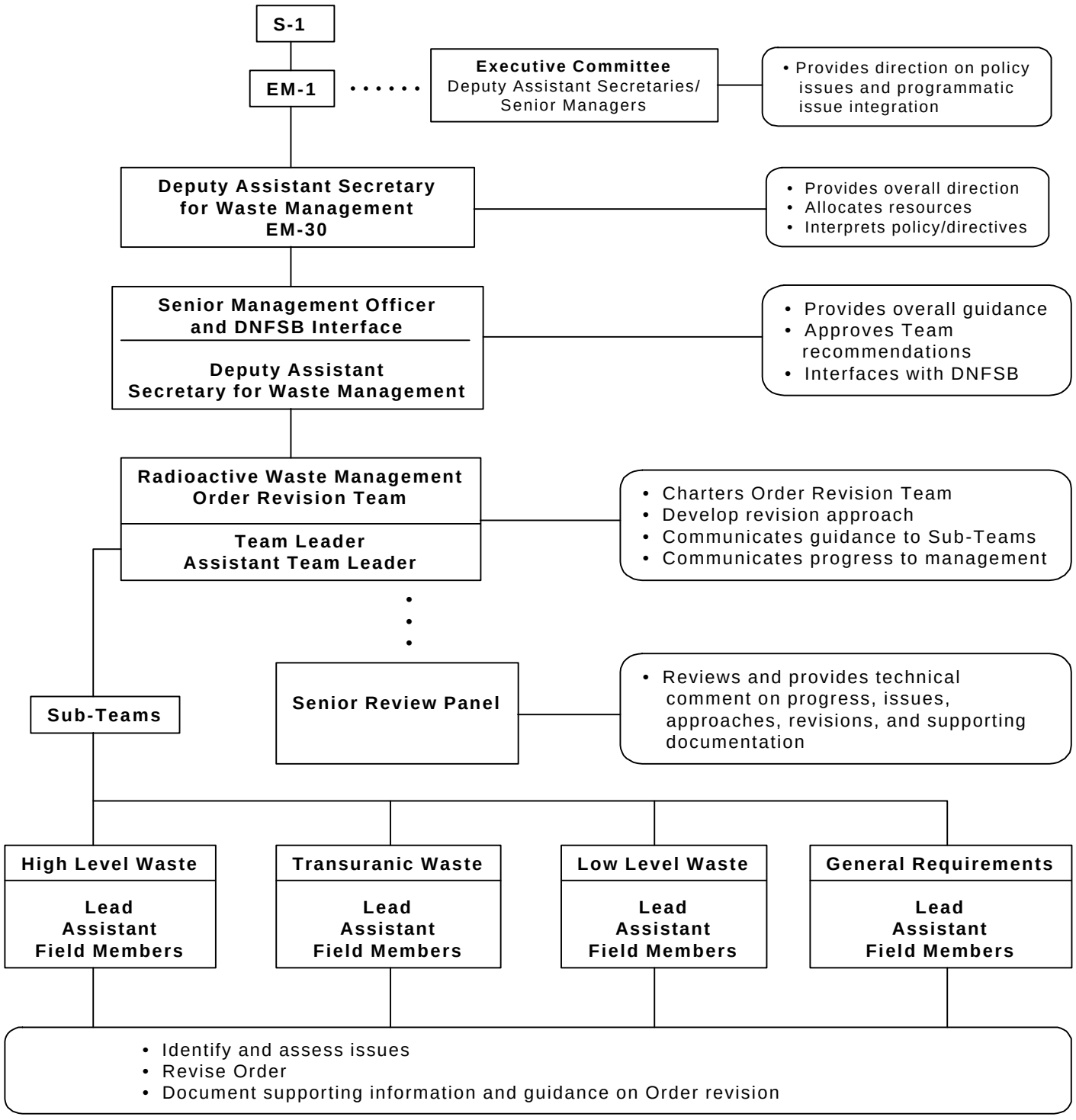


Figure 3-1: DOE Low-Level Waste (LLW) Management Essential Requirements Senior Review Panel Members

NAME	HIGHLIGHTS OF EXPERIENCE	STRENGTH
Paul L. Ziemer, Ph.D, CHP Chairman (317) 494-1435 (317) 496-1377 Fax	Adviser to DOE LLW Advisory Committee 1971; Former DOE Assistant Secretary for Environment, Safety and Health (EH); Member of the National Academy Science (NAS) BIER VI Committee Dean of School of Health Sciences, Purdue University; Past President of Health Physics Society.	Representation of professional and academic views; Familiarity with DOE practices, Order development & implementation, and political sensitivity; Established relations with DNFSB, EH, NAS, and others.
Dade Moeller, Ph.D., CHP, P.E. (919) 633-3352 (919) 633-3352 Fax	Former Chairman of NRC's Advisory Committee on Nuclear Waste (ACNW); Led DOE/Office Waste Management Disposal Site Working Group Senior Review Board.	Familiarity with Office of Waste Management; Experience with radiological performance assessments; Familiarity with NRC views and practices.
William A. Mills, Ph.D. (301) 774-0975	Former Senior Science/Policy Advisor to the Committee on Interagency Coordination on Radiation Research and Policy Coordination; Retired Public Health Service; Formerly with the Environmental Protection Agency and the Nuclear Regulatory Commission Past-President of the Health Physics Society	Representation of professional views; Familiarity with NRC policies and regulations; Familiarity with DOE practices. Familiarity with EPA policies and regulations;
Mary Birch, P.E., CHP 803 831-3310 803 831-344 Fax	Currently Engineering Supervisor, Duke Power Company Former Regulatory and Licensing Manager, U.S. DOE Civilian Radioactive Waste Management System Management and Operating Contractor Former Licensing Manager, Duke Engineering Services Former Technical System Manager, Radiation Protection, Duke Power Company Former Technical System Manager, Radioactive Waste Management Function, Duke Power Company Former Member of the North Carolina Governor’s Waste Management Board Chaired the Electric Power Research Institute Advisory Committee on Below Regulatory Concern	Familiarity with NRC policies and regulations; Familiarity with DOE practices; Familiarity with EPA policies and regulations; Familiarity with State Waste Management Issues; Extensive knowledge and understanding of commercial waste management practices.
Robert Bernero 301 926-3844 301 926-1368 Fax	Currently acting as a nuclear safety consultant on projects involving spent nuclear fuel and radioactive waste management Served as a member of the Commission of Inquiry for an International Review of Swedish Nuclear Regulatory Activities to examine the effectiveness of Swedish regulations for nuclear reactor safety, radiation protection and waste management Former Director NRC’s Office of Nuclear Material Safeguards and Security Former NRC Division Director for boiling water reactor licensing, reactor systems safety, and radiological safety Former NRC Division Director in Research for probablistic risk analysis and the analysis of severe reactor accidents	Representation of professional views; Familiarity with NRC policies and regulations; Familiarity with DOE practices.

4.0 ORDER REVISION PROCESS

The Order on radioactive waste management was revised using the following process which included the use of work and documents which were completed under a number of ongoing efforts, which supported the requirements and objectives of the Order revision task. The process included the following five steps:

1) Identification of radioactive waste management functions and activities based on standard systems engineering approaches.

2) Assessment of the hazards posed by performing the functions and activities.

3) Assessment of existing requirements (e.g., DOE directives, NRC regulations, EPA standards and international standards) for possible use and development of preferred language for the revised Order.

4) Development of requirements to address significant hazards and the technical basis for each requirement.

5) Solicitation of wide review and comment and resolution of comments.

This approach also corresponds to the grouping of activities used in DOE's Integrated Safety Management System (ISMS). This system establishes a logical process for integrating risk into all of DOE's activities and was used as the foundation for the next steps in the Order revision process. As noted, the ISMS outlines a simple and logical process for understanding and mitigating risks. Under this process, the development of work processes should include the following five steps: (1) identifying the functions (tasks) that must be performed to complete the work; (2) conducting a safety and hazards analysis of those functions; (3) identifying mitigating measures and controls based on that analysis; (4) applying the controls and implementing a periodic reassessment of the activities, and (5) providing for a feedback to revising the work processes as necessary. As described above, this analytical approach has been incorporated into the core of DOE's effort to revise the radioactive waste management Order, and represents the overall philosophical approach and major steps of this effort.

4.1 Identification of Radioactive Waste Management Functions and Activities

The identification of the functions associated with the management of each of the waste types was based on standard systems engineering approaches. These functions provided the framework for analysis of the tasks involved in radioactive waste management throughout the rest of the Order revision process. The identification of the functions associated with the management of low-level waste was performed as part of DOE's response to the DNFSB Recommendation 94-2. This

effort was documented in the *Low-Level Waste Systems Description Document (reference)*. The other waste type team members used this approach as a model for developing function maps for high-level and transuranic waste management activities. The use of this systems engineering approach resulted in a consistent approach across the specific waste types. The function maps for each of the waste types are included. The functions were grouped into three basic categories: those associated with planning (formulate the program); those involving performance of work tasks (execute the program); and those which provided for review of activities and feedback (evaluate the program).

4.2 Assessment of the Hazards

Following the development of the function maps for each of the waste types, a Safety and Hazards Analysis Workshop was conducted. The workshop was attended by both DOE Headquarters and Field Element staff and support was provided by contractor personnel. At the workshop, the waste-type teams formed breakout groups and using the functional maps for all of the waste types discussed their respective functional maps to identify any omissions or inconsistencies. After the functional maps were finalized the teams identified and documented the activities that occur in each of the functions. Once the task descriptions were completed, they were used to conduct a qualitative hazards and safety analysis. Through this analysis, scenarios were developed for each task of a radioactive waste management function to identify events that could result in an exposure to a worker or the public, a release of radioactivity to the environment, or an impact on disposal facility performance. Potentially affected receptors were then identified for each scenario, and the likelihood and consequences of the postulated exposure or release was qualitatively estimated. Next, the likelihood of occurrence and consequences were used to determine risk. The last step involved identifying the weakness or condition in the work performance and managerial structures which lead to the risk and developing mitigation options to address these weaknesses or conditions. This identification of weaknesses and conditions and associated mitigation options became part of the foundation for writing the technical basis for each of the requirements in the Order, Contractor Requirement Document, and Manual. This information was used to document the need for the final requirement. A diagram of the steps in the Safety and Hazards Analysis Process is presented in Figure 4.2. Each of the steps in the Safety and Hazards Analysis Process are discussed in greater detail in the following section.

The methodology for predictive hazard evaluation of the radioactive waste management system (Safety and Hazards Analysis Process) was used to identify system weaknesses and/or conditions, qualitatively estimate risks, and develop mitigation options associated with each of the functions of the radioactive waste management system. This analysis focused on the radiological hazards associated with the management of radioactive waste. The analysis was conducted from a complex-wide perspective using a generic facility concept that drew on site/facility specific knowledge as a basis. This information was then evaluated to provide the basis for identifying and developing the requirements and implementing guidance needed to safely manage radioactive

waste from a radiological perspective. The Safety and Hazards Analysis Process was performed on the low-level, high-level, and transuranic waste management systems described in each waste-type functions map. To the extent appropriate, existing systems engineering functional analysis maps were used as a starting point. The Safety and Hazards Analysis Process involved 11 steps. A flow diagram of the 11 steps is presented in Figure 4-2. The steps are as follows:

1. Operationalize the Function. Define and describe the physical activities associated with each function to be performed in managing each waste type.

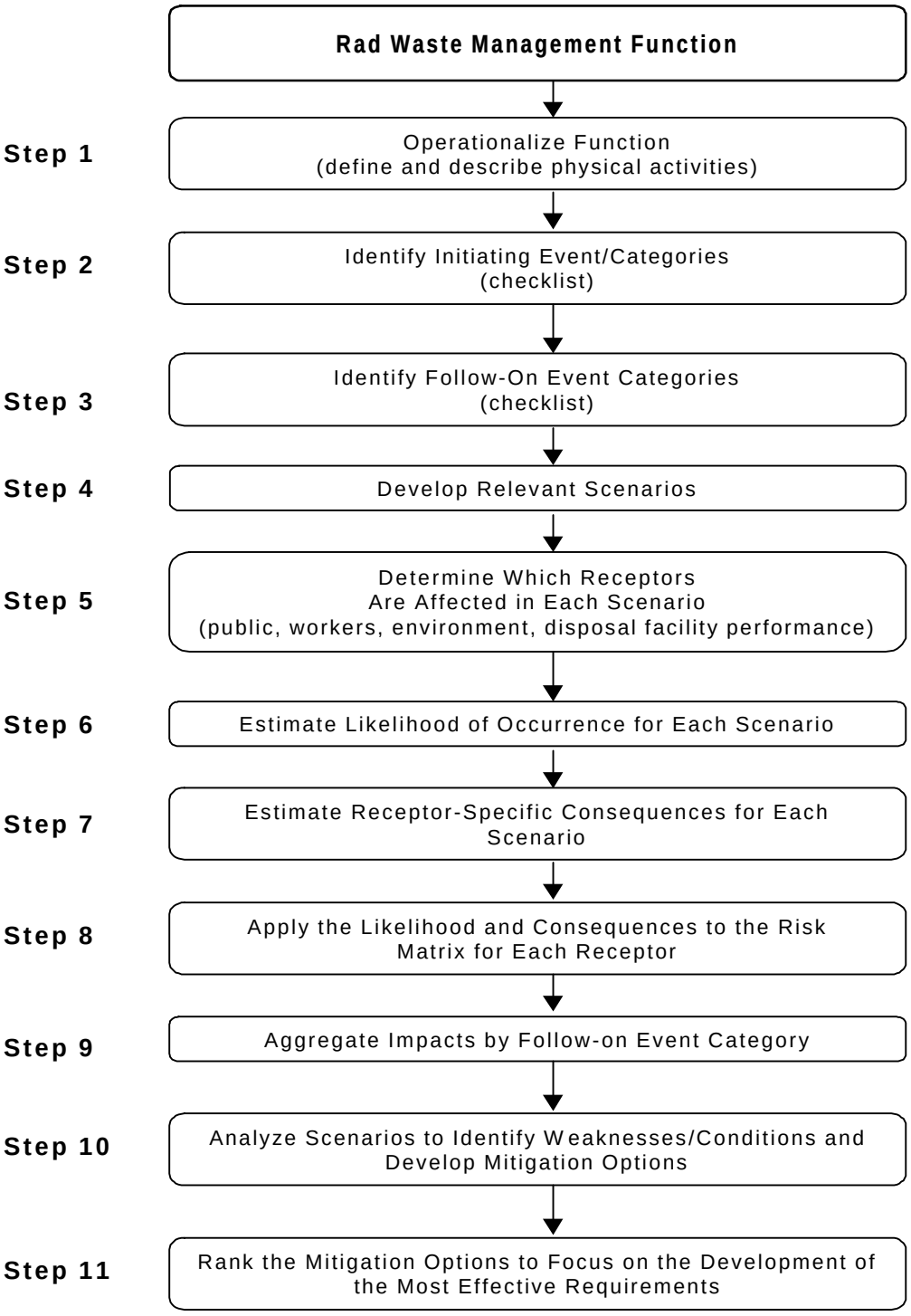
2. Identifying Initiating Event Categories. Initiating events are those in the chain of events that could affect the function as described in step 1. Initiating events were classified as either:

   - Natural Events (e.g., flood, earthquake, freezing temperatures, electrical storm);
   - Natural Processes/Passage of Time (e.g., corrosion, erosion, aging material, intrusion of plants/animals);
   - Equipment Malfunctions (e.g., instrument/sensor malfunction, process equipment malfunction);
   - External Events (e.g., fire, loss of utilities, high velocity impact); or
   - Human/Information Errors (e.g., communication error, operator error, documentation error, inadvertent intrusion by humans).

3. Identify Follow-on Event Categories. Follow-on events are those which could affect the function as described in step 1, and were classified as:

   - Structural Failure (e.g., building collapse, containment failure),
   - Infrastructure Failure (e.g., loss of water or water pipe break, loss of power or electrical surge),
   - Equipment Failure (e.g., instrument/sensor malfunction, process equipment malfunction),
   - Human Error (e.g., communication error, operator error),

STEPS IN THE SAFETY AND HAZARDS ANALYSIS



- Method/Information Failure (e.g., documentation error), or
- Other.

These categories reflect the first line of defense in preventing an initiating event from leading to exposure of a receptor.

4. Develop Relevant Scenarios. Sub-Team members developed one or more scenarios for each follow-on event category identified in step 3 that could reasonably lead to an exposure of a receptor (defined as workers, public, the environment, and disposal facility performance). The number of scenarios developed was determined by the need to address all of the activities identified in step 1. The scenarios were also used in step 10 as the basis for identifying the weaknesses and/or conditions that might exist in each scenario. The weaknesses and conditions identified were then used to focus the development of mitigation options.

5. Determine Which Receptors are Affected in Each Scenario. The scenarios developed may not have led to impacts to all four of the receptors. This step provided an opportunity for assessing which receptors were impacted under each scenario. Determining that a receptor was not impacted by a scenario eliminated the need to further evaluate that scenario/receptor combination.

6. Estimate Likelihood of Occurrence for Each Scenario. The frequency with which a scenario was expected to occur then was estimated using a set of ranges and the professional judgment of waste-type team members. The likelihood of occurrence was not meant to be a deterministic calculation, but a qualitative evaluation using experience or information on probabilities previously known or calculated (e.g., safety analysis evaluations). The likelihood of occurrence was used as one of the inputs to determine the receptor-specific qualitative risk in step 8. To determine the likelihood of the occurrence of such a scenario, each waste-type team used the process adapted from "*Risks and the Risk Debate: Searching for Common Ground "The First Step,'" Volume 1, June 1995,* and successfully employed in the *Complex-Wide Review of DOE's Low-Level waste Management ES&H Vulnerabilities.* The likelihoods of occurrence fall into categories of time:

   - < 1 year indicates a scenario whose consequence already exists or is expected to occur with a frequency of at least once per year;
   - 1 - 10 years indicates a scenario whose consequence is expected less frequently than once per year, but more frequently than once every 10 years;

- 10 - 100 years indicates a scenario whose consequence is expected less frequently than once every 10 years, but more frequently than once every 100 year); and

- > 100 years indicates a scenario whose consequence is unlikely to occur within the operating life of a facility, but is not completely precluded from occurring.

7. Estimate the Receptor-Specific Consequences for Each Scenario. The consequences for each scenario/receptor combination was estimated using broadly defined ranges of effects, allowing waste-type team members to use their professional judgement and experience. Again, information on consequences previously known or calculated (e.g., safety analysis evaluations) was applied. This information was a key input to the qualitative risk evaluation in step 8. To determine the consequences to the receptor, each waste-type team adapted the system from the *"Risks and the Risk Debate: Searching for Common Ground "The First Step"*. Consequences are receptor specific:

   - Injury/loss of life for workers;

   - Exposure/loss of life for the public;

   - Damage for the environment; and

   - Impact for the disposal facility performance.

8. Apply the Likelihood and Consequences to the Risk Matrix for Each Receptor and Aggregate the Impacts. The likelihood of occurrence (from step 6) and estimated consequence (from step 7) for each scenario was used in this step as the basis for qualitatively estimating the risk to a receptor through the standard risk matrices developed for each receptor type. This information along with the information from steps 4 through 7, was used to develop the mitigation options.

9. Aggregate Impacts by Follow-on Event Category. The risks for scenario/receptor combinations were then tabulated by follow-on event category to provide a relative measure of the potential risk associated with each category of follow-on events.

10. Analyze Scenarios to Identify Weaknesses and/or Conditions and Develop Mitigation Options. The scenarios developed in step 4 were analyzed to identify the weaknesses and/or conditions that were assumed in the operations or managerial structure of each scenario. The weaknesses and conditions identified were then used to help focus the development of mitigation options. Using the results of steps 4 through 9, the waste-type team members developed mitigation

measures that would address the weaknesses and/or conditions and that could reduce the likelihood of occurrence and/or consequences of an event. The information from steps 4 through 9 also were used to focus the development of the mitigation activities in the context of the scenarios. These mitigation options served as the basis for identification and development of the requirements and the implementing guidance for the safe management of radioactive waste.

11. Rank the Mitigation Options to Focus on the Development of the Most Effective Requirements. The tabulated risks for each scenario/receptor combination were used as the basis for ranking mitigation options for effectiveness in addressing safe management of radioactive waste. This ranking served as an input to the decision of which potential requirements and/or implementing guidance would be most effective in safely managing radioactive waste.

4.3 Requirements Analysis

Once the weaknesses and conditions and mitigation options to address these weaknesses or conditions were developed, existing requirements were evaluated to identify those which addresses the mitigation options. This was accomplished during the Requirements Analysis Workshop. The workshop was attended by both DOE Headquarters and Field Element staff and support was provided by contractor personnel. At the workshop the waste type teams formed breakout groups and using the weakness and conditions and associated mitigation options identified by all the waste types at the previous workshop they evaluated their own to identify any omissions or inconsistencies. Following this the weaknesses and conditions and associated mitigation options were finalized for each of the waste type. The process of searching through existing requirements to identify those that would address these weaknesses and conditions began. This effort was facilitated by the identification of potentially applicable requirement sources before the workshop. These sources were then readily available for the team members. This resulted in the inclusion of over 100 DOE directives (orders, manuals, guides, and policies) and other agency requirements and guides (EPA and NRC requirements and other national, international, and industry consensus standards).

The evaluation involved a determination of whether the requirement addressed the weakness or condition. If yes, did it adequately address the weakness or condition? If yes, it was adopted for use. If no, could it be modified to adequately address the weakness or condition? If yes, it was modified and adopted for use. If no, a requirement was written and adopted for use. To ensure a complete evaluation, checklists were prepared for each function which included a list of DOE directives and other requirements that might apply that were required to reviewed. If more than one requirement was identified which would address a weakness or condition, they were evaluated and the most appropriate one or a if necessary a hybrid using one or more of the requirements was adopted for use. This evaluation, modification, writing, and adoption for use

process became part of the foundation for writing the technical basis for each of the requirements in the final Order, Contractor Requirement Document, and Manual. This information was used to describe the source of the language used in the final requirement. The following describes the Requirements Analysis and each of its steps in more detail. A flow diagram of the steps in the Requirements Analysis, which includes decisions on which document is most appropriate for each requirement is depicted in Figure 5-1. The steps are as follows:

1) Operationalize Functions

For each waste type, the functions were listed along with the definition of the function and phrases representing the operationalization of the function. An example is high-level waste function 1.3.1.1.1.2 Characterize Site for Storage Facility: Recognize facility-specific characteristics and gather and review technical data from candidate sites.

2) Identify Needed Requirement Areas

For the function being analyzed, the list of items for which requirements were needed was included. This comprised a list of weaknesses and conditions from the Safety and Hazards Analysis process and a list of the vulnerabilities from the low-level waste Complex-Wide Review and similar evaluations of transuranic and high-level waste which have been identified.

3) Identified Existing and External Requirement Sources

For each function, the appropriate requirements were listed from sources that are or could be requirements for the safe and effective implementation of the function for managing radioactive waste. Each requirement was then linked to any weaknesses, conditions, or vulnerability which it could potentially address. Requirement sources included:

- DOE 5820.2A, *Radioactive Waste Management* and other DOE directives;
- Applicable Federal requirements (e.g., 40 CFR Part 190);
- A set of proposed multi-function requirements;
- Other Federal requirements (e.g., 10 CFR Part 61);
- International standards (if appropriate); and

- National standards and practices (if appropriate).

4) Evaluate Adequacy of Requirements

Each of the requirements compiled in Step 2 was evaluated to determine its adequacy in providing for safe management of radioactive waste for the function being analyzed. This evaluation was based on an analysis of the requirement against the following considerations:

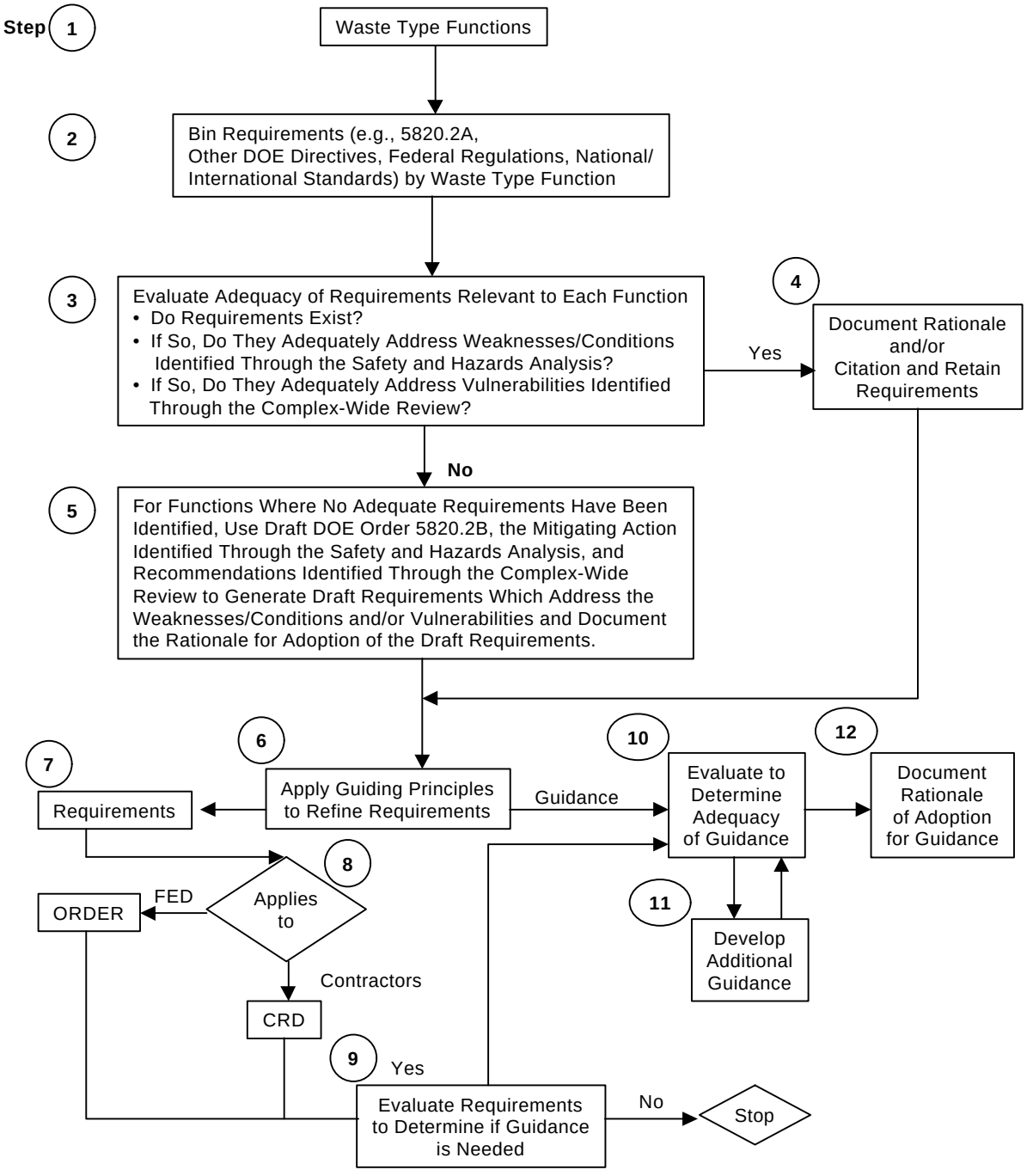
- Does the requirement support an upper-level requirement?
- Does the requirement address an activity of the function as defined in the function definition and operationalization?
- Does the requirement address a weakness or condition identified through the Safety and Hazards Analysis process?
- Does the requirement address a vulnerability identified through the Complex-Wide Review for low-level and mixed low-level wastes or other assessments for transuranic or high-level wastes?
- Does the requirement address the guiding principles for establishment of specific requirements to support the upper-level requirements?
- Does the requirement describe a best management practice or a proven site-specific method?

The requirements were evaluated in the following Order. First, any proposed multi-function requirements and other applicable Federal requirements and DOE directives were evaluated. Then requirements potentially applicable from DOE 5820.2A, *Radioactive Waste Management*, were evaluated. Finally, requirements from other non-applicable sources (similar U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency regulations, and national standards), followed by any international information were evaluated.

5) Identification of Additional Requirements

When the preceding steps in the requirements analysis were completed, the lists of vulnerabilities and weaknesses or conditions, and the list of operationalized functions were examined to identify if any additional requirements were needed. Similarly, the

Requirements Analysis



proposed requirements listed were examined to see if additional requirements were needed in order to effectively implement the waste management functions of each waste type.

5.0 OTHER CONSIDERATIONS

The following areas of consideration were identified as concepts and values to be incorporated in and reflected throughout the revised radioactive waste management order.

5.1 Protection of the Public

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be conducted and shown to assure adequate protection of the public from exposure to radioactive materials during both normal operations and during reasonably foreseen off-normal events. Adequate radiation protection is defined by the exposure limits set forth in 10 CFR Part 834. In addition, the DOE Nuclear Safety Policy defines safety goals that are expressed in terms of public risk of accidental fatality and fatal cancer incidence. The risk of prompt fatality to average individual due to an accident in the vicinity of a DOE facility is to be less than 0.1% of the sum of prompt fatalities due to other accidents to which members of the public are generally exposed. The risk of cancer fatality that might result from operations at a DOE site should not exceed 0.1% of the sum of all cancer fatality risks to the public resulting from all other causes [SEN-35-91].

5.2 Protection of the Workforce

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities, shall be conducted and shown to protect the workforce from hazards to a level commensurate with comparable, safe industrial facilities and shall meet the requirements of the *Occupational Safety and Health Act* (OSHA) requirements 29 CFR Part 1910 and 29 CFR Part 1926 [DOE O 440.1A]. Facilities shall be designed, operated, decontaminated, and closed to limit radiation exposures to the workforce during normal operations and during reasonably foreseen off-normal events to levels below limits set forth in 10 CFR Part 835 as supplemented by DOE Notice 441.1

5.3 As Low as Reasonably Achievable (ALARA)

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be analyzed to show and shall be conducted in manners such that radiation exposures of the public, the workforce, and environment are kept as low as reasonably achievable (ALARA). ALARA is the approach to radiation protection to manage and control exposures, taking into account social, technical, economic, practical and policy considerations. ALARA does not identify a dose limit but is

instead a process which has the objective of attaining doses as far below the applicable limits as can be reasonably achieved. [10 CFR 835.1001 and 10 CFR 835.1002]

5.4 Defense-in-depth

The safety strategy for radioactive waste management activities at DOE sites shall be based on defense-in-depth. In this context, defense-in-depth is the practice of using systems of equipment and systems of procedures in a structure of mutual re-enforcement to avoid exposures of the public, the workforce, and the environment to nuclear radiation [DNFSB/TECH-6]. A graded approach based on risk shall be utilized to comply with the requirement [10 CFR 830.3 and 10 CFR 830.7].

5.5 Protection of the Environment

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post closure activities shall be conducted to meet statutory limits and shown to minimize contamination of the environment in a cost-effective manner and to limit exposure of aquatic animals to levels below the limits specified in 10 CFR Part 834. Contamination of land by DOE activities shall be limited to avoid permanently restricting land from beneficial use [*Atomic Energy Act of 1954*, as amended; Executive Order 11514].

5.6 Compliance

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be compliant with applicable Federal, State, and local laws and regulations, as well as Compliance Orders [10 CFR Part 820]. These activities shall also comply with applicable Executive Orders, DOE's Strategic Plan, and DOE Policies [SEN-15-90; DOE Policy P 251.1].

5.7 Authorization Basis

Radioactive waste management activities at DOE sites shall have an authorization basis. "The authorization basis establishes the safety envelop for a facility operation or activity and defines what will have to be done to control safety of the operation [or activity]. The authorization basis includes the hazards analysis, the definition of administrative and engineering controls to prevent and mitigate hazards, and the associated technical and operation limits. The type of safety documents that will constitute the authorization basis will vary with the hazard and complexity of the operation or activity." [DOE O 425.1A; DOE 5480.21; DOE 5480.22; DOE 5480.23]

5.8 Cost-Effectiveness

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be shown to be cost effective with OMB Circular A-94. The evaluation of cost effectiveness shall include:

- Quantified estimates of life-cycle cost of proposed activities and alternatives. Life-cycle cost shall include capital investment, acceptance testing, operations, maintenance, decontamination, decommissioning, disposal, closure and post-closure activities.

- Quantified estimates of the benefits of proposed activities and alternatives. The benefits shall include waste minimization, increments in the expected radiation dose to the public, the workforce, and the contamination of the environment, land use, and timely disposal of waste. The conversion of benefits to monetary values for use in comparisons to cost shall have a defensible and documented basis. Estimates of costs and benefits shall include the time cost of capital and quantification of uncertainties. Selection among alternatives shall minimize life-cycle costs and investment risk while maximizing the net benefit for the timely disposition of wastes without compromising the protection of the public, the workforce, and the environment, nor the compliance with applicable laws and regulations [SEN-35-91 Section 1; Executive Order 12780 (1991)].

5.9 Voluntary Consensus Standards

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be conducted in conformance with applicable technical standards that are developed or adapted by voluntary consensus standard bodies to the extent that these standards are appropriate and practical [Public Law 104-113; SEN-35-91, Section 2, Paragraphs 1 and 2; DOE Policy 251.1].

5.10 Waste Minimization

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall minimize the waste quantity, volume, and toxicity to an extent technically and economically practical.

5.11 Property and Facility Protection

Radioactive waste management activities at DOE sites including design, construction, operation, decontamination, disposal, closure, and post-closure activities shall be conducted in manners that

minimize the threats to DOE property [*Atomic Energy Act of 1954*, as amended, Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*].

5.12 Timely Disposal of Waste

Radioactive waste management activities at DOE sites shall be prioritized to minimize with respect to life-cycle cost the time integral of risk of radiation exposure to the public and the workforce, as well as the time integral of the risk of environmental contamination.

5.13 Waste Characterization

Radioactive waste on DOE sites shall be characterized sufficiently to assure compliance with other requirements including those concerning limitations on radiation doses to the public and the workforce, possible degradation of the environmental quality, and the cost-effective management of radioactive waste, as well as to assure compliance with the waste acceptance criteria both on the site and at the eventual waste disposal site.

6.0 REQUIREMENT DOCUMENTATION AND TECHNICAL BASIS

6.1 Order Writing Process

The general requirements and waste-type teams took the requirements that resulted from applying the guiding principles and began to organize then into the draft outline of the Order and Manual. Once all of the requirements had been place into the appropriate section of the draft outline it was reviewed and modified to eliminate redundancies, provide for better flow and logic, identification of requirements common to all waste types (these requirements were then evaluated for possible inclusion in the General Requirements section), and other changes associated with consistency and wording selection. Once each of the individual waste-type chapters was completed the chapters were reviewed collectively for consistency and continuity and further revised to address suggested changes. Finally, the draft was sent out for a Department-wide review.

6.2 Documentation of Technical Basis Crosswalk

During the entire Order revision process, information needed to develop the technical basis for each of the requirements was identified and generated. The Safety and Hazards Analysis provided the technical basis for why the requirements are important and necessary for the safe management of radioactive waste. The Requirements Analysis provided the technical basis for the source and, in some cases, the wording of the requirements. The application of the guiding principles for generating requirements provided the technical basis for the wording of the requirements and, in the case of some of general requirements, also provided the technical basis for the need and

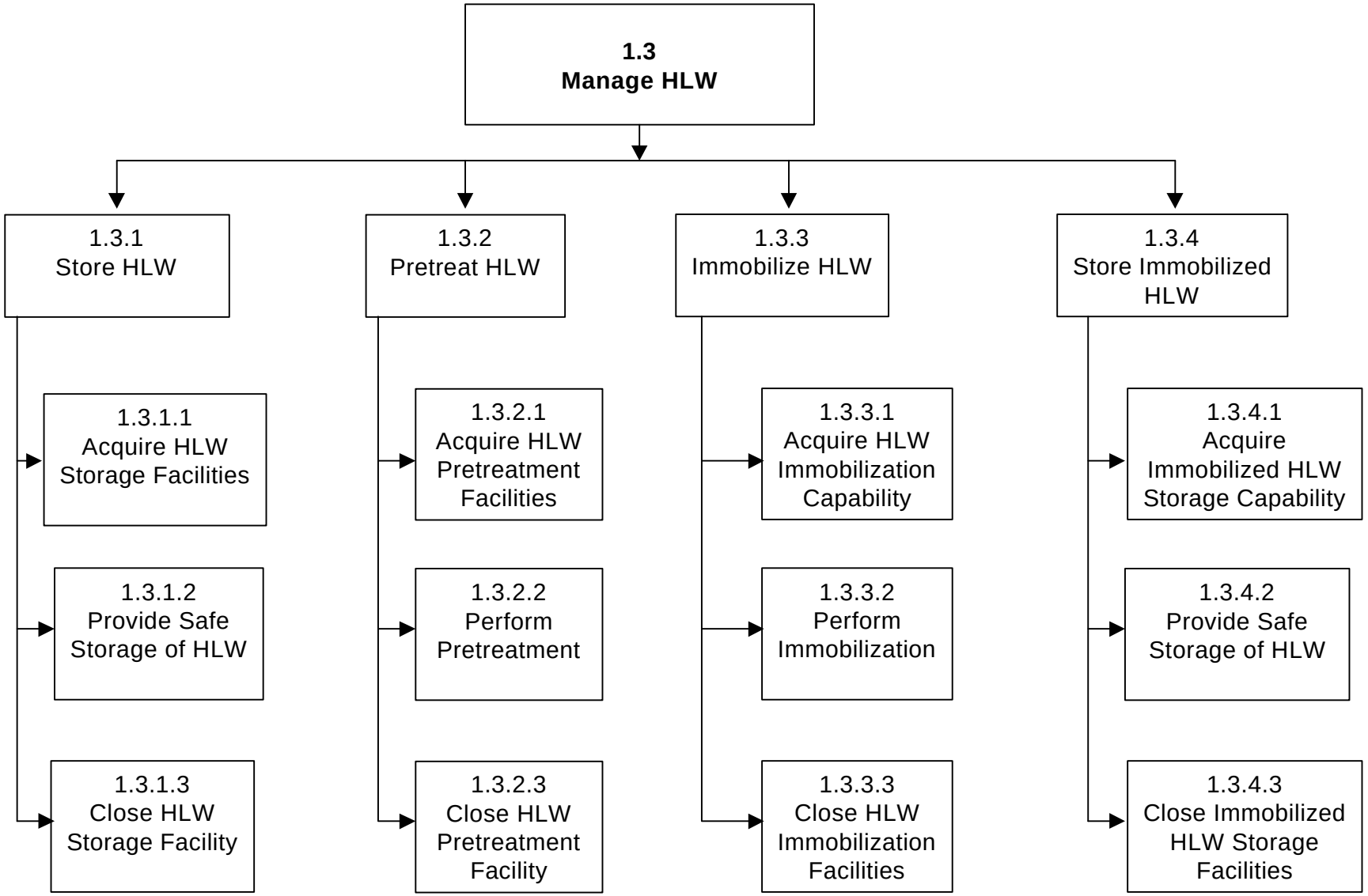
source of the requirements. The following sections provide a discussion of the approaches for the management of radioactive waste, high-level waste, transuranic waste, and low-level waste.

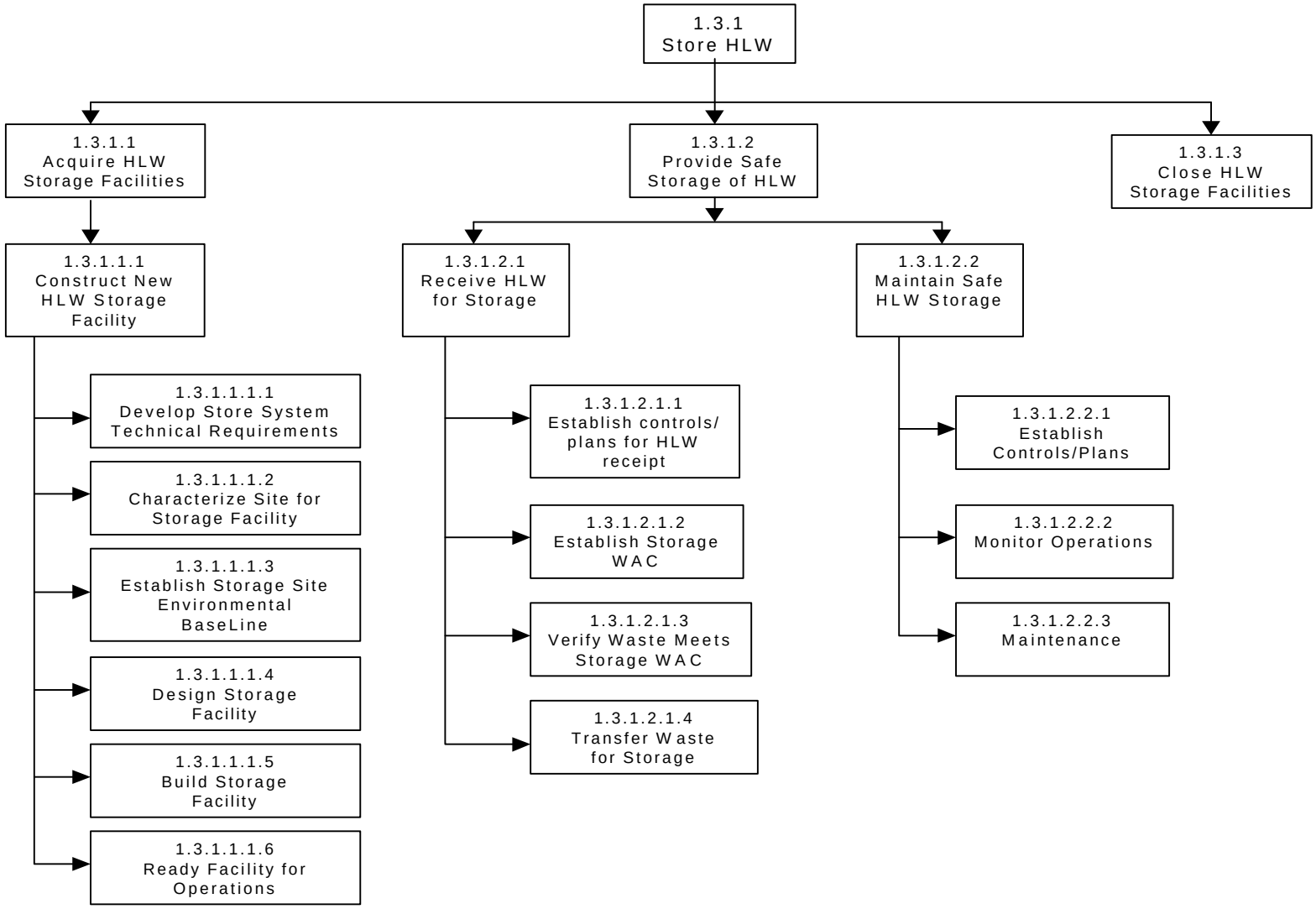
Additionally, a crosswalk of the requirements from DOE 5820.2A, *Radioactive Waste Management*, to Draft DOE O 435.1, *Radioactive Waste Management*, was conducted and the technical basis for each of the requirements is included for general requirements and the requirements for high-level waste management, transuranic waste management, and low-level waste management. The technical basis provides crosswalk tables (Attachment 1) depicting the revised 435.1 requirements, the 5820.2A requirements, and the technical basis for the revised requirements.

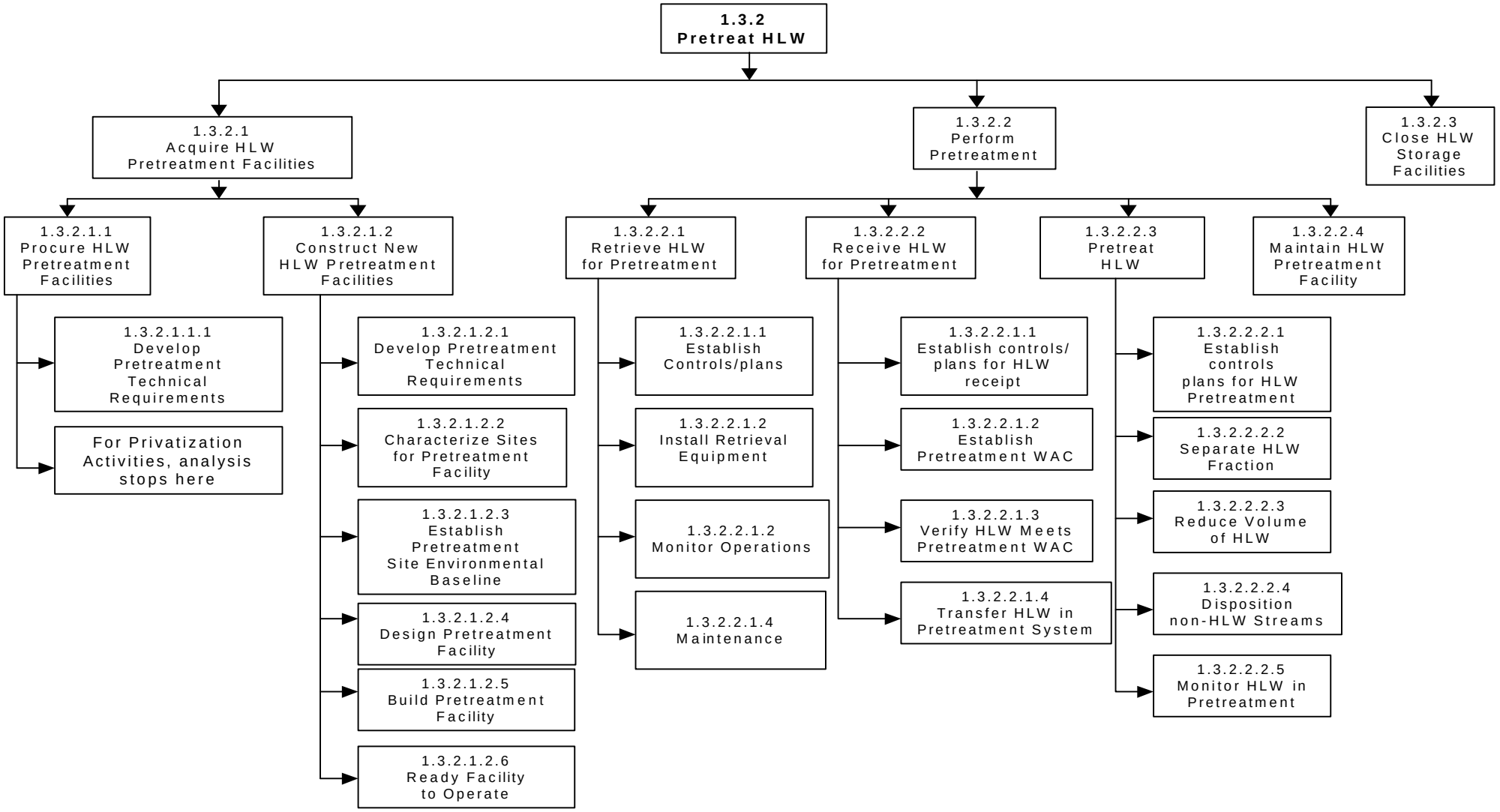
The technical basis for the revised requirement includes:

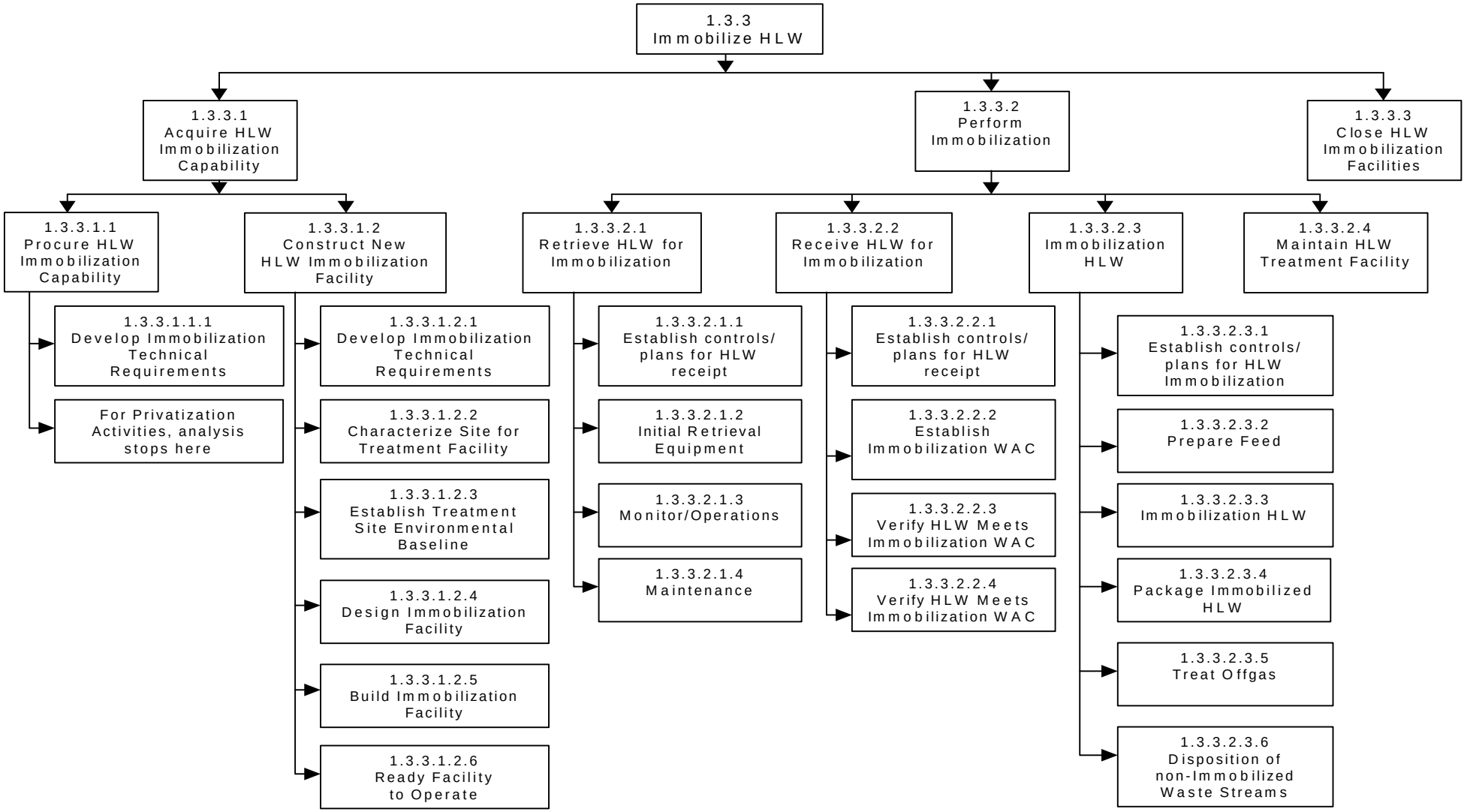
- The driver for the requirement (Safety and Hazard Analysis, Requirements Analysis, complex-wide review, etc.).
- The weakness/condition or vulnerability which the requirement addresses.
- The origin or source of the requirement.
- Other information (e.g., the requirement addresses other considerations as identified in Section 5.0, such as provides defense in depth, addresses ALARA, etc.).

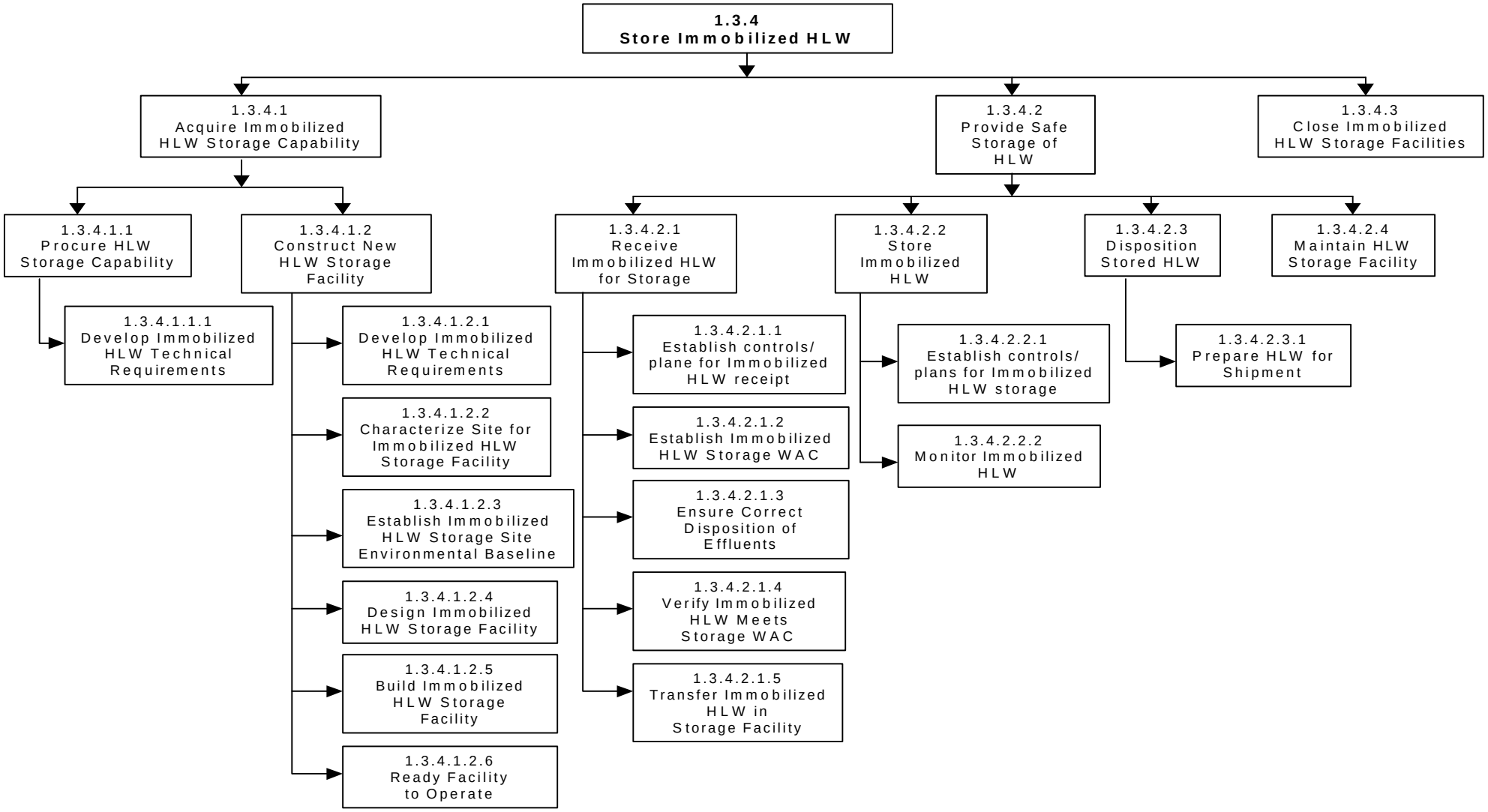
Functions Maps

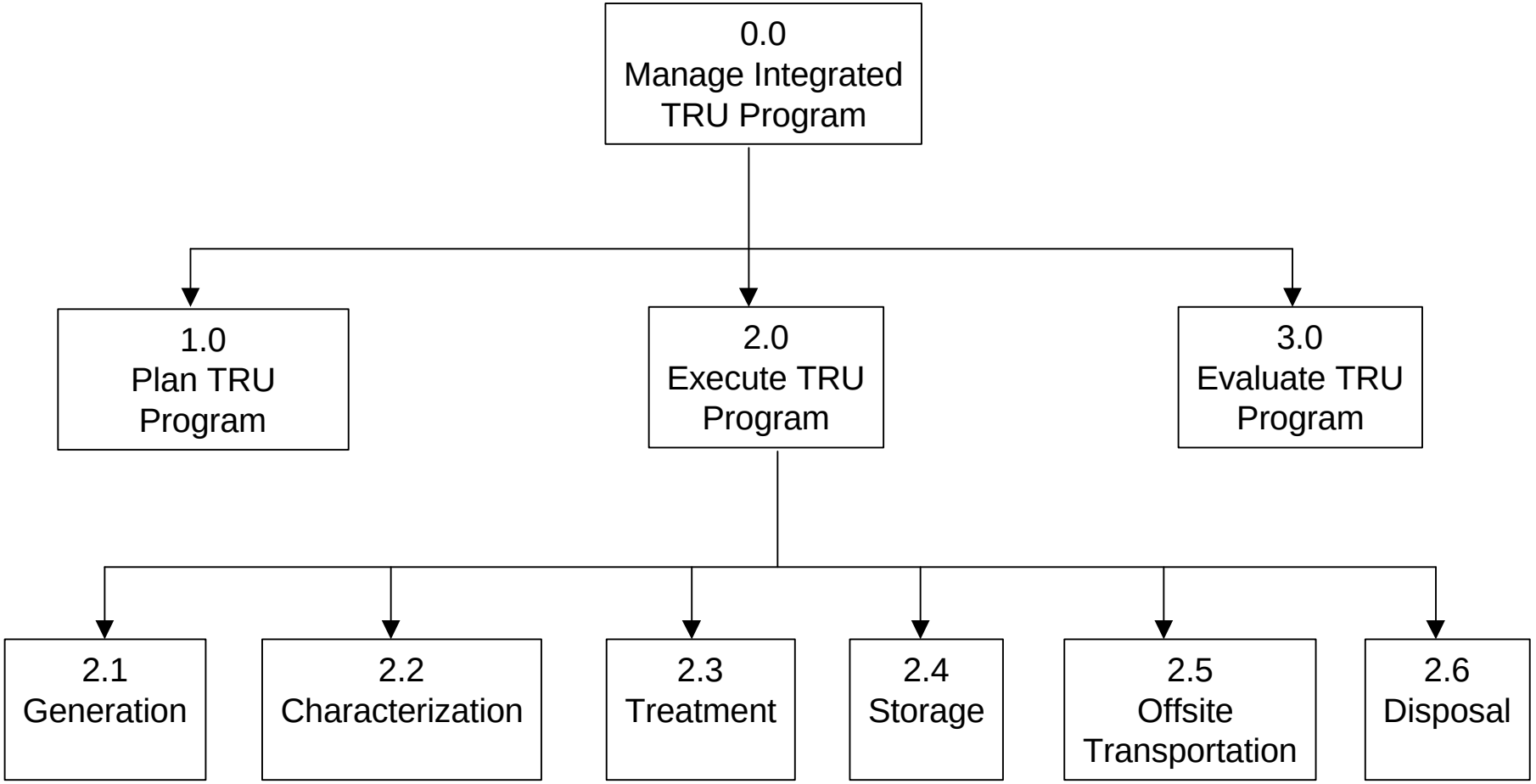

1.3
Manage HLW
1.3.1
Store HLW
1.3.2
Pretreat HLW
1.3.3
Immobilize HLW
1.3.4
Store Immobilized HLW
1.3.1.1
Acquire HLW Storage Facilities
1.3.1.2
Provide Safe Storage of HLW
1.3.1.3
Close HLW Storage Facility
1.3.2.1
Acquire HLW Pretreatment Facilities
1.3.2.2
Perform Pretreatment
1.3.2.3
Close HLW Pretreatment Facility
1.3.3.1
Acquire HLW Immobilization Capability
1.3.3.2
Perform Immobilization
1.3.3.3
Close HLW Immobilization Facilities
1.3.4.1
Acquire Immobilized HLW Storage Capability
1.3.4.2
Provide Safe Storage of HLW
1.3.4.3
Close Immobilized HLW Storage Facilities

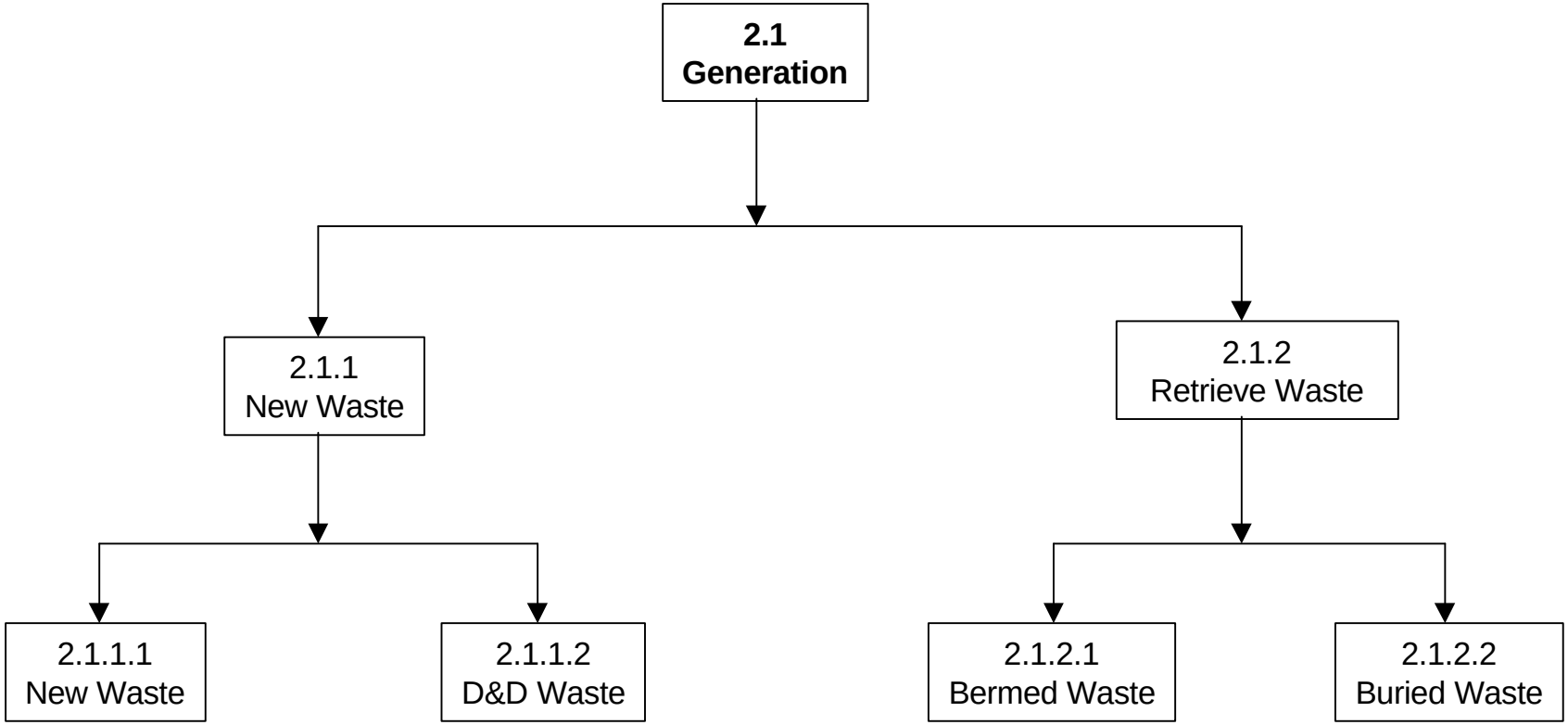

1.3.1
Store HLW
1.3.1.1
Acquire HLW
Storage Facilities
1.3.1.2
Provide Safe
Storage of HLW
1.3.1.3
Close HLW
Storage Facilities
1.3.1.1.1
Construct New
HLW Storage
Facility
1.3.1.2.1
Receive HLW
for Storage
1.3.1.2.2
Maintain Safe
HLW Storage
1.3.1.1.1.1
Develop Store System
Technical Requirements
1.3.1.1.1.2
Characterize Site for
Storage Facility
1.3.1.1.1.3
Establish Storage Site
Environmental
BaseLine
1.3.1.1.1.4
Design Storage
Facility
1.3.1.1.1.5
Build Storage
Facility
1.3.1.1.1.6
Ready Facility for
Operations
1.3.1.2.1.1
Establish controls/
plans for HLW
receipt
1.3.1.2.1.2
Establish Storage
WAC
1.3.1.2.1.3
Verify Waste Meets
Storage WAC
1.3.1.2.1.4
Transfer Waste
for Storage
1.3.1.2.2.1
Establish
Controls/Plans
1.3.1.2.2.2
Monitor Operations
1.3.1.2.2.3
Maintenance

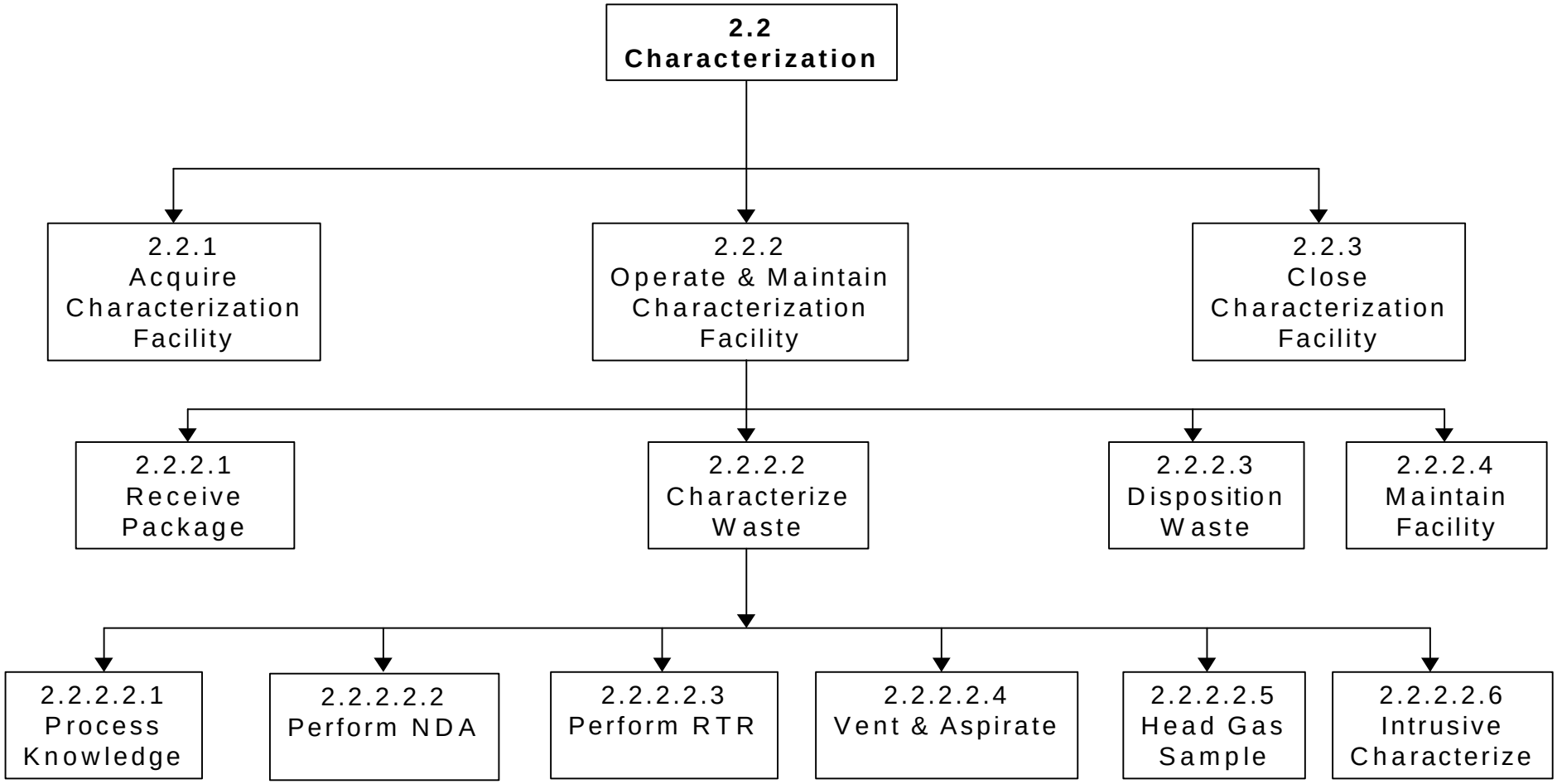

1.3.2
Pretreat HLW
1.3.2.1
Acquire HLW
Pretreatment Facilities
1.3.2.2
Perform
Pretreatment
1.3.2.3
Close HLW
Storage
Facilities
1.3.2.1.1
Procure HLW
Pretreatment
Facilities
1.3.2.1.2
Construct New
HLW Pretreatment
Facilities
1.3.2.2.1
Retrieve HLW
for Pretreatment
1.3.2.2.2
Receive HLW
for Pretreatment
1.3.2.2.3
Pretreat
HLW
1.3.2.2.4
Maintain HLW
Pretreatment
Facility
1.3.2.1.1.1
Develop
Pretreatment
Technical
Requirements
For Privatization
Activities, analysis
stops here
1.3.2.1.2.1
Develop Pretreatment
Technical
Requirements
1.3.2.1.2.2
Characterize Sites
for Pretreatment
Facility
1.3.2.1.2.3
Establish
Pretreatment
Site Environmental
Baseline
1.3.2.1.2.4
Design Pretreatment
Facility
1.3.2.1.2.5
Build Pretreatment
Facility
1.3.2.1.2.6
Ready Facility
to Operate
1.3.2.2.1.1
Establish
Controls/plans
1.3.2.2.1.2
Install Retrieval
Equipment
1.3.2.2.1.2
Monitor Operations
1.3.2.2.1.4
Maintenance
1.3.2.2.2.1
Establish controls/
plans for HLW
receipt
1.3.2.2.1.2
Establish
Pretreatment WAC
1.3.2.2.1.3
Verify HLW Meets
Pretreatment WAC
1.3.2.2.1.4
Transfer HLW in
Pretreatment System
1.3.2.2.2.1
Establish
controls
plans for HLW
Pretreatment
1.3.2.2.2.2
Separate HLW
Fraction
1.3.2.2.2.3
Reduce Volume
of HLW
1.3.2.2.2.4
Disposition
non-HLW Streams
1.3.2.2.2.5
Monitor HLW in
Pretreatment

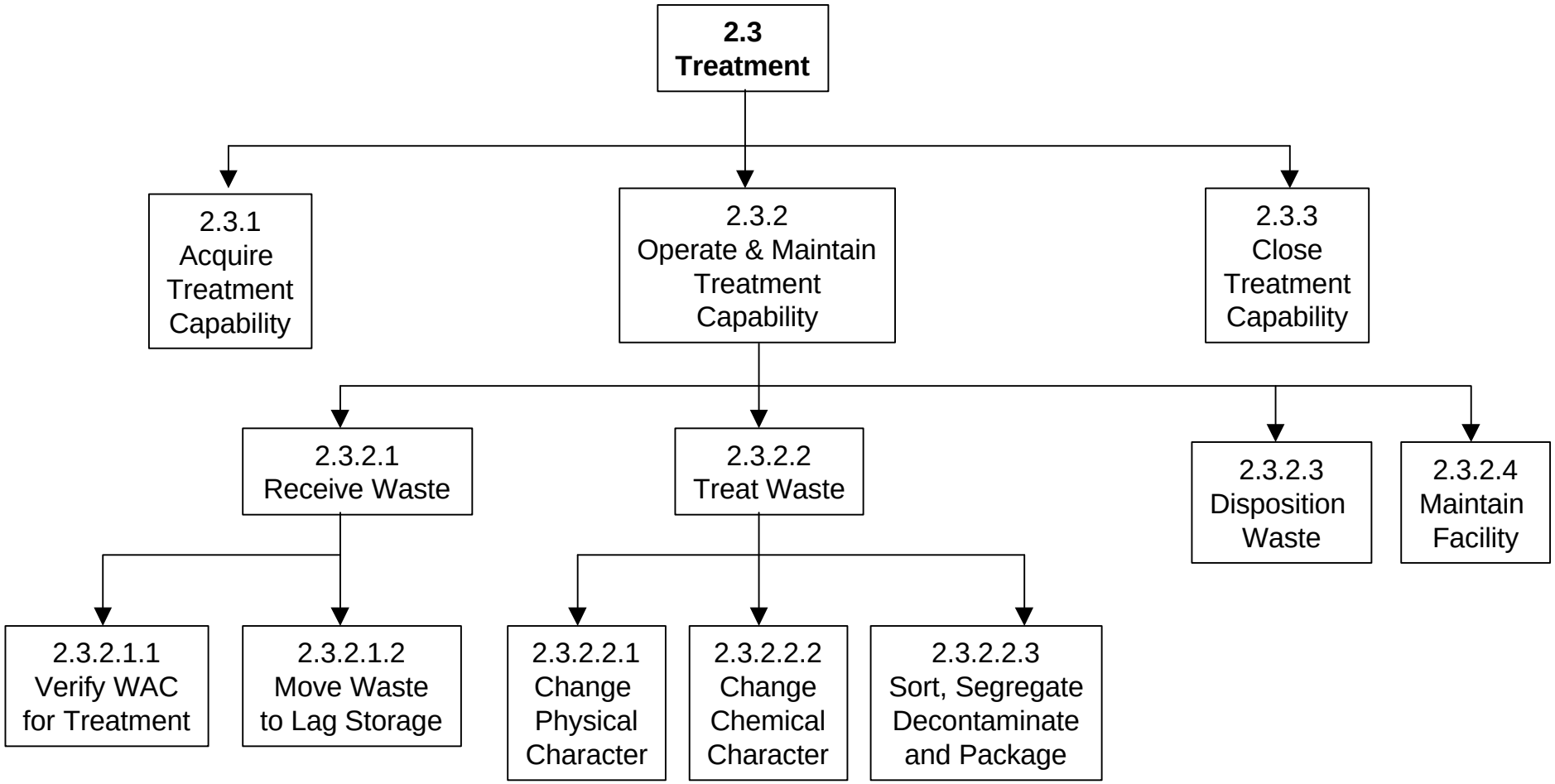

1.3.3 Immobilize HLW
1.3.3.1 Acquire HLW Immobilization Capability
1.3.3.2 Perform Immobilization
1.3.3.3 Close HLW Immobilization Facilities
1.3.3.1.1 Procure HLW Immobilization Capability
1.3.3.1.2 Construct New HLW Immobilization Facility
1.3.3.2.1 Retrieve HLW for Immobilization
1.3.3.2.2 Receive HLW for Immobilization
1.3.3.2.3 Immobilization HLW
1.3.3.2.4 Maintain HLW Treatment Facility
1.3.3.1.1.1 Develop Immobilization Technical Requirements
For Privatization Activities, analysis stops here
1.3.3.1.2.1 Develop Immobilization Technical Requirements
1.3.3.1.2.2 Characterize Site for Treatment Facility
1.3.3.1.2.3 Establish Treatment Site Environmental Baseline
1.3.3.1.2.4 Design Immobilization Facility
1.3.3.1.2.5 Build Immobilization Facility
1.3.3.1.2.6 Ready Facility to Operate
1.3.3.2.1.1 Establish controls/ plans for HLW receipt
1.3.3.2.1.2 Initial Retrieval Equipment
1.3.3.2.1.3 Monitor/Operations
1.3.3.2.1.4 Maintenance
1.3.3.2.2.1 Establish controls/ plans for HLW receipt
1.3.3.2.2.2 Establish Immobilization WAC
1.3.3.2.2.3 Verify HLW Meets Immobilization WAC
1.3.3.2.2.4 Verify HLW Meets Immobilization WAC
1.3.3.2.3.1 Establish controls/ plans for HLW Immobilization
1.3.3.2.3.2 Prepare Feed
1.3.3.2.3.3 Immobilization HLW
1.3.3.2.3.4 Package Immobilized HLW
1.3.3.2.3.5 Treat Offgas
1.3.3.2.3.6 Disposition of non-Immobilized Waste Streams

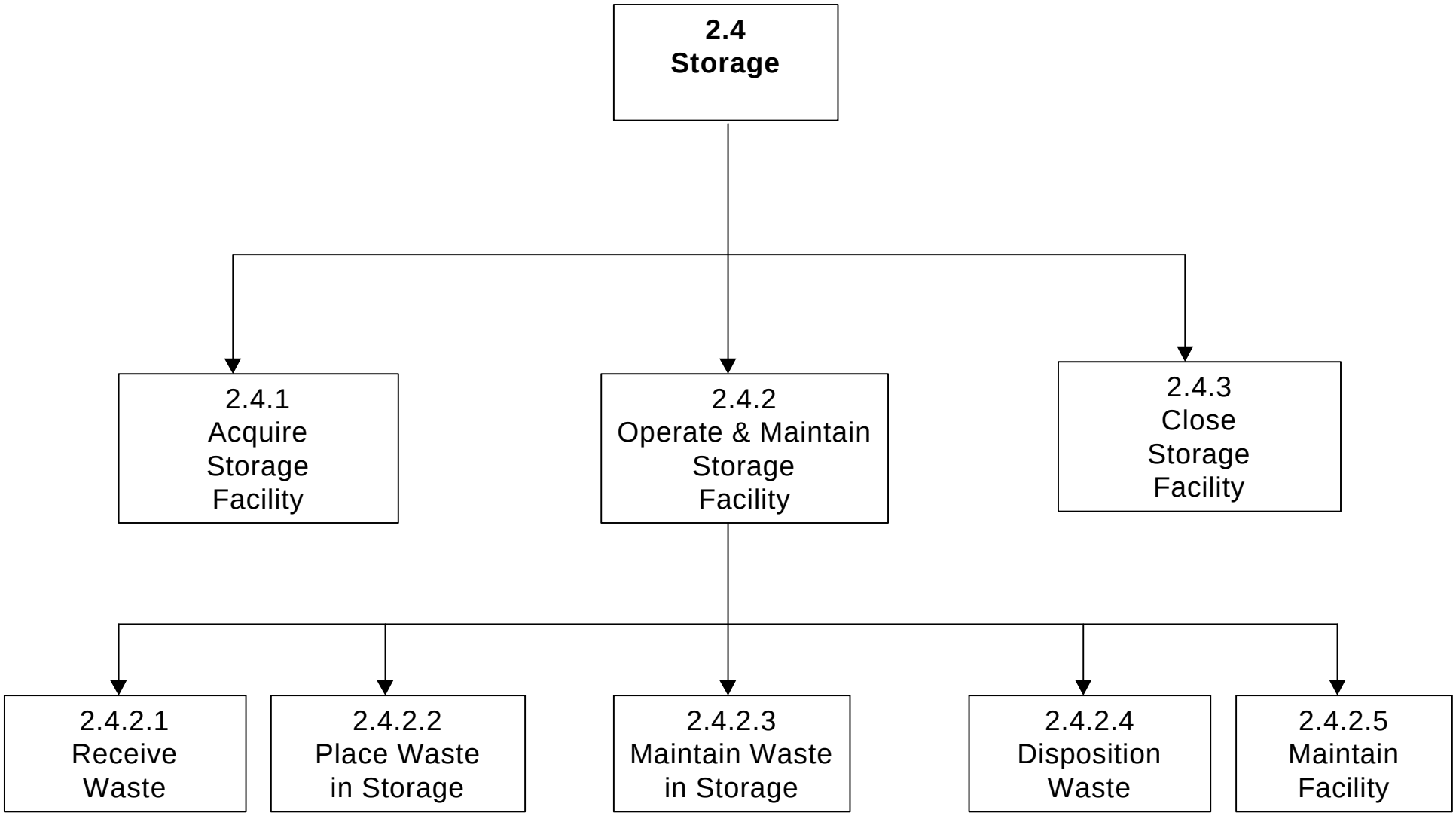

1.3.4
Store Immobilized HLW
1.3.4.1
Acquire Immobilized HLW Storage Capability
1.3.4.2
Provide Safe Storage of HLW
1.3.4.3
Close Immobilized HLW Storage Facilities
1.3.4.1.1
Procure HLW Storage Capability
1.3.4.1.2
Construct New HLW Storage Facility
1.3.4.2.1
Receive Immobilized HLW for Storage
1.3.4.2.2
Store Immobilized HLW
1.3.4.2.3
Disposition Stored HLW
1.3.4.2.4
Maintain HLW Storage Facility
1.3.4.1.1.1
Develop Immobilized HLW Technical Requirements
1.3.4.1.2.1
Develop Immobilized HLW Technical Requirements
1.3.4.1.2.2
Characterize Site for Immobilized HLW Storage Facility
1.3.4.1.2.3
Establish Immobilized HLW Storage Site Environmental Baseline
1.3.4.1.2.4
Design Immobilized HLW Storage Facility
1.3.4.1.2.5
Build Immobilized HLW Storage Facility
1.3.4.1.2.6
Ready Facility to Operate
1.3.4.2.1.1
Establish controls/ plane for Immobilized HLW receipt
1.3.4.2.1.2
Establish Immobilized HLW Storage WAC
1.3.4.2.1.3
Ensure Correct Disposition of Effluents
1.3.4.2.1.4
Verify Immobilized HLW Meets Storage WAC
1.3.4.2.1.5
Transfer Immobilized HLW in Storage Facility
1.3.4.2.2.1
Establish controls/ plans for Immobilized HLW storage
1.3.4.2.2.2
Monitor Immobilized HLW
1.3.4.2.3.1
Prepare HLW for Shipment

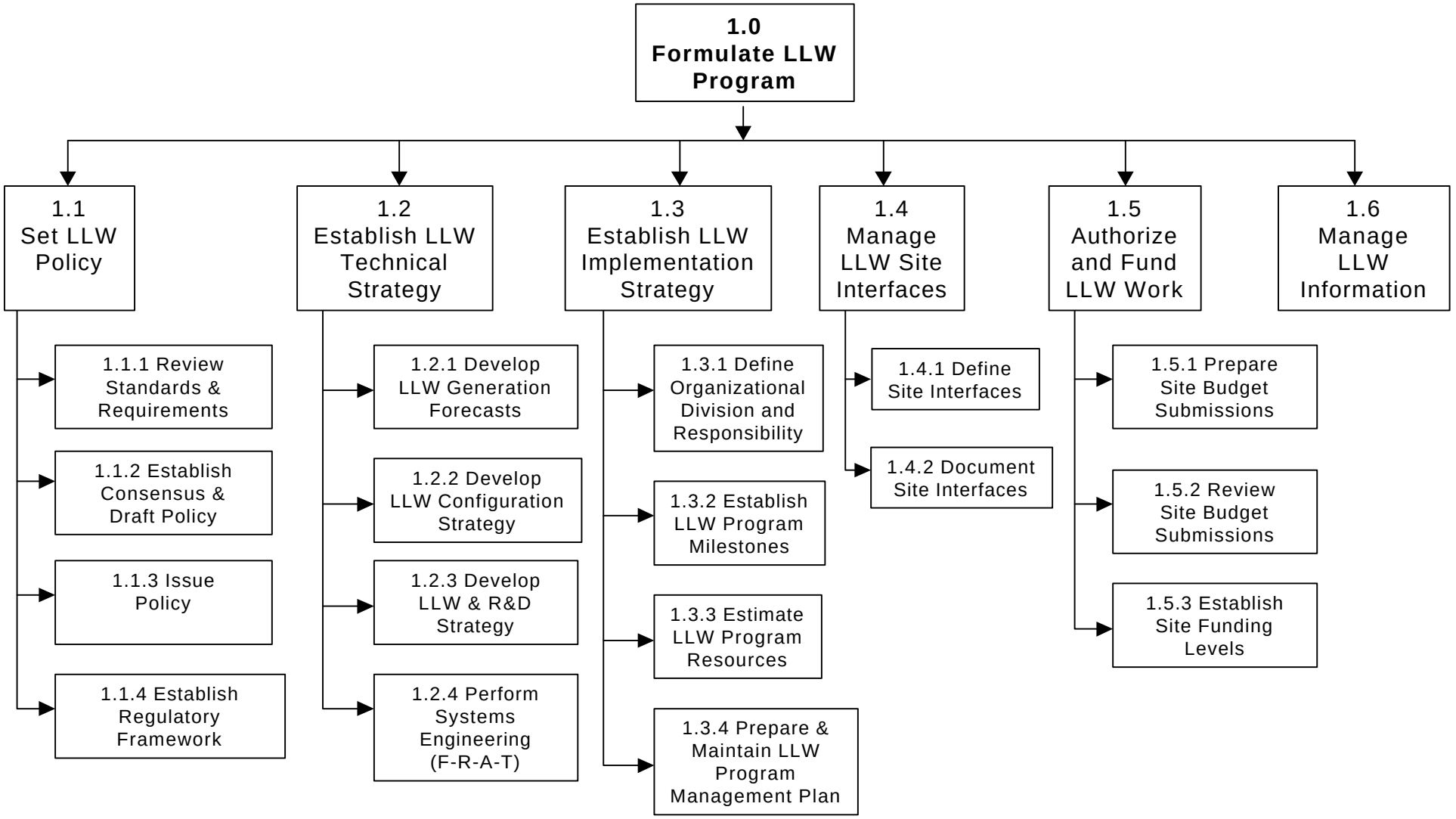

0.0
Manage Integrated
TRU Program
1.0
Plan TRU
Program
2.0
Execute TRU
Program
3.0
Evaluate TRU
Program
2.1
Generation
2.2
Characterization
2.3
Treatment
2.4
Storage
2.5
Offsite
Transportation
2.6
Disposal

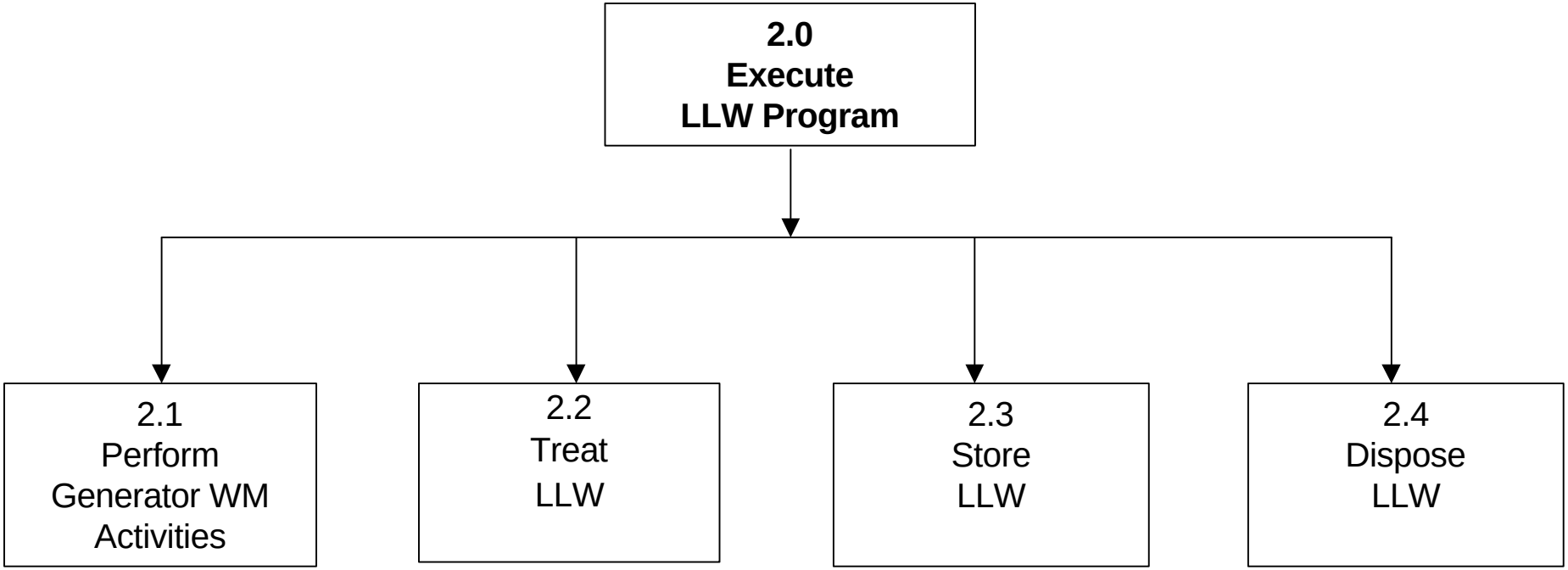

2.1
Generation
2.1.1
New Waste
2.1.2
Retrieve Waste
2.1.1.1
New Waste
2.1.1.2
D&D Waste
2.1.2.1
Bermed Waste
2.1.2.2
Buried Waste

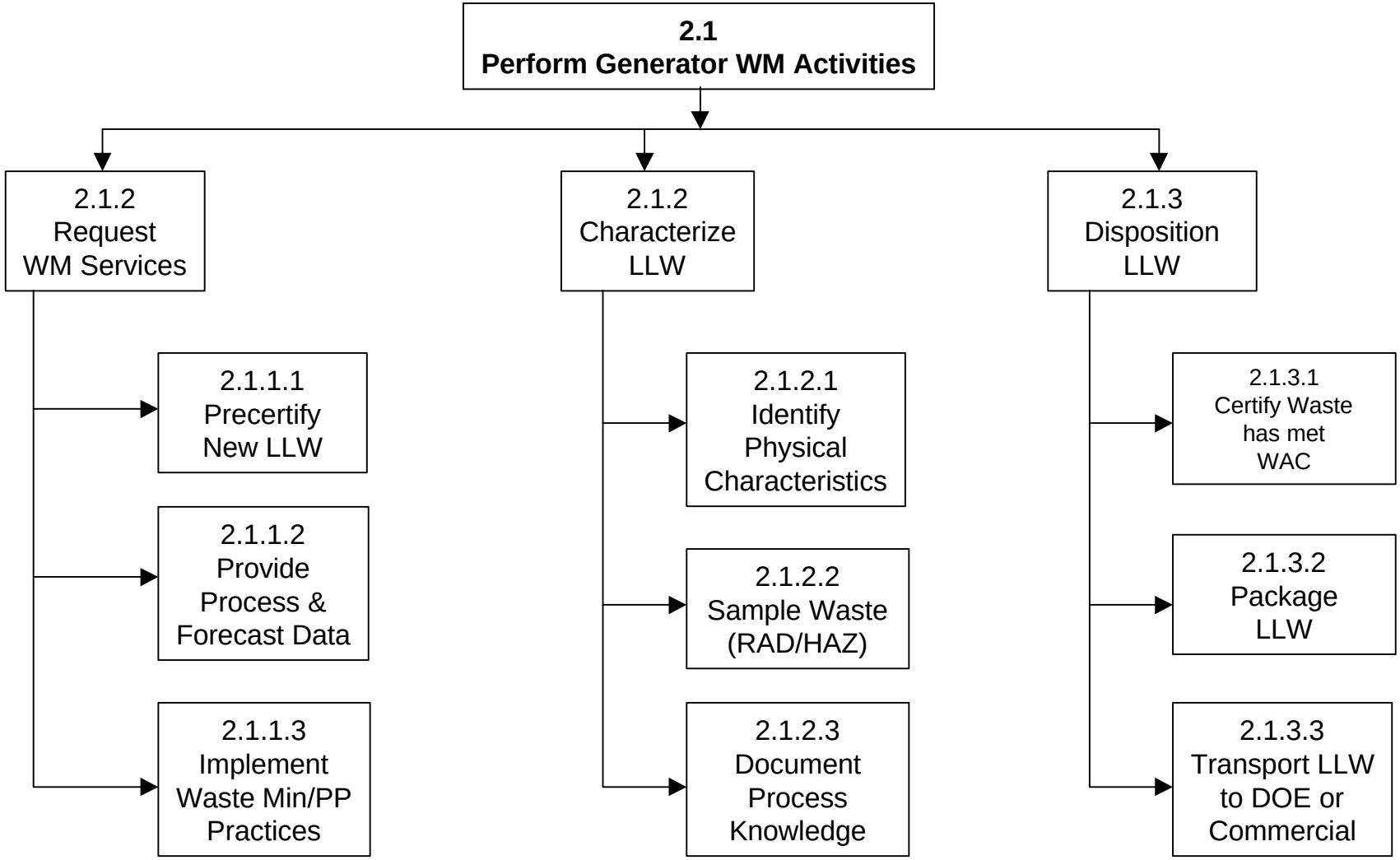

2.2
Characterization
2.2.1
Acquire
Characterization
Facility
2.2.2
Operate & Maintain
Characterization
Facility
2.2.3
Close
Characterization
Facility
2.2.2.1
Receive
Package
2.2.2.2
Characterize
Waste
2.2.2.3
Disposition
Waste
2.2.2.4
Maintain
Facility
2.2.2.2.1
Process
Knowledge
2.2.2.2.2
Perform NDA
2.2.2.2.3
Perform RTR
2.2.2.2.4
Vent & Aspirate
2.2.2.2.5
Head Gas
Sample
2.2.2.2.6
Intrusive
Characterize

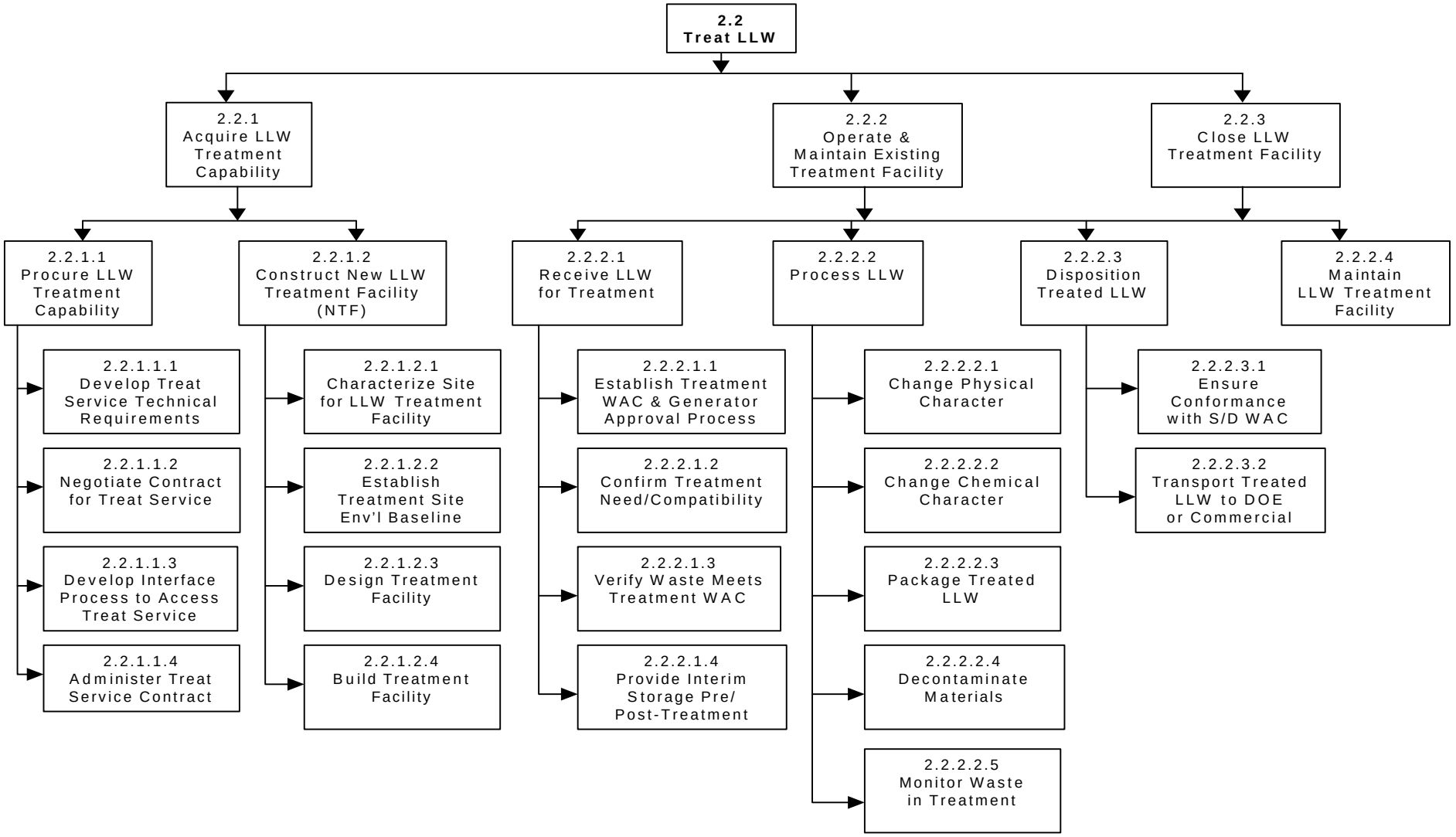

2.3
Treatment
2.3.1
Acquire
Treatment
Capability
2.3.2
Operate & Maintain
Treatment
Capability
2.3.3
Close
Treatment
Capability
2.3.2.1
Receive Waste
2.3.2.2
Treat Waste
2.3.2.3
Disposition
Waste
2.3.2.4
Maintain
Facility
2.3.2.1.1
Verify WAC
for Treatment
2.3.2.1.2
Move Waste
to Lag Storage
2.3.2.2.1
Change
Physical
Character
2.3.2.2.2
Change
Chemical
Character
2.3.2.2.3
Sort, Segregate
Decontaminate
and Package

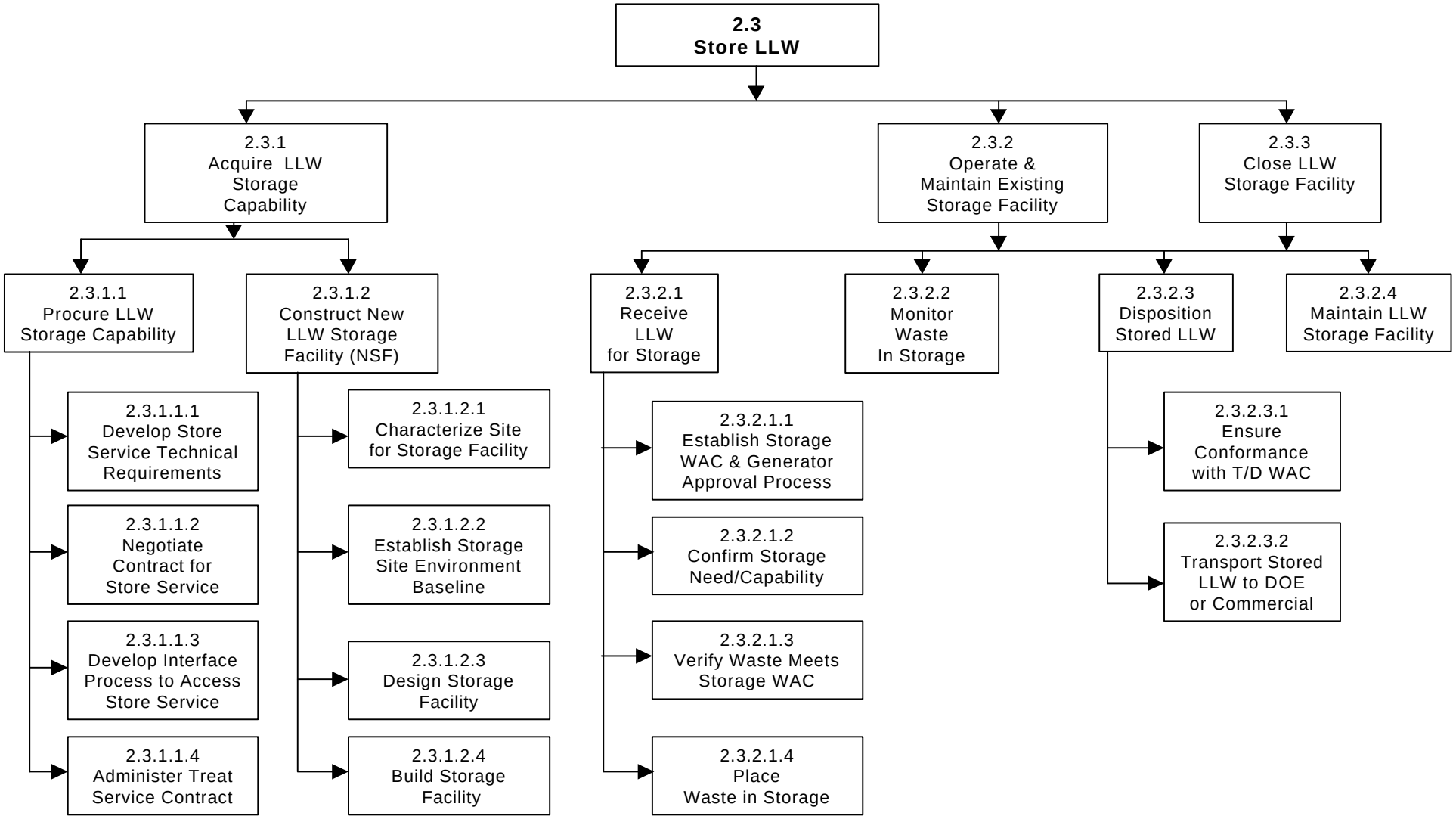

2.4
Storage
2.4.1
Acquire
Storage
Facility
2.4.2
Operate & Maintain
Storage
Facility
2.4.3
Close
Storage
Facility
2.4.2.1
Receive
Waste
2.4.2.2
Place Waste
in Storage
2.4.2.3
Maintain Waste
in Storage
2.4.2.4
Disposition
Waste
2.4.2.5
Maintain
Facility

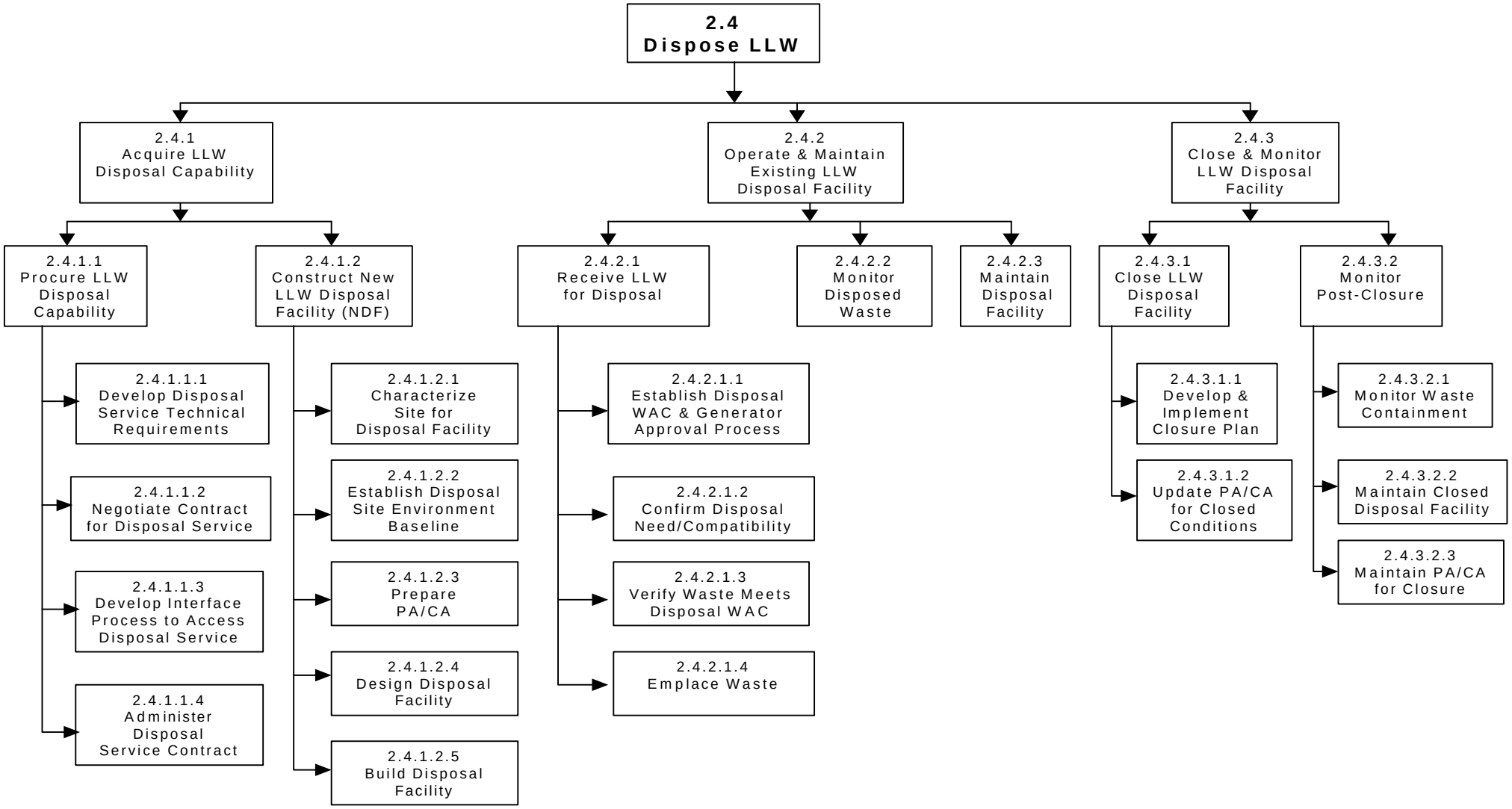

1.0
Formulate LLW Program
1.1
Set LLW Policy
1.2
Establish LLW Technical Strategy
1.3
Establish LLW Implementation Strategy
1.4
Manage LLW Site Interfaces
1.5
Authorize and Fund LLW Work
1.6
Manage LLW Information
1.1.1 Review Standards & Requirements
1.1.2 Establish Consensus & Draft Policy
1.1.3 Issue Policy
1.1.4 Establish Regulatory Framework
1.2.1 Develop LLW Generation Forecasts
1.2.2 Develop LLW Configuration Strategy
1.2.3 Develop LLW & R&D Strategy
1.2.4 Perform Systems Engineering (F-R-A-T)
1.3.1 Define Organizational Division and Responsibility
1.3.2 Establish LLW Program Milestones
1.3.3 Estimate LLW Program Resources
1.3.4 Prepare & Maintain LLW Program Management Plan
1.4.1 Define Site Interfaces
1.4.2 Document Site Interfaces
1.5.1 Prepare Site Budget Submissions
1.5.2 Review Site Budget Submissions
1.5.3 Establish Site Funding Levels

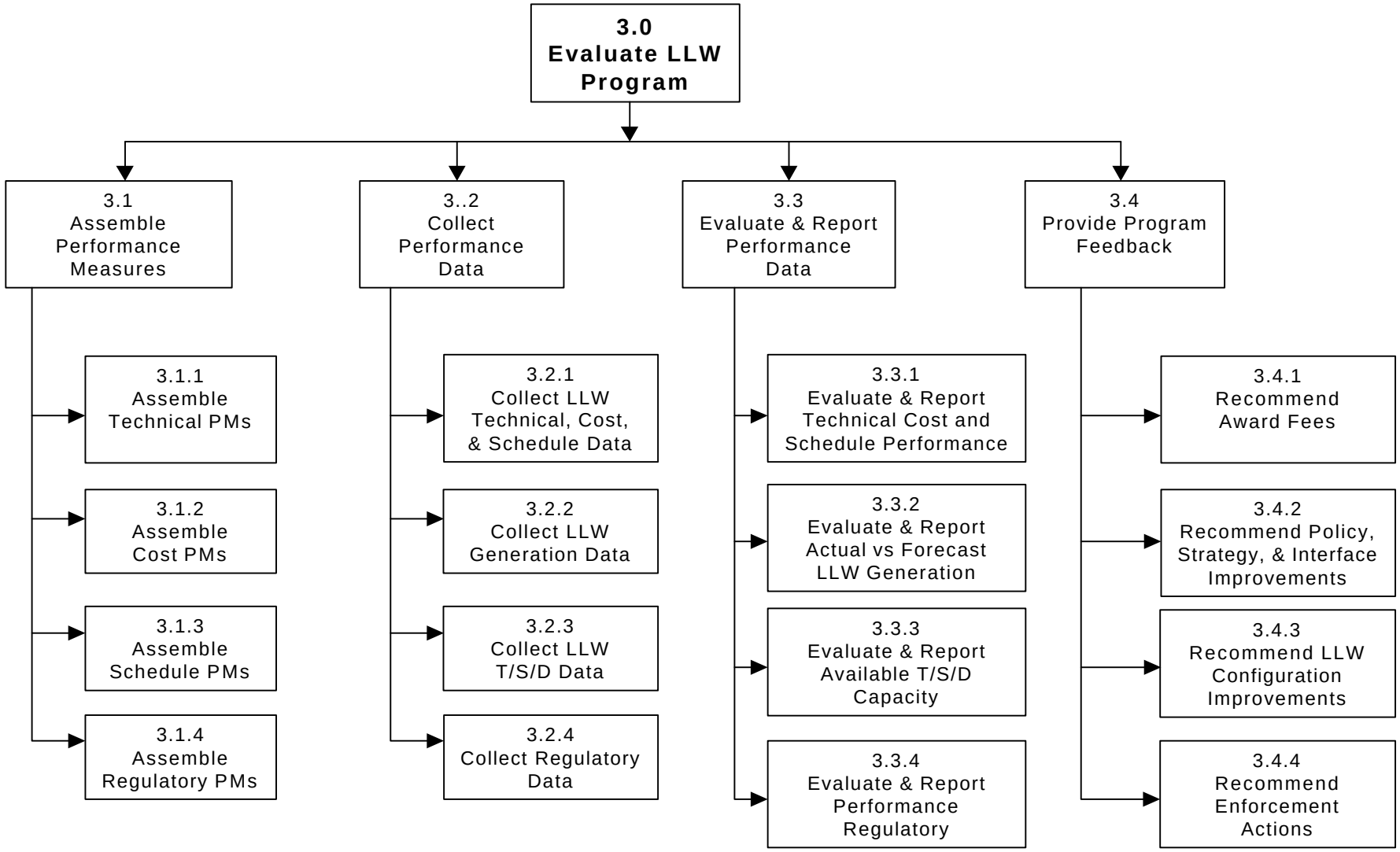

2.0
Execute
LLW Program
2.1
Perform
Generator WM
Activities
2.2
Treat
LLW
2.3
Store
LLW
2.4
Dispose
LLW


2.1
Perform Generator WM Activities
2.1.2
Request
WM Services
2.1.2
Characterize
LLW
2.1.3
Disposition
LLW
2.1.1.1
Precertify
New LLW
2.1.1.2
Provide
Process &
Forecast Data
2.1.1.3
Implement
Waste Min/PP
Practices
2.1.2.1
Identify
Physical
Characteristics
2.1.2.2
Sample Waste
(RAD/HAZ)
2.1.2.3
Document
Process
Knowledge
2.1.3.1
Certify Waste
has met
WAC
2.1.3.2
Package
LLW
2.1.3.3
Transport LLW
to DOE or
Commercial


2.2
Treat LLW
2.2.1
Acquire LLW
Treatment
Capability
2.2.2
Operate &
Maintain Existing
Treatment Facility
2.2.3
Close LLW
Treatment Facility
2.2.1.1
Procure LLW
Treatment
Capability
2.2.1.2
Construct New LLW
Treatment Facility
(NTF)
2.2.2.1
Receive LLW
for Treatment
2.2.2.2
Process LLW
2.2.2.3
Disposition
Treated LLW
2.2.2.4
Maintain
LLW Treatment
Facility
2.2.1.1.1
Develop Treat
Service Technical
Requirements
2.2.1.1.2
Negotiate Contract
for Treat Service
2.2.1.1.3
Develop Interface
Process to Access
Treat Service
2.2.1.1.4
Administer Treat
Service Contract
2.2.1.2.1
Characterize Site
for LLW Treatment
Facility
2.2.1.2.2
Establish
Treatment Site
Env'l Baseline
2.2.1.2.3
Design Treatment
Facility
2.2.1.2.4
Build Treatment
Facility
2.2.2.1.1
Establish Treatment
WAC & Generator
Approval Process
2.2.2.1.2
Confirm Treatment
Need/Compatibility
2.2.2.1.3
Verify Waste Meets
Treatment WAC
2.2.2.1.4
Provide Interim
Storage Pre/
Post-Treatment
2.2.2.2.1
Change Physical
Character
2.2.2.2.2
Change Chemical
Character
2.2.2.2.3
Package Treated
LLW
2.2.2.2.4
Decontaminate
Materials
2.2.2.2.5
Monitor Waste
in Treatment
2.2.2.3.1
Ensure
Conformance
with S/D WAC
2.2.2.3.2
Transport Treated
LLW to DOE
or Commercial


2.3
Store LLW
2.3.1
Acquire LLW
Storage
Capability
2.3.2
Operate &
Maintain Existing
Storage Facility
2.3.3
Close LLW
Storage Facility
2.3.1.1
Procure LLW
Storage Capability
2.3.1.2
Construct New
LLW Storage
Facility (NSF)
2.3.2.1
Receive
LLW
for Storage
2.3.2.2
Monitor
Waste
In Storage
2.3.2.3
Disposition
Stored LLW
2.3.2.4
Maintain LLW
Storage Facility
2.3.1.1.1
Develop Store
Service Technical
Requirements
2.3.1.1.2
Negotiate
Contract for
Store Service
2.3.1.1.3
Develop Interface
Process to Access
Store Service
2.3.1.1.4
Administer Treat
Service Contract
2.3.1.2.1
Characterize Site
for Storage Facility
2.3.1.2.2
Establish Storage
Site Environment
Baseline
2.3.1.2.3
Design Storage
Facility
2.3.1.2.4
Build Storage
Facility
2.3.2.1.1
Establish Storage
WAC & Generator
Approval Process
2.3.2.1.2
Confirm Storage
Need/Capability
2.3.2.1.3
Verify Waste Meets
Storage WAC
2.3.2.1.4
Place
Waste in Storage
2.3.2.3.1
Ensure
Conformance
with T/D WAC
2.3.2.3.2
Transport Stored
LLW to DOE
or Commercial


2.4
Dispose LLW
2.4.1
Acquire LLW
Disposal Capability
2.4.2
Operate & Maintain
Existing LLW
Disposal Facility
2.4.3
Close & Monitor
LLW Disposal
Facility
2.4.1.1
Procure LLW
Disposal
Capability
2.4.1.2
Construct New
LLW Disposal
Facility (NDF)
2.4.2.1
Receive LLW
for Disposal
2.4.2.2
Monitor
Disposed
Waste
2.4.2.3
Maintain
Disposal
Facility
2.4.3.1
Close LLW
Disposal
Facility
2.4.3.2
Monitor
Post-Closure
2.4.1.1.1
Develop Disposal
Service Technical
Requirements
2.4.1.1.2
Negotiate Contract
for Disposal Service
2.4.1.1.3
Develop Interface
Process to Access
Disposal Service
2.4.1.1.4
Administer
Disposal
Service Contract
2.4.1.2.1
Characterize
Site for
Disposal Facility
2.4.1.2.2
Establish Disposal
Site Environment
Baseline
2.4.1.2.3
Prepare
PA/CA
2.4.1.2.4
Design Disposal
Facility
2.4.1.2.5
Build Disposal
Facility
2.4.2.1.1
Establish Disposal
WAC & Generator
Approval Process
2.4.2.1.2
Confirm Disposal
Need/Compatibility
2.4.2.1.3
Verify Waste Meets
Disposal WAC
2.4.2.1.4
Emplace Waste
2.4.3.1.1
Develop &
Implement
Closure Plan
2.4.3.1.2
Update PA/CA
for Closed
Conditions
2.4.3.2.1
Monitor Waste
Containment
2.4.3.2.2
Maintain Closed
Disposal Facility
2.4.3.2.3
Maintain PA/CA
for Closure


3.0
Evaluate LLW
Program
3.1
Assemble
Performance
Measures
3..2
Collect
Performance
Data
3.3
Evaluate & Report
Performance
Data
3.4
Provide Program
Feedback
3.1.1
Assemble
Technical PMs
3.1.2
Assemble
Cost PMs
3.1.3
Assemble
Schedule PMs
3.1.4
Assemble
Regulatory PMs
3.2.1
Collect LLW
Technical, Cost,
& Schedule Data
3.2.2
Collect LLW
Generation Data
3.2.3
Collect LLW
T/S/D Data
3.2.4
Collect Regulatory
Data
3.3.1
Evaluate & Report
Technical Cost and
Schedule Performance
3.3.2
Evaluate & Report
Actual vs Forecast
LLW Generation
3.3.3
Evaluate & Report
Available T/S/D
Capacity
3.3.4
Evaluate & Report
Performance
Regulatory
3.4.1
Recommend
Award Fees
3.4.2
Recommend Policy,
Strategy, & Interface
Improvements
3.4.3
Recommend LLW
Configuration
Improvements
3.4.4
Recommend
Enforcement
Actions

BASIS FOR REGULATION OF RADIOACTIVE WASTE

The revised Order, designated DOE O 435.1, *Radioactive Waste Management*, establishes the requirements for management of radioactive waste consistent with the Department's *Atomic Energy Act of 1954*, as amended, responsibilities to provide for radiological protection from DOE operations. The scope of DOE O 435.1 includes: (1) high-level waste, including closure of high-level waste tank systems and management of associated incidental wastes; (2) transuranic waste, including safe treatment, storage, and characterization/certification to support disposal at the Waste Isolation Pilot Plant; and (3) low-level waste, with attention to disposal and the impacts of interacting source terms on projected public dose. The revised Order does not contain requirements for the management of the decontamination or decommissioning of radioactively contaminated facilities. Those requirements are incorporated in a revision of DOE O 430.1, *Life-Cycle Asset Management*. Additionally, the requirements for the management of spent nuclear fuel are not contained in this Order. The hazards analysis performed to identify requirements for high-level waste did not address the functions associated with management of spent nuclear fuel. Thus the requirements contained in DOE M 435.1-1 do not apply to this DOE-managed spent nuclear fuel.

Risk

The focus of the *Radioactive Waste Management Order* revision effort provided numerous challenges and opportunities to DOE for addressing risk. These opportunities and challenges operated at several different levels. As sources for understanding the overall scope of risk throughout the DOE complex and its operations, the DOE Risk Report to Congress and the findings of the Complex-Wide Review on low-level waste implemented under Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-2 were invaluable. Through these sources, DOE was able to conceptualize both the breadth and causes of the major risks within DOE's operations at the complex-wide and site-specific managerial levels.

DOE's *Integrated Safety Management System* (ISMS) establishes a logical process for integrating consideration of risk into all of DOE's planning and activities, and provides a uniform and common process for thinking about the problems of risk and developing solutions. In particular, the ISMS dictates a simple but logical process for understanding and mitigating risks. Under ISMS, the development of work processes follows a simple five-step approach: (1) identify the functions that must be performed to complete the work; (2) conduct a safety and hazards analysis of those functions; (3) develop the appropriate mitigating measures and controls based on that analysis; (4) apply the controls and implement a periodic reassessment of the activities, and (5) provide for a feedback to revising the work processes as necessary. This analytical approach has been incorporated into the heart of DOE's effort to revise the Radioactive Waste Management Order and represents the overall philosophical approach and major steps of this effort.

Performance-Based Requirements

One of the factors that contributed heavily to the shaping of the efforts to revise DOE's radioactive waste management requirements is the emphasis on performance-based requirements. Through the Department's system for revising and issuing directives there has been a strong movement away from detailed prescriptive requirements toward higher-level and more performance-based requirements. The implementation of performance-based requirements requires methods of measurement or demonstration in order to determine effective implementation and/or compliance. Such requirements are difficult to implement if the requirements are not clearly written, complete guidance is not provided, or the technical basis of the requirements is not known or understood. A particular challenge to this effort, therefore, was to develop not only the appropriate level of performance-based requirements, but to also develop the appropriate level of associated guidance and technical basis. Notably, these key elements of an effective performance-based requirements system have also been some of the key areas of failure with DOE's past requirements, especially with regard to DOE's radioactive waste management requirements.

When both the goals of performance-based and risk-based requirements are considered, an approach is necessary, which if developed and used properly, can provide the avenue for implementing such requirements effectively. One method of achieving this balance and allowing for a graded approach in the application of the requirements is to implement the requirements at the site level through the development of operation-specific authorization basis documentation. Under the concept of authorization basis documentation, each site-specific waste management operation develops its own vehicle for demonstrating methods of compliance, documenting implementation-level procedures and requirements, and providing the baseline for measurement of performance. The authorization basis is developed based on site-specific conditions and the particular risks and performance needs for the facility, and is approved by the cognizant DOE manager.

An example of such authorization basis documentation is the process that DOE currently uses for developing Safety Analysis Reports (SARs) and authorizing facilities to operate. Under this approach, each operation or facility is required to analyze the key hazards of the facility's operations and processes, describe them, develop the controls to mitigate the hazards and the technical basis for such, and provide an overall framework for the operation of the facility. When authorized, the facility then operates to the procedures and operational envelope identified in the authorization basis documentation. Events or occurrences which deviate from the authorization basis trigger re-evaluation and development of additional work process and requirements as necessary.

The requirements developed under the General Requirements Chapter of DOE M 435.1-1 provide the umbrella which incorporates the considerations of risk, performance, and authorization basis

documentation into DOE's radioactive waste management system. The technical basis and crosswalk tables presented in this document address both the waste-type specific requirements and the general requirements of DOE M 435.1-1, and where appropriate, references across chapters of the Manual have been included.

CHAPTER I

GENERAL REQUIREMENTS AND RESPONSIBILITIES

1. REQUIREMENTS

A. Delegation of Authority. Managers charged with responsibilities within this Manual may delegate authority for these tasks to another manager. All delegations of authority shall be documented.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need for there to always be a DOE manager with direct responsibility for ensuring activities are conducted in a fashion that protects the public, workers, and the environment. This requirement specifically addresses several weaknesses and conditions associated with lack of management and lack of documentation of decisions.

Requirements Analysis. New requirement derived for the Manual.

Other Considerations. The requirement implements a best management practice in place at most Departmental levels, and is included to emphasize the importance of accountability for ensuring radioactive waste management activities conducted by the Department are done so safely.

B. Use of Guidance. Additional information supporting the requirements in this Manual is contained in the Implementation Guide for use with DOE M 435.1-1, *Radioactive Waste Management Manual*. This Guide, DOE G 435.1-1, *Implementation Guide for DOE M 435.1-1*, shall be reviewed when implementing the requirements of this Manual. The Guide provides additional information and acceptable methods for meeting the requirements. Other methods may be used but must ensure an adequate level of safety commensurate with the hazards associated with the work and be consistent with the radioactive waste management basis.

Basis:

Functions Evaluated. This requirement derives from the analysis of most Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. This requirement derives from the vetting process used in the safety and hazards analyses. Mitigating activities were identified to control the weaknesses and conditions identified, and in many cases, better guidance was recognized as the most effective mitigating action, especially in cases where there was a longstanding requirement that was considered sufficient. The preparation of effective implementation guidance for all requirements was indicated as a result of the safety and hazards analyses.

Requirements Analysis. The requirement partially derives from the evaluation of DOE O 251.1A, *Directives System*, DOE M 251.1-1A, *Directives System Manual*, and its implementation guidance.

Other Considerations. The use of guidance to explain the intention of requirements, along with acceptable ways of meeting the requirements, is a well developed regulatory method used by the NRC. The use of guidance as described in the requirement implements this best management practice for DOE management of radioactive waste. Also, some of the acceptable ways for meeting requirements included in the guidance are there due to the vetting process used in development of performance-based requirements. The source of these acceptable methods is often another requirements document (e.g., WIPP Waste Acceptance Criteria). They may represent the only acceptable way to meet the requirement right now, but the level of specificity is not appropriate for the Manual and the activities to which it applies. The requirement includes the need to document the use of alternative methods, and a rationale if one is used.

C. <u>Radioactive Waste Management</u>. All radioactive waste subject to DOE O 435.1, *Radioactive Waste Management*, and the requirements of this Manual shall be managed as high-level waste, transuranic waste, low-level waste, or mixed low-level waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level functions for all three waste types: Formulate, Execute, and Evaluate.

Safety and Hazard Analyses. The safety and hazards analyses conducted for determining the essential requirements for radioactive waste management assumed that all radioactive waste was either high-level waste, transuranic waste, or low-level waste, based on the definitions assumed for the three waste types (The definitions in DOE 5820.2A were assumed). Special case waste, non-defense transuranic waste, and other wastes that have been management problems in the past were included in the analysis for the purposes of determining technical requirements needed to manage them, and the essential requirements included in the manual are believed to be sufficient for managing <u>all</u> of the Department's radioactive waste as one of the three waste types.

Requirements Analysis. New requirement derived for the Manual.

Other Considerations. Because of the special needs of management of mixed low-level waste, the Department has established and manages a mixed low-level waste program independent of the low-level waste management program. The requirement includes consideration of the effectiveness of this program by recognizing that all DOE radioactive waste could be managed within one of these four programs.

D. <u>Analysis of Environmental Impacts</u>. Existing and proposed radioactive waste management facilities, operations, and activities shall meet the requirements of 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures*; and DOE O 451.1A, *National Environmental Policy Act Compliance Program*. All reasonable alternatives shall be considered, as appropriate. Nothing in this Order is meant to restrict consideration of alternatives to proposed actions.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions in all three waste types associated with siting, designing, and constructing new waste management facilities. It also partially derives from the analysis of the Develop the program functions for all three waste types

Safety and Hazard Analyses. The requirement partially addresses some weaknesses and conditions associated with poor siting of facilities, and inadequate site characterization data. The requirement also partially addresses the need to involve stakeholders in decision making, a need identified in some of the program development requirements.

Requirements Analysis. The requirement is essentially equivalent to and updates the reference in DOE 5820.2A, 6.10. to DOE 5440.1C, *National Environmental Policy Act.*

Other Considerations. None.

E. <u>Requirements of Other Regulations and DOE Directives</u>. The following requirements and DOE directives are required for all DOE radioactive waste management facilities, operations, and activities as applicable. Any of the requirements for the following Departmental directives may be waived or modified through application of a DOE-approved requirements tailoring process, such as the "Necessary and Sufficient Closure Process" in DOE P 450.3 and DOE M 450.3-1 and DOE P 450.4, *Safety Management System Policy*, or by an exemption processed in accordance with the requirements of that directive or DOE M 251.1-1A, *Directives System Manual*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. During the safety and hazard analysis, numerous weaknesses and conditions and needs for controls for radioactive waste management were identified as potentially covered by requirements or DOE directives already in place. Some examples of these weaknesses and conditions are safety documentation, personal protective equipment, and effluent monitoring. The safety and hazards analysis identified the controls and mitigating actions included in these other requirements and directives.

Requirements Analysis. The requirements and directives identified in the safety and hazard analyses that contained necessary mitigating actions and controls were evaluated for their adequacy in addressing the weaknesses and conditions identified for radioactive waste management. Many of these requirements and directives were found to provide controls that were essential to the protection of the public, workers, and the environment. These are listed below to ensure that the requirements they invoke are followed for radioactive waste management facilities. The directives that are listed under this requirement represent those that addressed weaknesses and conditions that; were associated with high hazard scenarios, were associated with numerous accident scenarios, or are known to be significant in management of one of the radioactive waste types. More discussion appears about the specific weaknesses and conditions addressed by the requirement or directive in the following sections. The requirement also imposes the Department's Integrated Safety Management System as required under DOE P 45.4, *Safety Management System Policy*. This ensures that if any of these essential requirements and directives are modified or waived, that the hazard associated with the requirement is being adequately controlled.

Other Considerations. The requirement includes allowing waivers or modifications to requirements in these directives through any of the accepted processes for doing so within the Department. This is included to implement the Department's integrated safety management system. The principle allows that alternative requirements are acceptable if a similar process as the one followed in developing the Order demonstrates the controls are the correct set for the situation.

E. <u>Requirements of Other Regulations and DOE Directives</u>.

(1) Analysis of Operations Information. Data that measure the environment, safety, and health performance of radioactive waste management facilities, operations, and activities shall be identified, collected, and analyzed as required by DOE O 210.1, *Performance Indicators and Analysis of Operations Information*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Evaluate top-level function for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need to perform evaluations of the performance of radioactive waste management facilities in protecting the public, workers, and the environment, and improving performance in critical activities if indicated.

Requirements Analysis. Analysis of DOE O 210.1, *Performance Indicators and Analysis of Operations Information*, indicates that it provides the essential requirements necessary for radioactive waste management facilities to implement an effective analysis of operations information.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(2) Classified Waste. Radioactive waste for which access has been limited for national security reasons and cannot be declassified shall be managed in accordance with the requirements of DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*, and DOE 5633.3B, *Control and Accountability of Nuclear Materials*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The safety and hazards analyses assumed that classified waste was included in the radioactive wastes for which essential requirements were being developed.

Requirements Analysis. Analysis of DOE 5632.1C, *Protection and Control of Safeguards and Security Interests*, and DOE 5633.3B, *Control and Accountability of Nuclear Materials*, indicate that they provide the essential requirements necessary for the national security protections needed for management of classified radioactive waste at DOE waste management facilities.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(3) Conduct of Operations. Radioactive waste management facilities, operations, and activities shall be conducted in a manner based on consideration of the associated hazards. Waste management facilities, operations, and activities shall meet the requirements of DOE 5480.19, *Conduct of Operations Requirement for DOE Facilities*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate procedures to be developed and implemented for all radioactive waste management operations and activities important to protection of the public, workers, and the environment. Weaknesses and conditions associated with lack of or poor procedures were identified repeatedly in the safety and hazards analysis.

Requirements Analysis. Analysis of DOE 5480.19, *Conduct of Operations Requirement for DOE Facilities*, indicates that it provides the essential requirements necessary for effective development of procedures and other conduct of operations at DOE radioactive waste management facilities. Meeting of these requirements is emphasized by this DOE M 435.1-1 requirement because the weaknesses and conditions associated with poor or lack of procedures was repeatedly identified as potentially contributing to management problems with radioactive waste.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(4) Criticality Safety. Radioactive waste management facilities, operations, and activities shall be covered by a criticality safety program in accordance with DOE O 420.1, *Facility Safety*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for criticality to be considered in the management of wastes containing fissile or fissionable materials. Potentially

catastrophic consequences were identified in the safety and hazard analyses for storage, treatment, and disposal scenarios involving weaknesses involving criticality concerns.

Requirements Analysis. Analysis of DOE O 420.1, *Facility Safety*, indicates that it provides the essential requirements necessary for an effective criticality safety program at DOE radioactive waste management facilities. Meeting of these requirements is emphasized by this DOE M 435.1-1 requirement because of the potential for large consequences indicated in the safety and hazards analyses if criticality safety programs are not carefully adhered to.

Other Considerations. The requirement is included for emphasis based partially on comments of the Senior Review Panel on draft versions of the Manual.

E. Requirements of Other Regulations and DOE Directives.

(5) Emergency Management Program. Radioactive waste management facilities, operations, and activities shall maintain an emergency management program in accordance with DOE O 151.1, *Comprehensive Emergency Management System*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate emergency management to respond to accident scenarios and potentially hazardous situations involving radioactive waste management. The need for emergency management was identified as a very important mitigating action for situations involving high hazard activities, especially weaknesses and conditions associated with storage of high-level waste, and treatment and pre-treatment of high-level waste, and transportation of all wastes.

Requirements Analysis. Analysis of DOE O 151.1, *Comprehensive Emergency Management System* indicates that it provides the essential requirements necessary for development of an effective emergency management program for DOE that will include radioactive waste management facilities, operations, and activities. Meeting of these requirements is emphasized by this DOE M 435.1-1 requirement to ensure that the high hazard activities involved in the management of some radioactive wastes has the necessary mitigating activities to ensure protection of the public, workers, and the environment.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(6) Environmental and Occurrence Reporting. Radioactive waste management facilities, operations, and activities shall meet the reporting requirements of DOE O 231.1, *Environment, Safety and Health Reporting,* and DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions and the Evaluate the program functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide reporting of environmental monitoring and operational data for radioactive waste management operations and activities to ensure the protection of the public, workers, and the environment continues to meet regulatory and stakeholder requirements. The requirement also addresses the need to implement an effective feedback system within an integrated safety management system to effectively evaluate radioactive waste management facilities, operations, and activities.

Requirements Analysis. The requirement is essentially equivalent to and updates the reference in DOE 5820.2A, 6. References to the environmental monitoring order which has been canceled, DOE 5484.1, and the occurrence reporting order which has been canceled, DOE O 231.1, *Environment, Safety, and Health Reporting,* and DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information* were evaluated and found to be adequate in implementing environmental monitoring reporting requirements and occurrence reporting requirements for radioactive waste management. This is included to implement the Department's integrated safety management system, as invoked in the introductory requirement to this section of the Manual, Requirements of Other Regulations and DOE Directives.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(7) Environmental Monitoring. Radioactive waste management facilities, operations, and activities shall meet the environmental monitoring requirements of DOE 5400.1, *General Environmental Protection Program;* and DOE 5400.5, *Radiation Protection of the Public and the Environment.*

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide monitoring of radioactive waste management operations and activities to ensure the protection of the public, workers, and the environment continues to meet regulatory and stakeholder requirements. The requirement also partially addresses the need to involve stakeholders in decision making, a need identified in some of the program development requirements.

Requirements Analysis. The requirement is essentially equivalent to and updates the reference in DOE 5820.2A, 6. References to several environmental compliance orders which have been canceled that required environmental and effluent monitoring. DOE 5400.1, *General Environmental Protection;* and DOE 5400.5, *Radiation Protection of the Public and Environment* were evaluated and found to be adequate in implementing environmental monitoring requirements for radioactive waste management facilities. (Some additional monitoring requirements appear in the waste type chapters where specific waste management situations warrant.)

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(8) Hazard Analysis Documentation and Authorization Basis. Radioactive waste management facilities, operations, and activities shall implement DOE Standards, DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23, Nuclear Safety Analysis Reports,* and/or DOE-EM-STD-5502-94, *DOE Limited Standard: Hazard Baseline Documentation,* and shall, as applicable, prepare and maintain hazard analysis documentation and an authorization basis as required by DOE O 425.1A, *Startup and Restart of Nuclear Facilities,* DOE O 5480.21, *Unreviewed Safety Questions,* DOE 5480.22, *Technical Safety Requirements,* and DOE 5480.23, *Nuclear Safety Analysis Reports*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for constructing a new facility for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need for the analysis of the specific hazards associated with a specific radioactive waste management facility, operation, or activity to be considered in the determination of whether the public, workers, and environment are adequately protected. Poor or lack of hazard analysis has been identified repeatedly by the Defense Nuclear Facilities Safety Board as a weakness requiring correction for many Departmental programs.

Requirements Analysis. DOE O 425.1A, *Startup and Restart of Nuclear Facilities*, DOE O 5480.21, *Unreviewed Safety Questions*, DOE 5480.22, *Technical Safety Requirements*, and DOE 5480.23, *Nuclear Safety Analysis Reports* contain the Department's requirements for implementing appropriate safety and hazards documentation for those facilities which warrant it. The requirement is emphasized here because of the potential for large consequences indicated in the safety and hazards analyses if this process is carefully adhered to.

Other Considerations. The requirement is included to implement one of the top-level requirements established for the Order revision, the use of the authorization basis concept. It was recognized during the development of essential requirements that some radioactive waste management facilities activities, and operations already function under the authorization basis system established in the Directives that are invoked by this requirement. This situation is addressed in the guidance on DOE M 435.1-1 under the General Requirement for a radioactive waste management basis.

E. <u>Requirements of Other Regulations and DOE Directives</u>.

(9) Life-Cycle Asset Management. Planning, acquisition, operation, maintenance, and disposition of radioactive waste management facilities shall be in accordance with DOE O 430.1A, *Life-Cycle Asset Management,* and DOE 4330.4B, *Maintenance Management Program,* including a configuration management process to ensure the integrity of physical assets and systems. Corporate physical asset databases shall be maintained as complete, current inventories of physical assets and systems to allow reliable analysis of existing and potential hazards to the public and workers.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all functions for all three radioactive waste types.

Safety and Hazard Analyses. Several effective mitigating actions were identified in the safety and hazard analyses that were assumed to be potentially covered by the implementation of a couple of newer DOE directives. These mitigating activities included improved planning for waste management activities, operations, and facilities, better maintenance of radioactive waste management facilities, equipment, and assets, and a configuration management process for controlling changes to facilities, activities, and requirements important to protection of the public, workers, and the environment. Numerous weaknesses and conditions in many functions were addressed by one of these mitigating actions.

Requirements Analysis. DOE O 430.1A, *Life-Cycle Asset Management*, and DOE 4330.4B, *Maintenance Management Program*, were evaluated and found to be adequate in implementing

improved life-cycle asset planning, project management, configuration control, and maintenance for radioactive waste management. Implementation of DOE O 430.1A essentially updates the reference in DOE 5820.2A, 6. References, to the canceled DOE Orders, DOE 4700.1 *Project Management System*, and DOE 4300.1B, *Real Property and Site Development Planning*. (Some additional life-cycle planning requirements appear in the waste type chapters where specific waste management situations warrant.)

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(10) Mixed Waste. Radioactive waste that contains both source, special nuclear, or by-product material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component is also subject to the *Resource Conservation and Recovery Act* (RCRA), as amended.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all functions for all three radioactive waste types.

Safety and Hazard Analyses. Mixed waste was included in the radioactive wastes that required management in the safety and hazard analyses for all three waste types. Needs for specific controls and specific weaknesses and conditions, if any, were addressed for the management of mixed waste. It was determined that, with a few exceptions, the hazardous constituents were probably sufficiently controlled by any hazardous waste requirements in place.

Requirements Analysis. The requirement implements the longstanding Department policy, reflected in the requirement DOE O 435.1, 4.b.(4) that radioactive waste management facilities, operations, and activities will comply with all applicable Federal, State, and local laws and regulations. This is consistent with and essentially continues the DOE 5820.2A Policy O.5, references to 10 CFR Part 962, in DOE 5820.2A, 6. References.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(11) Packaging and Transportation. Radioactive waste shall be packaged and transported in accordance with DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all Execute functions in all three radioactive waste type analyses that involve transport of radioactive waste to another facility. The requirement also derives from the packaging functions in the treatment, storage, and disposal functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide adequate controls on the packaging of radioactive waste, and transportation of radioactive waste management from facility to facility, to ensure the protection of the public, workers, and the environment. Transportation of radioactive waste has long been recognized as one of the most hazardous activities associated with radioactive waste management, and also, the activity is conducted with regularity, increasing the chances of a mishap. The requirement also addresses the weaknesses and conditions associated with poorly packaged radioactive waste, leaking waste packages, repackaging of waste, waste that must be returned to the generator, and waste that does not contribute to the performance of a disposal facility. The requirement also partially addresses the need to consider stakeholders in development of requirements or in decision making, a need identified in some of the program development requirements.

Requirements Analysis. The requirement is essentially equivalent to and updates the references in DOE 5820.2A, 6. References to several Departmental directives on transportation which have been canceled. DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management* were evaluated and found to be adequate in implementing packaging and transportation requirements for radioactive waste. (Some additional packaging and transportation requirements appear in the waste type chapters where specific waste management situations warrant.)

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(12) Quality Assurance Program. Radioactive waste management facilities, operations, and activities shall develop and maintain a quality assurance program that meets the requirements of 10 CFR 830.120, *Quality Assurance Requirements*, and DOE O 414.1, *Quality Assurance*, as applicable.

Basis:

Functions Evaluated. This requirement derives from the analysis of most of the Execute functions of all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for radioactive waste management facilities, operations, and activities that are important to protection of the public, workers, and the environment to adhere to a controlled process for contracting, production, record keeping, auditing, labeling, and other elements that are addressed in quality assurance programs implemented in nuclear facilities. The requirement addresses the weaknesses and conditions of poor quality materials, workmanship, documentation, training, and evaluations.

Requirements Analysis. This requirement implements requirements promulgated since DOE 5820.2A, 6. References, referred to DOE 5700.6B, *Quality Assurance*. 10 CFR 830.120, *Quality Assurance Requirements and Responsibilities*, and DOE O 414.1, *Quality Assurance*, provide Departmental approved quality assurance programs and processes adequate for radioactive waste management. They are emphasized in DOE M 435.1-1 because adherence to the requirements in Quality Assurance Programs was identified as an extremely effective mitigating factor for many weaknesses and conditions identified in the safety and hazard analyses .

Other Considerations. Following the requirements of the quality assurance directives also addresses the needs for conducting effective evaluations of radioactive waste management facilities, operations, and activities which were identified in the analysis of the Evaluate functions for all three waste types.

E. Requirements of Other Regulations and DOE Directives.

(13) Radiation Protection. Radioactive waste management facilities, operations, and activities shall meet the requirements of 10 CFR Part 835, *Occupational Radiation Protection,* and DOE 5400.5, *Radiation Protection of the Public and the Environment.*

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide the protection of the public, workers, and the environment from radioactive waste management operations and activities.

Requirements Analysis. The requirement is essentially equivalent to and updates the DOE 5820.2A, 6. References to several environmental compliance orders which have been canceled that required protection of the workers, public, and the environment for radioactive waste management operations and activities. These requirements are also consistent with the Policy of DOE 5820.2A contained in that Order at paragraph 5. 10 CFR Part 835, *Occupational Radiation Protection,* and DOE 5400.5, *Radiation Protection of the Public and Environment* are the

fundamental Departmental directives that provide these protection requirements. This requirement implements three of the top-level requirements of the Department for providing controls on the management of radioactive waste, and also implements in the Manual, the fundamental requirements of DOE O 435.1, O.4, Requirements.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(14) Records Management. Radioactive waste management facilities, operations, and activities shall develop and maintain a record-keeping system, as required by DOE O 200.1, *Information Management Program*, and DOE O 414.1, *Quality Assurance*. Records shall be established and maintained for radioactive waste generated, treated, stored, transported, or disposed. To the extent possible, records prepared in response to other requirements may be used to satisfy the documentation requirements of this Manual. Additional records may be required to satisfy the regulations applicable to the hazardous waste components of mixed waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of almost all of the functions of all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for radioactive waste management facilities, operations, and activities to provide effective record keeping on information and data are important to protection of the public, workers, and the environment. The requirement addresses significant weaknesses and conditions associated with poor or lack of effective record keeping in storage, treatment, and disposal of waste. Particular concerns were identified when waste was left in storage longer than anticipated, during any transfers of waste and information, and for long-term considerations such as disposal.

Requirements Analysis. This requirement implements requirements promulgated since DOE 5820.2A, 6. References, referred to DOE 5700.6B, *Quality Assurance*. DOE O 200.1, *Information Management Program*, and DOE O 414.1, *Quality Assurance*, were evaluated and found to provide adequate record keeping controls for radioactive waste management. The requirement specifically calls out record keeping for the activities of generation, storage, treatment, transportation, and disposal because some significant consequences were identified if record keeping was not sufficient, and because poor record keeping practices had already contributed to known problems in the complex.

Other Considerations. This general requirement contains additional requirements beyond a reference to another DOE directive or a requirement due to consolidation of some similar requirements in the individual waste type chapters, and in response to comments on draft versions of the Manual.

E. Requirements of Other Regulations and DOE Directives.

(15) Release of Waste Containing Residual Radioactive Material. The process for determining and documenting that waste is suitable to be released and managed without regard to its radioactive content shall be in accordance with the criteria and requirements in DOE 5400.5, *Radiation Protection of the Public and the Environment.*

Basis:

Functions Evaluated. This requirement derives from the analysis of the Develop the program functions for low-level waste management.

Safety and Hazard Analyses. The requirement addresses the need to recognize that some low-level waste contains so little radioactivity that it is more appropriate to manage it without regard for its radioactive content, and still provide adequate protection to the public, workers, and the environment.

Requirements Analysis. The requirement is a new requirement that further implements policies established by the Office of Environment and Health for release of property containing residual radioactive material, including waste. Guidance for the policy, implemented under DOE 5440.5, entitled *Application of DOE 5400.5 Requirements for Release and Control of Property Containing Residual Radioactive Material*, is the source of the requirement statement. The Order and guidance are considered sufficient to implement a program and process for managing some radioactive waste without regard to its radioactivity.

Other Considerations. This requirement addresses the upper level criterion of achieving cost-effective operations for radioactive waste management. The final wording of the requirement is consistent with the policy direction of the Office of Environment and Health.

E. Requirements of Other Regulations and DOE Directives.

(16) Safeguards and Security. Appropriate features shall be incorporated into the design and operation of radioactive waste management facilities, operations, and activities to prevent unauthorized access and operations, and for purposes of nuclear materials control and accountability, where applicable; and shall be consistent with DOE O 470.1, *Safeguards and Security Program*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate security and safeguards of special nuclear material to be implemented and conducted for all radioactive waste management operations and activities. Weaknesses and conditions associated with lack of or poor security and safeguards were identified repeatedly in the safety and hazards analysis

Requirements Analysis. Analysis of DOE O 470.1, *Safeguards and Security Program*, indicates that the essential requirements necessary for effective deployment of safeguards and security at DOE radioactive waste management facilities are in that directive. Meeting these requirements is emphasized by this DOE M 435.1-1 requirement because the weaknesses and conditions associated with poor or lack of security and safeguards for special nuclear material were repeatedly identified as potentially contributing to management problems with radioactive waste.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(17) Safety Management System. Radioactive waste management facilities, operations, and activities shall incorporate the principles of integrated safety management as described in DOE P 450.4, *Safety Management System Policy*, and DOE P 450.5, *Line Environment, Safety and Health Oversight*, and meet the requirements of the safety management systems sections of 48 CFR Chapter 9, *Department of Energy Acquisition Regulations* and DOE M 411.1-1, *Manual of Safety Management Functions, Responsibilities, and Authorities*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Evaluate functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for the Department's integrated Safety Management System's policies and procedures to be implemented for all radioactive waste management facilities, operations, and activities. Weaknesses and conditions associated with lack of or poor oversight and evaluations of radioactive waste management functions were identified repeatedly in the safety and hazards analysis. The need for systematic evaluation of radioactive waste management programs, facilities, and operations was identified during development of the Implementation Plan in response to Defense Nuclear Facilities Safety Board Recommendation 94-2, and is included as a commitment to the Board in that document.

Requirements Analysis. During the requirements analysis, the Department's integrated Safety Management System was still in a developmental stage, and the benefits of full implementation of it were not recognized. Even though some elements of the system were used in the development of the Order and Manual, the original set of requirements did not include a citation for radioactive waste management facilities, operations, and activities to follow the Safety Management System requirements (see Other Considerations). Only a few requirements were cited in the Manual concerning evaluations of programs, facilities, operations, and activities and how to utilize the results of evaluations for improvement.

Other Considerations. In response to comments on the draft versions of the Order and Manual by DOE-EH, the citation for following the Department's integrated Safety Management System was added. Effective evaluations and oversight of radioactive waste management facilities, operations, and activities will result from following the Safety Management System Directives. Improvements from feedback systems, such as internal safety audits, will result from full implementation of the Safety Management System.

E. Requirements of Other Regulations and DOE Directives.

(18) Site-Evaluation and Facility Design. New radioactive waste management facilities, operations, and activities shall be sited and designed in accordance with DOE O 420.1, *Facility Safety*, and DOE O 430.1A, *Life-Cycle Asset Management*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute function for constructing new facilities in all three radioactive waste type analyses.

Safety and Hazard Analyses. The requirement addresses the need to provide adequate site characteristics to the facility design process, and for adequately designing the facility to address protection of the public, workers, and the environment. The requirement addresses numerous weaknesses and conditions associated with problems that could potentially develop from poor design, especially in terms of processing waste in treatment, and in the need for long-term performance of a disposal facility. The requirement partially addresses some scenarios in the safety and hazards analyses that have high consequences associated with an accident involving the facility.

Requirements Analysis. The requirement is essentially equivalent to and updates the references in DOE 5820.2A, 6. References to DOE 6430.1A, which is canceled. DOE O 420.1, *Facility Safety*, and DOE O 430.1A, *Life-Cycle Asset Management* were evaluated and found to be mostly adequate in implementing site evaluation and facility design requirements for radioactive waste management facilities. However, some weaknesses and conditions significant to

management of radioactive waste are not specifically addressed in these two Orders. They are still invoked because they do address a large number of weaknesses and conditions, and also establish administrative and program elements that are necessary to control site evaluation and facility design. To address the specific weaknesses and conditions not addressed in the two Orders, additional site evaluation and facility design requirements appear in the waste type chapters where specific waste management situations warrant.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(19) Training and Qualification. A training and qualification program shall be implemented for radioactive waste management program personnel, and shall meet the requirements of DOE O 360.1, *Training*, and DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Execute functions for all three waste types.

Safety and Hazard Analyses. The requirement addresses the need for adequate training and qualification of personnel to be implemented and conducted for all radioactive waste management operations and activities important to protection of the public, workers, and the environment. Weaknesses and conditions associated with lack of or poor training and personnel qualifications were identified repeatedly in the safety and hazards analysis

Requirements Analysis. Analysis of DOE O 360.1, *Training,* and DOE 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities,* indicates that they provide the essential requirements necessary for effective development of training procedures and programs and qualification of personnel procedures at DOE radioactive waste management facilities. Meeting these requirements is emphasized by this DOE M 435.1-1 requirement because the weaknesses and conditions associated with poor or lack of training and qualification of personnel was repeatedly identified as potentially contributing to management problems with radioactive waste.

Other Considerations. None.

E. Requirements of Other Regulations and DOE Directives.

(20) Waste Minimization and Pollution Prevention. Waste minimization and pollution prevention shall be implemented for radioactive waste management facilities, operations, and activities to meet the requirements of Executive Order 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements*, and Executive Order 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*, and DOE 5400.1, *General Environmental Protection Program*.

Basis:

Functions Evaluated. This requirement derives from the analysis of specific functions identified in the analysis of all three waste types for minimization of waste generation.

Safety and Hazard Analyses. The safety and hazard analyses identified that waste minimization, pollution prevention, and where appropriate, volume reduction, were effective mitigating actions against many of the hazards associated with radioactive waste management.

Requirements Analysis. The requirement is consistent with the policy implemented at DOE 5820.2A, paragraph 5. The existence of several executive level positions that are called out in the requirement provided the necessary controls that were needed to flow down to appropriate waste minimization techniques at the actual activity level, and were found to be sufficient.

Other Considerations. Implementation of waste minimization and pollution prevention was one of the top-level principles formulating the basic requirements for the Order and Manual.

E. Requirements of Other Regulations and DOE Directives.

(21) Worker Protection. Radioactive waste management facilities, operations, and activities shall meet the requirements of DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*.

Basis:

Functions Evaluated. This requirement derives from the analysis of all of the Execute functions for all three radioactive waste types.

Safety and Hazard Analyses. The requirement addresses the need to provide the protection of the workers from radioactive waste management operations and activities that involve hazards not solely associated with the radioactive characteristic of material being used, but which are required to be conducted. Because of the need to provide protection from the radioactive hazard, workers

may be subjected to other hazards, such as working in confined spaces, or with complex machinery, that involve their own hazards for which workers must be protected.

Requirements Analysis. The requirement is consistent with the Policy of DOE 5820.2A contained in that Order at paragraph 5. for protecting workers. DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* is the Departmental directive that provides the basic protection requirements for workers. This requirement implements the top-level requirement of the Department for providing controls on the management of radioactive waste, and also implements in the Manual, the requirements of DOE O 435.1, O.4 Requirements, paragraph (3), *Protect the work force.*

Other Considerations. None.

2. RESPONSIBILITIES

A. Program Secretarial Officers. Program Secretarial Officers with radioactive waste management facilities, operations, or activities are responsible within their respective programs for ensuring that the Field Element Managers meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

B. Assistant Secretary for Environmental Management. The Assistant Secretary for Environmental Management is responsible for:

(1) Complex-Wide Radioactive Waste Management Programs. Establishing and maintaining integrated Complex-Wide Radioactive Waste Management Programs for high-level, transuranic, low-level, and mixed low-level waste. These programs shall use a systematic approach to planning, execution, and evaluation to ensure that waste generation, storage, treatment, and disposal needs are met and coordinated across the DOE complex.

(2) Changes to Regulations and DOE Directives. Ensuring changes to regulations and DOE directives are reviewed and, when necessary, incorporated into revisions of this Manual to ensure the basis for safe radioactive waste management facilities, operations, and activities is maintained.

C. Assistant Secretary for Environment, Safety, and Health. The Assistant Secretary for Environment, Safety and Health is responsible for providing an independent overview of DOE radioactive waste management and

decommissioning programs to determine compliance with DOE environment, safety, and health requirements and applicable Environmental Protection Agency (EPA) and state regulations, including:

(1) Advising the Secretary of the status of Departmental compliance with the requirements of DOE O 435.1, this Manual, and applicable provisions of other DOE Orders.

(2) Conducting independent appraisals and audits of DOE waste management programs.

(3) Reviewing site Waste Management Plans with regard to compliance with DOE environment, safety, and health requirements.

D. Deputy Assistant Secretary for Waste Management. The Deputy Assistant Secretary for Waste Management is responsible for:

(1) Complex-Wide Radioactive Waste Management Program Plans. Developing, implementing, and maintaining integrated Complex-Wide Radioactive Waste Management Program Plans for high-level, transuranic, low-level, and mixed low-level waste. Each plan shall, at the DOE complex-wide level, describe the functional elements, organizations, responsibilities, and activities that comprise the system needed to store, treat and dispose of radioactive waste in a manner that is protective of the public, workers, and the environment. In addition, the plans shall:

(a) Present a waste management strategy that integrates waste projections and life-cycle waste management planning into complex-wide facility configuration decisions; and

(b) Describe the approach to research and technology development being pursued to improve safety and/or efficiency in managing radioactive waste.

(2) Waste Management Data System. Establishing and maintaining a system to compile waste generation projection data and other information concerning radioactive waste management facilities, operations, and activities across the complex.

E. Deputy Assistant Secretaries for Waste Management and Environmental Restoration. The Deputy Assistant Secretary for Waste Management and the Deputy Assistant Secretary for Environmental Restoration are responsible for:

(1) Disposal. Reviewing and approving, along with EH-1, transuranic waste disposal facility performance assessments and other disposal documents as required in waste specific chapters for which DOE is responsible for making compliance determinations. Reviewing and approving performance assessments and composite analyses, or appropriate CERCLA documentation, for low-level waste disposal facilities, and issuing disposal authorization statements.

(a) The Deputy Assistant Secretaries shall establish a review panel consisting of DOE personnel to review low-level waste disposal facility performance assessments and composite analyses, review appropriate CERCLA documentation, recommend low-level waste disposal facility compliance determinations to the Deputy Assistant Secretaries, and develop disposal authorization statements.

(b) The Deputy Assistant Secretaries shall issue disposal authorization statements containing conditions that low-level waste disposal facilities must meet in order to operate with an approved radioactive waste management basis.

(2) Site Closure Plans. Reviewing and approving closure plans and other closure documentation for deactivated high-level waste facilities/sites and issuing authorization for closure activities to proceed.

Basis:

Functions Evaluated. Generally the Responsibilities do not derive from the analysis of radioactive waste management functions. The specific responsibilities reflected in the above requirements are derived from the analysis of the top-level functions of Develop, Execute, and Evaluate the Program evaluated for all three radioactive waste management types.

Safety and Hazard Analyses. Generally, the Responsibilities do not derive from the safety and hazards analyses of radioactive waste management. These requirements address the Low-Level Waste Complex-Wide Review Vulnerabilities on Waste Forecasting, Disposal Facility Capacity, and Approval of Radiological Performance Assessments for low-level waste disposal facilities. The responsibility concerning changes to regulations did derive from the safety and hazards analyses. Existing regulations and directives were found to provide controls which mitigated weakness and conditions identified during the safety and hazards analysis, so any changes in these existing regulations need to be analyzed for their impact on the safety of radioactive waste management activities.

Requirements Analysis. These requirements are essentially equivalent to the assignments of Responsibilities in DOE 5820.2A. The specific responsibilities reflect updates to the responsibilities in DOE 5820.2A to reflect the current organizations, revisions to remove any responsibility discussions of organizations that do not implement any essential radioactive waste management functions or requirements, the implementation of the principle of a radioactive waste management basis for operating a facility, and the implementation of the majority of radioactive waste management functions integral to protecting the public, the workers, and the environment by DOE field operations. Commitments made in response to Defense Nuclear Facilities Safety Board Recommendation 94-2 provide the basis for the review and approval of performance assessments and composite analyses, and the issuance of a disposal authorization statement (see Other Considerations). The low-level waste chapter technical basis contains additional discussions about these requirements.

Other Considerations. The final wording and the elements that appear in the Responsibilities section result from achieving consistency between waste type chapters and from responses to comments on the draft versions of the Manual. The specific discussions on the review panel for low-level waste disposal facilities' performance assessments and composite analyses are included in response to comments made by the Defense Nuclear Facilities Safety Board so that DOE M 435.1-1 would be consistent with commitments made and review methods implemented in response to Recommendation
94-2.

2. <u>RESPONSIBILITIES</u>

F. <u>Field Element Managers</u>. Field Element Managers are responsible for:

(1) Site-Wide Radioactive Waste Management Programs. Developing, documenting, implementing, and maintaining a Site-Wide Radioactive Waste Management Program. The Program shall use a systematic approach for planning, executing, and evaluating the site-wide management of radioactive waste in a manner that supports the Complex-Wide Radioactive Waste Management Programs and ensures that the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Radioactive Waste Management Basis. Ensuring a radioactive waste management basis is developed and maintained for each DOE radioactive waste management facility, operation, and activity; and ensuring review and approval of the basis before operations begin. The Radioactive Waste Management Basis shall:

(a) Reference or define the conditions under which the facility may operate based on the radioactive waste management documentation;

(b) Include the applicable elements identified in the specific waste-type chapters of this Manual; and

(c) Be developed using the graded approach process.

(3) Waste Minimization and Pollution Prevention. Ensuring implementation of waste minimization and pollution prevention programs.

(4) Approval of Exemptions for Use of Non-DOE Facilities. DOE radioactive waste shall be treated, stored, and in the case of low-level waste, disposed of at the site where the waste is generated, if practical; or at another DOE facility. If DOE capabilities are not practical or cost effective, exemptions may be approved to allow use of non-DOE facilities for the storage, treatment, or disposal of DOE radioactive waste based on the following requirements:

(a) Such non-DOE facilities shall:

1. Comply with applicable Federal, State, and local requirements;

2. Have the necessary permit(s), license(s), and approval(s) for the specific waste(s); and

3. Be determined by the Field Element Manager to be acceptable based on a review conducted annually by DOE.

(b) Exemptions for the use of non-DOE facilities shall be documented to be cost effective and in the best interest of DOE, including consideration of alternatives for on-site disposal, an alternative DOE site, and available non-DOE facilities; consideration of life-cycle cost and potential liability; and protection of public health and the environment.

(c) DOE waste shall be sufficiently characterized and certified to meet the facility's waste acceptance criteria.

(d) Appropriate *National Environmental Policy Act* (NEPA) review must be completed. For actions taken under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), it is DOE's policy to incorporate NEPA values into the CERCLA documentation.

(e) Headquarters shall be notified of any exemption allowing use of a non-DOE facility and the Office of the Assistant Secretary for Environment, Safety and Health (EH-1) shall be consulted prior to the exemption being executed.

(f) Host States and State Compacts where non-DOE facilities are located shall be consulted prior to approval of an exemption to use such facilities and notified prior to shipments being made.

(5) Environmental Restoration, Decommissioning, and Other Cleanup Waste. Ensuring the management and disposal of radioactive waste resulting from environmental restoration activities, including decommissioning, meet the substantive requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual. Environmental restoration activities using the CERCLA process (in accordance with Executive Order 12580) may demonstrate compliance with the substantive requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual (including the Performance Assessment and performance objectives, as well as the Composite Analysis) through the CERCLA process. However, compliance with all substantive requirements of DOE O 435.1 not met through the CERCLA process must be demonstrated. Environmental restoration activities which will result in the off-site management and disposal of radioactive waste must meet the applicable requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual for the management and disposal of those off-site wastes. Field Elements performing environmental restoration activities involving development and management of radioactive waste disposal facilities under the CERCLA process shall:

(a) Submit certification to the Deputy Assistant Secretary for Environmental Restoration that compliance with the substantive requirements of DOE O 435.1 have been met through application of the CERCLA process; and

(b) Submit the decision document, such as the Record of Decision, or any other document that serves as the authorization to dispose, to

the Deputy Assistant Secretary for Environmental Restoration for approval.

(6) Radioactive Waste Acceptance Requirements. Ensuring development, review, approval, and implementation of the radioactive waste acceptance requirements for facilities that receive waste for storage, treatment, or disposal. Radioactive waste acceptance requirements shall establish the facility's requirements for the receipt, evaluation, and acceptance of waste.

(7) Radioactive Waste Generator Requirements. Ensuring development, review, approval, and implementation of a program for waste generation planning, characterization, certification, and transfer. This program shall address characterization of waste, preparation of waste for transfer, certification that waste meets the receiving facility's radioactive waste acceptance requirements, and transfer of waste.

(8) Closure Plans. Ensuring development, review, approval, and implementation of closure plans for radioactive waste management facilities in accordance with the applicable requirements in the waste-type chapters of this Manual.

(9) Defense-In-Depth. Ensuring defense-in-depth principles are incorporated where potential uncertainties or vulnerabilities warrant their use when reviewing and approving radioactive waste management activities and documents. These principles advocate the use of multiple levels of engineered and administrative controls to provide protection to the public, workers, and the environment.

(10) Oversight. Ensuring oversight of radioactive waste management facilities, operations, and activities is conducted. Oversight shall ensure radioactive waste management program activities are conducted in accordance with a radioactive waste management basis and meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(11) Training and Qualification. Ensuring a training and qualification program is implemented for designated radioactive waste management program personnel, and the training is commensurate with job duties and responsibilities. Only those personnel who have been trained and qualified shall design or operate safety (safety class and safety significant) structures, systems, and components.

(12) As Low As Reasonably Achievable (ALARA). Ensuring ALARA principles for radiation protection are incorporated when reviewing and approving radioactive waste management activities.

(13) Storage. Ensuring all radioactive waste is stored in a manner that protects the public, workers, and the environment in accordance with a radioactive waste management basis, and that the integrity of waste storage is maintained for the expected time of storage and does not compromise meeting the disposal performance objectives for protection of the public and environment when the waste is disposed.

(14) Treatment. Ensuring all radioactive waste requiring treatment is treated in a manner that protects the public, workers, and the environment and in accordance with a radioactive waste management basis.

(15) Disposal. Ensuring radioactive waste is disposed in a manner that protects the public, workers, and the environment and in accordance with a radioactive waste management basis. Reviewing specific transuranic or low-level waste documentation including the performance assessment and composite analysis, or appropriate CERCLA documentation, prior to forwarding them to Headquarters for approval, and obtaining and ensuring the facility is operated in accordance with the disposal authorization statement. Conducting performance assessment and composite analysis maintenance.

(16) Monitoring. Ensuring monitoring is conducted for all radioactive waste management facilities as required. Ensuring that disposal facilities are monitored, as appropriate, for compliance with conditions of the disposal authorization statement.

(17) Material and Waste Declassification and Waste Management. Ensuring, to the extent practical, radioactive material and waste generated under a program that is classified for national security reasons is declassified or rendered suitable for unclassified radioactive waste management.

(18) Waste Incidental to Reprocessing. Ensuring that waste incidental to reprocessing determinations are made by either the "citation" or "evaluation" process described in Chapter II of this Manual. Ensuring consultation and coordination with the Office of Environmental Management for waste determined to be incidental to reprocessing through the "evaluation" process.

(19) Waste With No Identified Path to Disposal. Ensuring a process is developed and implemented for identifying the generation of radioactive waste with no identified path to disposal, and reviewing and approving conditions under which radioactive waste with no identified path to disposal may be generated. Headquarters shall be notified of the decisions to generate a waste with no identified path to disposal.

(20) Corrective Actions. Ensuring a process exists for proposing, reviewing, approving, and implementing corrective actions when necessary to ensure that the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met, and to address conditions that are not protective of the public, workers, or the environment. The process shall allow workers, through the appropriate level of management, to stop or curtail work when they discover conditions that pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Basis:

Functions Evaluated. Generally the Responsibilities for the Field Element Manager do not derive from the analysis of any specific radioactive waste management functions. However, the specific responsibility of the Field Element Manager to develop and implement a site-wide radioactive waste management program is derived from the analysis of the top-level functions of Develop, Execute, and Evaluate the Program evaluated for all three radioactive waste management types.

Safety and Hazard Analyses. Generally, the Responsibilities do not derive from the safety and hazards analyses of radioactive waste management. These requirements do address the Complex-Wide Review Vulnerabilities on Waste Forecasting, Disposal Facility Capacity, Storage of Low-Level Waste, Waste Characterization, and No Path Forward Waste.

Requirements Analysis. These requirements are basically equivalent to the assignment of Responsibilities in DOE 5820.2A to the heads of field organizations. These specific responsibilities reflect updates to the responsibilities in DOE 5820.2A to reflect the current facilities, functions, operations, organizations, and activities associated with radioactive waste management, the implementation of the principle of a radioactive waste management basis for operating a facility, and the implementation of the majority of radioactive waste management functions integral to protecting the public, the workers, and the environment by DOE field operations. Commitments made in response to Defense Nuclear Facilities Safety Board Recommendation 94-2 provide the basis for several specific Field Element Manager responsibilities. The language for some of these is derived from the DNFSB 94-2 deliverable, "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management

and Disposal," (letter from A. Alm, July 31, 1996), and the DNFSB 94-2 deliverable, "Guidance for Complying with DOE 5820.2A, *Radioactive Waste Management*, for Onsite Management and Disposal of Low-Level Waste (LLW) Resulting from Environmental Restoration Activities." Language for the use of non-DOE facilities requirement is derived from, "Delegation of Authority to Grant Exemptions to Department of Energy Order 5820.2A to Allow for the Use of Commercial Facilities for Disposal of Department of Energy Low-Level Waste."

Other Considerations. Implementation of waste minimization and pollution prevention, defense-in-depth, a radioactive waste management basis, ALARA, and corrective actions reflect implementation of top-level criteria for the Order and Manual requirements development. Also, some of the requirements implement specific responsibilities of the Department's Integrated Safety Management System. (The implementation of the top-level criteria and the Department's integrated safety management system continues through the specification of some waste type chapter requirements. The waste type chapter technical bases should be consulted for additional discussions to find those contributions to meeting the upper level criteria). The final contents of some of the Field Element Manager responsibilities is due to achieving consistency among the waste types. This included consolidating elements of a requirement common to all three waste types into one general requirement, and responding to comments on draft versions of the Manual, especially from field personnel.

G. <u>All Personnel</u>. All personnel are responsible for:

(1) Problem Identification. Identifying and reporting radioactive waste management facilities, operations, or activities that do not meet the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual, or that pose a threat to the safety of the public, workers, or the environment.

(2) Shutdown or Curtailment of Activities. Stopping or curtailing work, through the appropriate level of management, to prohibit continuation of conditions or activities which pose an imminent danger or other serious hazard to workers or the public, or are not protective of the environment.

Basis:

Functions Evaluated. Generally the Responsibilities do not derive from the analysis of radioactive waste management functions. These responsibilities of all personnel involved with radioactive waste management derive from the analysis of the top-level function of Evaluate the Program for all three radioactive waste management types.

Safety and Hazard Analyses. Generally, the Responsibilities do not derive from the safety and hazards analyses of radioactive waste management.

Requirements Analysis. New requirement derived for the Manual. DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, was evaluated and this essential set of requirements was derived from the requirements of that Order.

Other Considerations. Implementation of responsibilities for identification of problems and implementing corrective actions through appropriate levels of management implements the Department's integrated safety management system, as invoked in the introductory requirement to this section of the Manual, Requirements of Other Regulations and DOE Directives.

BASIS FOR REGULATION OF HIGH-LEVEL WASTE

The Department of Energy (DOE) O 5820.2A, *Radioactive Waste Management,* issued in September 1988, established the policies and guidelines for managing the Department's high-level waste and any other materials which, because of their highly radioactive nature (level of health risk, longevity of health risk and thermal activity) require similar handling. The Order assumed that unless demonstrated to the contrary, all high-level waste shall be considered to be radioactive mixed waste and subject to the requirements of the *Atomic Energy Act of 1954,* as amended, and the *Resource Conservation and Recovery Act.* In addition, the Order did not apply to the management by the Department of commercially generated high-level radioactive waste nor did it apply to the geologic disposal of high-level waste produced by the Department's activities and operations. Such materials were to be managed by the Office of Civilian Radioactive Waste Management under the requirements of the *Nuclear Waste Policy Act of 1982,* as amended.

The basic assumptions made in DOE 5820.2A for the management of high-level waste are still valid for DOE O 435.1. However, since the issuance of DOE 5820.2A the need to comply with a series of regulatory requirements has contributed to the focus and content of the revised *Radioactive Waste Management* Order, DOE O 435.1. For example, since 1988 the Office of Civilian Radioactive Waste Management has issued DOE/RW-0351P, *Waste Acceptance System Requirements Document* (WASRD), that describes the technical requirements and functions to be satisfied by high-level waste form producers in order that their spent nuclear fuel and high-level radioactive waste can be accepted into the Civilian Radioactive Waste Management System. The waste acceptance requirements contained in this document are derived from a number of documents, including statutes, regulations, and DOE directives with a primary driver being the Nuclear Regulatory Commission's 10 CFR Part 60 regulation, *Disposal of High-Level Radioactive Wastes in Geologic Repositories.* In response to the WASRD the DOE Office of Environmental Management has developed, and implemented, DOE-EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS), which serve as the technical specifications which the high-level waste form producers are required to meet in order to ensure acceptance of their vitrified waste form into the Civilian Radioactive Waste Management System.

In 1992, Congress passed amendments to the *Solid Waste Disposal Act,* entitled the *Federal Facility Compliance Act,* which required DOE to prepare plans for the developing treatment capacities and technologies for mixed waste. Pursuant to this Act, DOE prepared site-specific treatment plans, and consent orders or agreements that were reached with the affected States and EPA. These consent orders and agreements typically specify how and when high-level wastes which also exhibit hazardous characteristics or contain RCRA-regulated hazardous components are to be retrieved, characterized, treated, and stored for shipment to the geologic repository. This process has involved many stakeholder groups and different regulatory entities.

The High-Level Waste Requirements chapter of the *Radioactive Waste Management Manual*, DOE M 435.1-1, is consistent with the legislation and requirements associated with the disposal of high-level waste at a geologic repository. In addition, to requirements contained in DOE 5820.2A, the current requirements for the management of high-level waste have been prepared to apply to a broad range of management functions, from generation through storage, pretreatment, treatment, and post-treatment storage. The previously detailed requirements related to managing and preparing waste for disposal are now replaced by a higher-level, performance-based set of requirements.

The following pages explain the basis for the high-level waste management requirements included in DOE M 435.1-1.

CHAPTER II

HIGH-LEVEL WASTE REQUIREMENTS

II.A. Definition of High-Level Waste.

High-level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

Basis:

Functions Evaluated. Requirement is not based on functions.

Safety and Hazard Analyses. Requirement is not based on safety and hazard analyses.

Requirements Analysis. The requirement is based on the definition of high-level waste contained in the *Nuclear Waste Policy Act of 1982*, as amended, and implemented by 10 CFR Part 60, *Disposal of High-Level Radioactive Waste in Geologic Repositories*. Slight revisions to the *Nuclear Waste Policy Act* definition for high-level waste were directed by DOE General Counsel for the definition contained in DOE M 435.1-1. These revisions include a deletion of the reference to the Nuclear Regulatory Commission. This is replaced by the wording "consistent with existing law," and remains a mechanism for determining a waste is high-level waste. The wording in DOE M 435.1-1 is fundamentally the same as the definition contained in DOE 5820.2A. However, this latter definition, contained in an attachment to the Order titled, *Definitions*, did not include the authority for other waste to be determined to be high level that require permanent isolation.

Other Considerations. This definition reflects DOE application of the statutory definitions to the scope of this Order. High-level waste, as defined in DOE M 435.1-1, does not include DOE-managed spent nuclear fuel since, at the time of the preparation of the Manual, DOE had not declared this material a waste.

II.B. Waste Incidental to Reprocessing.

Waste resulting from reprocessing spent nuclear fuel that is determined to be incidental to reprocessing is not high-level waste, and shall be managed under DOE's regulatory authority in accordance with the requirements for transuranic

waste or low-level waste, as appropriate. When determining whether spent nuclear fuel reprocessing plant wastes shall be managed as another waste type or as high-level waste, either the citation or evaluation process described below shall be used:

(1) Citation. Waste incidental to reprocessing by citation includes spent nuclear fuel reprocessing plant wastes that meet the description included in the Notice of Proposed Rulemaking (34 FR 8712) for proposed Appendix D, 10 CFR Part 50, Paragraphs 6 and 7. These radioactive wastes are the result of reprocessing plant operations, such as, but not limited to: contaminated job wastes including laboratory items such as clothing, tools, and equipment.

(2) Evaluation. Determinations that any waste is incidental to reprocessing by the evaluation process shall be developed under good record-keeping practices, with an adequate quality assurance process, and shall be documented to support the determinations. Such wastes may include, but are not limited to, spent nuclear fuel reprocessing plant wastes that:

(a) Will be managed as low-level waste and meet the following criteria:

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and

2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*; and

3. Are to be managed, pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, *Waste Classification*; or will meet alternative requirements for waste classification and characterization as DOE may authorize.

(b) Will be managed as transuranic waste and meet the following criteria:

1. **Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and**

2. **Will be incorporated in a solid physical form and meet alternative requirements for waste classification and characteristics, as DOE may authorize; and**

3. **Are managed pursuant to DOE's authority under the *Atomic Energy Act of 1954,* as amended, in accordance with the provisions of Chapter III of this Manual, as appropriate.**

Basis:

Functions Evaluated. This requirement is not based on functions.

Safety and Hazard Analyses. This requirement is not based on safety and hazard analyses.

Requirements Analysis. The Citation process is based on the cited Federal Register Notice, Notice of Proposed Rulemaking (34 FR 8712) for Appendix D, 10 CFR Part 50. The Evaluation process is based on the NRC response to the petition regarding disposal of waste at the Hanford site, the NRC (States of Washington & Oregon): Denial of Petition for Rulemaking, 58 FR 12342-12347, March 4, 1993; and the NRC previous determination that similar operations at SRS (separation of the low-activity fraction) should be characterized as incidental waste and not high-level waste (*52 FR 5992-6001*). DOE 5820.2A did not contain a requirement regarding a waste incidental to reprocessing determination process.

Other Considerations. Requirement reflects input from discussions with the NRC staff and the DOE Office of General Counsel and DOE Office of Environment, Safety, and Health (EH). Discussions with NRC staff resulted in their offer to review, on macro basis, DOE Evaluation Process determinations, if DOE decided their participation was needed. DOE General Counsel's review of draft versions of the Evaluation process agreed with the NRC, NRC participation is not required and that DOE clearly has the authority to review and accept Evaluation process determinations. DOE EH review resulted in clarifying the differences in evaluation process criteria for low-level waste and transuranic waste. This requirement formalizes a determination process that has been used by DOE high-level waste sites.

II.C. <u>Management of Specific Wastes</u>.

The following provide for management of specific wastes as high-level waste in accordance with the requirements in this Chapter:

(1) Mixed High-Level Waste. Unless demonstrated otherwise, all high-level waste shall be considered mixed waste and is subject to the requirements of both the *Atomic Energy Act of 1954*, as amended, the *Resource Conservation and Recovery Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. High-level waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act*, as amended, DOE O 435.1, *Radioactive Waste Management*, and this Manual.

Basis:

Functions Evaluated. Requirement is not based on functions.

Safety and Hazard Analyses. Requirement is not based on safety and hazards analyses.

Requirements Analysis. This requirement is based on DOE policy to ensure conservatism in complying with the requirements of the *Resource Conservation and Recovery Act*, as amended, and the *Toxic Substances Control Act*, as amended. DOE 5820.2A, paragraph I.1., also required that all high-level waste be considered mixed waste unless demonstrated otherwise.

Other Considerations. Since high-level waste may contain hazardous constituents, this requirement contributes to defense-in-depth and protection of workers and the environment, and is a best management practice.

II.D. <u>Complex-Wide High-Level Waste Management Program</u>.

A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level high-level waste management functions: formulate, execute, and evaluate the high-level waste program.

Safety and Hazard Analyses. This requirement addresses the need for a complex-wide integrated program that is necessary for planning, executing, and evaluating the high-level waste program. The requirement addresses the needs for a description of functional elements, organizations, responsibilities and activities that comprise the system needed to manage high-level waste. It also addresses the need to develop a waste management strategy that integrates waste

projections and life-cycle waste management planning into complex-wide facility configuration decisions.

Requirements Analysis. The requirement for a high-level waste management program has no predecessor requirements in DOE 5820.2A. A site-wide radioactive waste program is established in Chapter I of the Manual to accomplish appropriate flow of information between the sites and the complex-wide program. The requirement for a high-level waste management program plan is an improvement to the requirement for a waste management plan in Chapter VI of DOE 5820.2A. The high-level waste management program plan is an integrated, complex-wide, plan developed using input from the site-wide radioactive waste management programs required in Chapter I of the Manual.

Other Considerations. Facility optimization, configuration management, cost-savings, and the other goals of the high-level waste management program are best accomplished by an integrated program that includes documented milestones and measures of accomplishment.

II.E. Site-Wide Radioactive Waste Management Program.

In addition to the items in Chapter I of this Manual, documentation of the Site-Wide Radioactive Waste Management Program shall include a description of the High-Level Waste Systems Engineering Management Program to support decision-making related to nuclear safety, including high-level waste requirements analysis, functional analysis and allocation, identification of alternatives, and alternative selection and system control.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level high-level waste management functions: formulate, execute, and evaluate the high-level waste program.

Safety and Hazard Analyses. This requirement addresses the need for a documented logical basis for making significant high-level waste programmatic decisions that are important to nuclear safety that are reflected in the site-wide radioactive waste management program. This site-wide integrated program that is necessary for planning, executing, and evaluating the high-level waste program at each site becomes an input to the complex-wide plan required by section II.D.

Requirements Analysis. The content of this requirement is based on interim technical standard, EIA/IS-632 *System Engineering* dated December 1994, published by the Electronic Industries Association. This same interim standard is also cited in DRAFT DOE G 420.1-X *Implementation Guide for Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria,* Rev. G dated September 1995. Standards Proposal No. 3537-A has been issued which proposes to upgrade and revise EIA/IS-632. When the proposed upgrade and revision is approved, the

standard will be published as ANSI/EIA-632, and EIA-IS-632 will be CANCELED. DOE 5820.2A did not specifically require systems engineering to support decision making related to nuclear safety.

Other Considerations. This requirement is included in DOE O 435.1 based on DOE's Implementation Plan in response to DNFSB Recommendation 92-4, which proposed a systems engineering approach to construct a rational and integrated program at the Hanford site. No specific weakness from the hazard and risk analysis is cited to justify this requirement. However, the Order Revision Team used a systems engineering approach to identify the functions and conduct the hazards analyses.

II.F. Radioactive Waste Management Basis.

High-level waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Pretreatment and Treatment Facilities. The waste acceptance requirements and waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level high-level waste management functions: formulate, execute, and evaluate the high-level waste management program.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions due to the lack of, or poor integration of programs, documentation, and controls considered important for the safe operation of high-level waste management facilities.

Requirements Analysis. The requirement for a radioactive waste management basis for high-level waste management facilities has no predecessor requirements in DOE 5820.2A. As described in M 435.1-1, Section I.2.F.(2), the radioactive waste management basis references, or defines, the conditions under which a facility may operate based on radioactive waste management documentation, using the graded approach process. It also specifically includes certain elements identified in the specific waste-type chapters of the Manual. For high-level waste, the waste

certification program and the waste acceptance requirements are specifically identified. However, the identification of these two specific requirements does not preclude the inclusion of other requirements from the high-level waste Manual. For instance, the controls for maintaining a safe operating envelope under which the use of tanks that are known or suspected to have leaked previously for continued storage of high-level waste may very well be included as part of the authorization basis. The radioactive waste management basis employs the principles of the Authorization Basis for radioactive facilities, as required by DOE 5480.21, *Unreviewed Safety Questions*, and DOE 5480.23, *Nuclear Safety Analysis Reports*, and extends them to facilities and operations that are not subject to the requirements of these Orders.

Other Considerations. The radioactive waste management basis concept being employed is performance-based and employs the graded approach process, i.e., the rigor of documentation is commensurate with the hazards of the activities being carried out at a given facility. The concept also supports the defense-in-depth philosophy for added worker protection.

II.G. <u>Quality Assurance Program</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Product Quality. The requirements of RW-0333P, *Quality Assurance Requirements and Description,* shall apply to those high-level waste items and activities important to waste acceptance/product quality.

(2) Audits and Assessments. The evaluation and assessment requirements of RW–0333P, *Quality Assurance Requirements Document and Description,* and associated implementing procedures shall be met for high-level waste acceptance and product quality activities, in addition to the assessment requirements of other DOE directives and requirements identified in Chapter I of this Manual.

Basis:

Functions Evaluated. The requirement is based on the analysis of treating high-level waste and storing immobilized high-level waste

Safety and Hazard Analyses. This analysis identified low range probabilities and consequences that resulted from a weakness in inspection of immobilized high-level waste and the treatment (immobilization) of high-level waste.

Requirements Analysis. The requirement invokes the requirements contained in RW-0333P, *Quality Assurance Requirements Document and Description.* DOE 5820.2A contained QA requirements but did not cite DOE/RW-0333P.

Other Considerations. These requirements are also included based on statutory (*Nuclear Waste Policy Act of 1982*, as amended), regulatory (10 CFR Part 60) and DOE Policy (DOE/RW-0333P) directives. For the purpose of activities within the scope of DOE O 435.1, the statute, requirement, and policy apply to development, production and acceptance of the solidified high-level waste form. The statute supports the DOE longstanding planning that DOE high-level waste be disposed in a geologic repository regulated by NRC, for which the Quality Assurance requirements are published in 10 CFR Part 60, Subpart G. Compliance with NRC's quality assurance requirements must be demonstrated before DOE can dispose high-level waste at the repository.

To prepare for that demonstration, as well as to meet its own quality standards, DOE's Office of Civilian Radioactive Waste Management (OCRWM), published DOE/RW-0333P, *Quality Assurance Requirements Document and Description* (QARD). DOE/RW-0333P states that its provisions "… apply to every level of every organization performing work for, or to be accepted by, OCRWM."

DOE 5820.2A cited the quality assurance requirements in DOE 5700.6B and appropriate national consensus standards. However, DOE 5820.2A did not include the high-level waste specific quality assurance requirements related to the development, production and acceptance of immobilized high-level waste at the repository.

II.H. <u>Contingency Actions</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving high-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of waste contained in any one storage vessel, pretreatment facility, or treatment facility. Tanks or other facilities that are designated for high-level waste contingency storage shall be maintained in an operational condition when waste is present and shall meet all the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Basis:

Functions Evaluated. This requirement is based on analyses of the following functions: operate, monitor and maintain high-level waste storage systems; maintain safe storage envelope; and transferring high-level waste to storage.

Safety and Hazard Analyses. The analyses identified potential significant consequences from leaking storage tanks without adequate spare capacity and adequate transfer equipment.

Requirements Analysis. This requirement is based on that contained in DOE 5820.2A, paragraph 1.3.b.(4)(d), and draft DOE 5820.2B, Chapter II paragraph 3.c.(3)(g). However, the requirement in DOE M 435.1-1 goes further than that contained in DOE 5820.2B, in that it also invokes the requirements for design requirements for structural integrity for new tanks, should they be constructed for use as contingency storage. The new requirement also invokes the storage requirement for structural integrity for existing double and/or single shell tanks in order to use such tanks for contingency storage. Should it be necessary to use tanks that have, or are suspected to have, leaked in the past for contingency storage, the requirement provides in Section II.Q.(2), Structural Integrity Program, for the conditions under which such tanks could be used in emergency situations only, and is to include the identification of a safe operational envelope and the controls necessary to maintain that envelope.

Other Considerations. The readily available capability to respond to emergency situations involving loss of confinement supports the defense-in-depth concept, protection of workers and the environment, and the radioactive waste management basis.

II.I. <u>Corrective Actions</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Basis:

Functions Evaluated. The requirement is derived from the analysis of the top-level functions: formulate, execute, and evaluate the high-level waste management program.

Safety and Hazard Analyses. The requirement addresses the need for conducting evaluations, e.g., inspections, reviews, of high-level waste management activities associated with the protection of the public, workers, and the environment, and for correcting situations which are not in accordance with requirements of DOE O 435.1, or M 435.1-1. The requirement addresses a normal management function, i.e., to follow-up to see that directives are carried out in a disciplined manner, and to evaluate the effectiveness of the order to establish the overall requirements to mitigate the hazards posed by DOE radioactive waste management activities. The requirement also addresses the potential weaknesses and conditions due to poor, or non-existent documentation that demonstrates the implementation of an approved radioactive waste management basis for an operation and the need to limit the operation of waste management activities to the constraints/bounds identified in the facility's radioactive waste management basis.

Requirements Analysis. The requirement for corrective actions has no predecessor requirements in DOE 5820.2A. The authorization basis concept of DOE 5480.21, and DOE 5480.23, and their implementation, was utilized as a basis for the implementation of the radioactive waste management basis. Corrective actions are used by the NRC in reactor licensing for dealing with situations that could be inimical to public health and safety, however, no additional essential requirement language was derived from those requirements.

Other Considerations. The use of the corrective actions requirement, in conjunction with the radioactive waste management basis requirement, provide feedback mechanisms which are necessary to make measurable improvements to the high-level waste management program and is considered a best management practice.

II.J. <u>Waste Acceptance</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all high-level waste storage, pretreatment, or treatment facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form that ensures the chemical and physical stability of the waste under conditions that might be encountered during transfer, storage, pretreatment, or treatment;

(c) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each

exception request shall be documented, including its disposition as approved or not approved; and

(d) Pretreatment, treatment, storage, packaging, and other operations shall be designed and implemented in a manner that will ultimately comply with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste.

Basis:

Functions Evaluated. The requirement is derived from the safety and hazards analysis that addressed the following functions: transferring and receiving high-level waste for pretreatment, treatment, and storage activities and maintaining safe storage of high-level waste.

Safety and Hazard Analyses. The requirement addresses the need for the establishment of waste acceptance requirements by pretreatment, treatment, and storage facilities receiving waste and for ensuring the waste acceptance requirements are met at the receiving facility. The requirement also addresses the weaknesses and conditions identified by the safety and hazards analyses concerning the receipt of incompatible high-level waste streams in high-level waste management facilities. In addition, the requirement ensures that no high-level waste management activity jeopardizes compliance with the EM *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS) or the *Civilian Radioactive Waste Management System Requirements Document* (DOE/RW-0406).

Requirements Analysis. The high-level waste acceptance requirements have no predecessor requirements in DOE 5820.2A, however, waste acceptance requirements (criteria) were a requirement in the Order for low-level waste. Part of the requirement was derived from specific criteria for exceptions that appear in DOE site-specific waste acceptance criteria documents. Exception provisions are common in performance-based requirements documents, as long as the basis for the exception is identified and the authorizing process to avoid unjustified exceptions is provided.

Other Considerations. Effective waste acceptance experience at DOE facilities establishes this requirement as a best management practice, supportive of the principle of defense-in-depth, and the DOE M 435.1-1 principle of radioactive waste management basis.

II.J.(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and

administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Basis:

Functions Evaluated. This requirement is derived from the safety and hazards analysis that addressed the following functions: transferring and receiving high-level waste for pretreatment, treatment, and storage activities and maintaining safe storage of high-level waste.

Safety and Hazard Analyses. The requirement addresses the need for establishing a confirmation step for assuring that generators meet waste acceptance requirements of storage, pretreatment, and treatment facilities and that the receiving facility verifies that the acceptance requirements are met before the waste is accepted. The requirement addresses potential weaknesses and conditions that could arise from a storage, pretreatment, or treatment facility receiving poorly characterized waste or waste containing unacceptable constituents. The requirement also addresses the weaknesses and conditions identified with the acceptance of waste that does not conform with the requirements of the facility that received it.

Requirements Analysis. The requirement has no predecessor requirement in DOE 5820.2A, however, waste acceptance requirements (criteria) were a requirement in the Order for low-level waste. Specifically, DOE 5820.2A, Requirement III.3.e.(4) required audits of waste certification programs. Current waste acceptance documents and practices were evaluated for the essential requirements to address the weaknesses and conditions identified

Other Considerations. The requirement adds defense-in-depth to the waste acceptance and waste certification processes by adding an evaluation and acceptance step by the receiving facility. The language was developed from best management practices of current DOE facilities and allows for flexibility in implementation and use of the graded approach.

II.K. <u>Waste Generation Planning</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all high-level waste streams.

(2) Waste With No Identified Path to Disposal. High-level waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste (compliance with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*).

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions for certifying waste, providing waste forecast data, and approval of generator processes by the receiving facility.

Safety and Hazard Analyses. The requirement addresses the need for generators, and pretreatment, treatment, and storage facilities management to identify and acquire as much information as possible about a waste stream prior to its generation; to prevent the generation of waste streams that may not have a path forward to disposal; and to implement an authorization process for managing no path forward wastes. Specific weaknesses and conditions addressed are the generation of waste streams that can not be certified or accepted at high-level waste management facilities because they have no path forward through disposal, or they challenge the capacity of existing waste management facilities.

Requirements Analysis. The requirements have no direct predecessor requirements in DOE 5820.2A, however, Chapter VI does require a Waste Management Plan. This requirement, and the concepts it embodies, have been significantly modified in DOE M 435.1-1 to clarify that the focus of these activities is on the life-cycle management of high-level waste streams and not on information about managing facilities and their achievements. The requirements in DOE M 435.1-1 emphasize life-cycle planning and the resolution of issues that may prevent the disposal of high-level waste in accordance with the provisions of the *Nuclear Waste Policy Act of 1982*, as amended.

However, this requirement must be viewed in the context of the related requirements in DOE M 435.1-1, Chapter I. These requirements assign to the Field Element Manager the responsibility to approve conditions under which radioactive waste with no path to disposal may be generated, and to notify DOE HQ of any decision to generate such waste. The objective is to bring issues associated with the potential generation of high-level waste with no identified path to disposal to the attention of appropriate DOE Managers before such waste is generated to resolve problems that preclude its disposal. The requirement and guidance establishes a Departmental position to avoid the generation of such waste. The guidance also expressly elicits the development of plans for resolving issues that prevent disposal.

Other Considerations. The concepts of life-cycle planning and approval, prior to generation, support the defense-in-depth philosophy. The objective of resolving issues that prevent disposal before the waste is generated addresses the need for waste management personnel to ensure that a high-level waste stream is not generated unless there is evidence to support confidence that the waste can ultimately comply with the Office of Environmental Management *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms* (EM-WAPS).

II.L. <u>Waste Characterization</u>.

High-level waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any solidification media;

(c) Radionuclides or source information sufficient to describe the approximate radionuclide content of the waste; and

(d) Any other information which may be needed to demonstrate compliance with the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified, immobilized high-level waste.

(3) Hazardous Characteristics. Waste characterization processes shall yield sufficient chemical and physical data to clearly identify any hazardous characteristics that may degrade the ability of structures, systems, and components to perform their radioactive waste management function.

Basis:

Functions Evaluated. The following functions were evaluated to support this requirement: transfer high-level waste to storage (slurry); transfer high-level waste to storage (calcine); disposition of non-high-level waste streams; maintain a safe storage envelope; and disposition of non-immobilized high-level waste.

Safety and Hazard Analyses. The analyses identified weakness related to characterization that included record-keeping errors and inadequate analysis equipment.

Requirements Analysis. This requirement is based on the requirements contained in DOE 5820.2A at paragraphs 1.3.b.(1)(a), 1.3.b.(1)(b), and DOE Draft O 5820.2B, paragraph 3.b.(3).

Other Considerations. Characterization of waste is necessary to determine compatibility when wastes from different processes or tanks are combined, and to support determinations of structural integrity, all of which are necessary to maintain a safe storage envelope. Characterization is also necessary to ensure that waste accepted for storage can be processed to meet the requirements of DOE/EM-0093, *Waste Acceptance Specifications for Vitrified High-Level Waste Forms.* Characterization data to support safe storage and meeting vitrified waste acceptance specifications contribute to defense-in-depth and protection to workers, the public and the environment. The data quality objective process invoked for characterization provides a structured, industry-accepted process approach to determining specific characterization requirements.

II.M. <u>Waste Certification</u>.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving high-level waste for storage, pretreatment, treatment, and disposal are met.

(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

(2) Certification Before Transfer. High-level waste shall be certified as meeting the waste acceptance requirements before it is transferred to the facility receiving the waste.

(3) Maintaining Certification. High-level waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, pretreatment, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Basis:

Functions Evaluated. This requirement is based on the functions of transferring high-level waste to storage, pretreatment, or treatment facilities prior to immobilization, and comparing the high-level waste characteristics to the waste acceptance criteria of the receiving facility.

Safety and Hazard Analyses. This requirement resulted, in part, from the hazard of combining incompatible waste streams in a waste storage tank, pretreatment facility, or treatment facility. The consequences could result in a tank being placed in a condition that is outside the receiving facility's radioactive waste management basis, or loss of confinement due to a deleterious chemical/thermal reaction.

Requirements Analysis. This requirement is considered necessary to ensure a facility or operation's radioactive waste management basis, or authorization basis, is identified and maintained. This requirement did not appear in DOE 5820.2A.

Other Considerations. This requirement, together with the requirement for Waste Acceptance (Section II.J.) provides defense-in-depth by requiring that both the generator and the receiver implement a program that documents that the waste to be transferred meets the receiving facility's waste acceptance requirements. Implementing such a program reduces the likelihood that transferred wastes contain unacceptable materials or characteristics, thereby avoiding hazards that would occur from the unnecessary transportation and handling of waste streams which do not meet waste acceptance requirements. A certification program also contributes to waste minimization and is a best-management practice.

II.N. <u>Waste Transfer</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Authorization. High-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Basis:

Functions Evaluated. The requirement derives from the analysis of the functions to transfer waste to storage, pretreatment and treatment facilities.

Safety and Hazard Analyses. The hazards are that safe storage will not be maintained and that waste will be received or generated for which there is no path forward to disposal. The hazards are created by the receipt of waste without the cognizance or approval of personnel at the receiving facility, or because the receiving facility personnel failed to properly determine the acceptability of the waste. The receipt of waste prior to authorization may preclude instituting the controls necessary for its safe management. The waste may be incompatible with the receiving tank materials and/or the contents of the tank, leading to loss of containment via overflows, degradation of its structural integrity, or by chemical /criticality reactions. The receipt of waste which is incompatible with that already contained in the receiving tank could also result in generating a waste with no path forward for disposal.

Requirements Analysis. This requirement addresses the need for establishing a process for assuring that personnel at the receiving facility verify the acceptance of the waste to be received, including its compatibility with the receiving tank and its contents, and have authorized the transfer. The requirement that high-level waste shall not be transferred until personnel responsible for the facility receiving the waste authorizes the transfer has no predecessor in DOE 5820.2A. The requirement provides for appropriate controls to ensure safe management of high-level waste during transfers.

Other Considerations. This requirement provides an additional level of defense in depth to avoid the receipt of incompatible wastes and/or wastes with no path forward for disposal. Authorization by receiving facilities for transfer provides this defense-in-depth when waste is transferred, a vulnerable period in the life cycle of the waste.

II.N.(2) Data. Waste characterization data and generation, storage, pretreatment, treatment, and transportation information for high-level waste shall be transferred with or be traceable to the waste.

Basis:

Functions Evaluated. The requirement derives from the analysis of the function to maintain safe storage, and from the functions to verify the waste meets the acceptance criteria at storage pretreatment and treatment facilities.

Safety and Hazard Analyses. The hazards are that safe storage will not be maintained and that waste will be received or generated for which there is no path forward to disposal. The hazard arises because of the potential for losing the characterization data for specific wastes, which in turn could lead to situations in which waste will be received that is incompatible with the tank or the contents of the tank; or waste will be received or generated for which there is no path for disposal. Data supporting the acceptability of canistered waste forms are also important to preclude the receipt of waste which might not be acceptable at a geologic repository. Specific

weaknesses and conditions include losing knowledge about waste at any step of the waste management process. Particularly vulnerable stages of the process include transfer operations, and when pretreatment or treatment changes the waste form, and when storage lasts longer than anticipated.

Requirements Analysis. The requirement addresses the need for maintaining and being able to access accurate characterization data on which transfer authorization will be based, and for the maintenance of that data at all stages of the waste management process for high-level waste, from generation through post-treatment storage. This requirement has no predecessor in DOE 5820.2A, since the EM-WAPS and WASRD were published subsequent to the issuance of DOE 5820.2A.

Other Considerations. The principle of ALARA is supported by this requirement in preventing re-certification or re-characterization of waste, or doing unnecessary sampling and analysis, if all characterization data are properly maintained and transferred. Similarly, the principle of waste minimization is supported by this requirement through reducing unnecessary samples that must be dispositioned.

II.N.(3) Records and Transfer Reporting. The records and transfer requirements for canistered high-level waste forms shall comply with DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified, immobilized high-level waste

Basis:

Functions Evaluated. The requirement in part responds to the high-level waste functional analysis requirements for waste acceptance criteria and receipt of immobilized waste.

Safety and Hazard Analyses. The requirement is based on the need for documentation that demonstrates the compliance of each canistered waste form with the requirements of DOE/EM-0093 or DOE/RW-0351P, not on the safety and hazards analysis.

Requirements Analysis. The undesirable outcome that this requirement seeks to preclude is that the records and transfer requirements for canistered high-level waste forms will not comply with applicable specifications. The requirement addresses the need to ensure high-level waste activities generate and maintain records that demonstrate immobilized high-level waste meets the requirements of DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0406, *Civilian Radioactive Waste Management System Requirements Document,* for non-vitrified, immobilized high-level waste. This requirement has

no predecessor in DOE 5820.2A, since the EM-WAPS and WASRD were published subsequent to the issuance of DOE 5820.2A.

Other Considerations. None.

II.O. Packaging and Transportation.

The following requirement is in addition to those in Chapter I of this Manual.

(1) Canistered Waste Form. Immobilized high-level waste shall meet the requirements of the DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified, immobilized high-level waste.

Basis:

Functions Evaluated. The requirement in part responds to the high-level waste functional analysis requirements for waste acceptance criteria and receipt of immobilized waste.

Safety and Hazard Analyses. This requirement is focused on the need for documentation that demonstrates the compliance of each canistered waste form with the requirements of DOE/EM-0093 or DOE/RW-0406, not on the safety and hazards analysis.

Requirements Analysis. The undesirable outcome that this requirement seeks to preclude is that the canistered high-level waste form will not meet the requirements for acceptance into the Civilian Radioactive Waste Management System, and/or that documentation is not available to so demonstrate. The requirement addresses the need to ensure that, before packaging and transporting, each immobilized high-level waste form meets the requirements specified by DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* or DOE/RW-0406, *Civilian Radioactive Waste Management System Requirements Document,* for non-vitrified, immobilized high-level waste. This requirement has no predecessor requirement in DOE 5820.2A since the EM-WAPS and the WASRD were published subsequent to the issuance of DOE 5820.2A**.**

Other Considerations. None.

II.P. Site Evaluation and Facility Design. The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for high-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new high-level waste facility or expansion of an existing high-level waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, or human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Basis:

Functions Evaluated. These requirements are based on the outcome of safety and hazard analyses that addressed the functions: construct new facilities (storage); construct new facilities (pretreatment); construct new facilities (immobilization); and construct new facilities (storage of immobilized waste).

Safety and Hazard Analyses. There are numerous hazards involved in the construct new facilities functions stemming from inadequate siting, the most critical being the loss of containment. Scenarios examined included those in which the risk posed by natural phenomena as well as man-induced events could not be solely offset by facility design and construction, or the site evaluation failed to identify certain hazards to be incorporated into the design. Similarly, design and construction cannot always offset the potential effects of the facility on the population and sensitive environmental issues associated with the region in which the facility is proposed to be sited.

Requirements Analysis. This performance-based requirements is based on the siting evaluation requirements of 10 CFR Part 72, Sub-Part E, *Siting Evaluation Factors.* DOE 5820.2A, Section I.3.a.(1)(a), did require that the design requirements for new facilities protect against the effects of natural phenomena. There were no explicit requirements in DOE 5820.2A for site evaluation to consider other critical factors as a precursor to design and construction of new facilities.

Other Considerations. This requirement supports the defense-in-depth concept and can be expected to lead to selection of sites that result in reduced risk.

II.P.(2) Facility Design. The following facility design requirements, at a minimum, apply:

(a) Safety (Safety Class and Safety-Significant) Structures, Systems, and Components. Safety structures, systems, and components for high-level waste storage, pretreatment, and treatment facilities shall be designated and designed consistent with the provisions of DOE O 420.1, *Facility Safety;* DOE 5480.22, *Technical Safety Requirements*; and DOE 5480.23, *Nuclear Safety Analysis Reports*.

Basis:

Functions Evaluated. These requirements are based on analyses of the following functions: construct new facilities (storage); construct new facilities (pretreatment); construct new facilities (immobilization); construct new facilities (storage of immobilized waste); compare high-level waste to receiving facility waste acceptance criteria; prepare feed; and package immobilized high-level waste.

Safety and Hazard Analyses. There are numerous hazards involved in the construct new facilities functions stemming from inadequate design, the most critical being the loss of containment due to an initiating event of a deflagration or detonation of flammable and explosive gases. The weaknesses identified in the construct new facilities functions were inadequate identification of design requirements and inadequate incorporation of requirements into the design. Other weaknesses identified were failure to identify hazards, waste stationary in unshielded lines, and personnel in unauthorized areas.

Requirements Analysis. This requirement is based on the requirements in current DOE Orders (420.1 *Facility Safety*; 5480.*22 Technical Safety Requirements*; 5480.23, *Nuclear Safety Analysis Reports)* and on DOE-STD-3009.94, *Preparation Guide for U. S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports.* DOE 5820.2A addresses the design of new facilities in requirement 1.3.a.(1)(a) in which design objectives for new facilities were required to assure the protection of the public, worker and to comply with DOE policies regarding nuclear safety, safeguards and security, but did not require the identification of Safety Class and Safety Significant systems, structures, and components. Because several high hazard scenarios were identified in the safety and hazards analysis, it was decided to invoke these specific requirements in this Order to provide an enhanced safety posture.

Other Considerations. This requirement supports defense-in-depth and is a best management practice. This requirement is consistent with the thrust of the DOE 5820.2A citation regarding nuclear safety but adds the requirement for a systematic assessment of functions to identify safety class and safety significant structures, systems and components. The additional rigor that is required by this 435.1 requirement is expected to lead to a higher degree of safety in the design and construction of new high-level waste facilities.

II.P.(2) Facility Design.

(b) Confinement. High-level waste systems and components shall be designed to maintain waste confinement. The following requirements apply to new or modifications to existing high-level waste systems, ancillary systems, and components:

1. Secondary confinement systems shall be designed to prevent any migration of wastes or accumulated liquid out of the waste system; shall be capable of detecting, collecting, and retrieving releases into the secondary confinement; and shall be constructed of, or lined with, materials that are compatible with the waste(s) to be placed in the waste system.

2. Tank and piping systems used for high-level waste collection, pretreatment, treatment, and storage shall be welded construction, except where remote configurations or periodic rerouting of high-level waste streams require non-welded construction.

Basis:

Functions Evaluated. This requirement is based on analyses of the functions: construct new HLW facilities (storage, pretreatment/treatment, and immobilization storage), prepare facility/site for closure as LLW disposal site, transfer calcine to storage, maintain safe storage envelope, and transfer waste to storage (slurry).

Safety and Hazard Analyses. The analyses identified potential weaknesses in the design process (failure to identify or incorporate correct and accurate design parameters into the design), as well as operational weaknesses. The operational weaknesses included failures due to aging, erosion, corrosion, and mechanical damage.

Requirements Analysis. The requirements are based on canceled DOE 6430.1A, Section 1323-5.2, 40 CFR Part 264, Subpart J and 40 CFR Part 265, Subpart J. DOE 5820.2A contained a number of citations related to, but not encompassing all of the elements of this requirement. For instance, DOE 5820.2A, Section I.3.b.(2)(a) required double containment for all new high-level waste facilities.

Other Considerations. The specific cited RCRA requirements extracted from 40 CFR Part 264 and 40 CFR Part 265 are invoked in this requirement solely to provide control and containment of the radioactive component of the waste. The double containment requirements that result from invoking the RCRA provisions also address the radiation hazard present in managing high-level waste.

II.P.(2) Facility Design.

(c) Lifting Devices. The design of hoisting and rigging devices shall comply with the following specific requirements.

1. Lifting devices that are designated as safety class or safety significant shall be designed to prevent free fall of loads.

2. Loading and unloading systems for lifting devices that are designated as safety class or safety significant shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

Basis:

Functions Evaluated. This requirement is based on the analyses of the following functions: maintain a safe storage envelope; package immobilized high-level waste; operate and maintain a high-level waste immobilization facility; operate, monitor and maintain high-level waste storage systems; and install retrieval equipment.

Safety and Hazard Analyses. The analyses identified the potential accidental release of large objects (e.g. shielding blocks, canister of vitrified high level waste; tank pump assembly) which could result in deflagrations or conflagrations, uncontrolled releases of radioactivity, and injuries/exposures to workers.

Requirements Analysis. These requirements are based on those contained in 10 CFR Part 60, paragraph 60.131 (b)(10). This requirement has no predecessor requirement in DOE 5820.2A.

Other Considerations. This requirement supports defense-in-depth, ALARA, performance-based requirements, and waste authorization basis concepts.

II.P.(2) Facility Design.

(d) Ventilation.

1. Design of high-level waste pretreatment, treatment, and storage facilities shall include ventilation through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the applicable requirements.

Basis:

Functions Evaluated. The requirement is based on the weaknesses identified during the safety and hazard analyses of the following functions: operate and monitor retrieval systems from storage; operate and monitor retrieval system from pretreatment; transfer high-level waste to storage; and maintain safe storage.

Safety and Hazard Analyses. The hazard is the release of radioactive material in airborne effluents that exceed the criteria established in 10 CFR Part 835, *Occupational Radiation Protection,* DOE 5400.5, *Radiation Protection of the Public and the Environment,* and 40 CFR Part 61 *National Emission Standards for Hazardous Air Pollutants,* which promulgates standards to implement the *Clean Air Act.* Filtration may be required during both normal and off-normal operations to meet these requirements, and a specific determination should be made through the facility safety analysis process. However, the safety and hazard analysis performed in support of DOE O 435.1 assumed ventilation to be required and identified the failure of the HEPA filter due to moisture, either from tank washing or failure to shut off steam jets, as a weakness requiring special attention during design.

Requirements Analysis. DOE 5820.2A, paragraph 1.3.b.2.f, required ventilation systems to maintain radionuclide release within published guidelines. The requirement in DOE M 435.1-1 for ventilation systems to control the release of radionuclides is essentially the same as that in DOE 5820.2A

Other Considerations. This requirement is also based on requirements in 10 CFR Part 835, *Occupational Radiation Protection,* DOE 5400.5 *Radiation Protection of the public and Environment, and* 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*. It also promotes ALARA and defense-in-depth principles.

II.P.(2) Facility Design

(d) Ventilation.

2. When conditions exist for generating gases in flammable and explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Basis:

Functions Evaluated. This requirement is based on an analysis of the function to maintain a safe storage envelope, both in storage tanks and high-level waste pretreatment/treatment facilities.

Safety and Hazard Analyses. The safety and hazards analyses identified the generation, accumulation and ignition of flammable, explosive and oxidizer gases in the high-level waste storage tank headspace as one of the highest risk scenarios resulting in uncontrolled releases, of radioactive material to the public, workers and the environment.

Requirements Analysis. This requirement is an expansion of that contained in DOE 0 5820.2A, paragraph 1.3.b.2.f. which also requires means to prevent deflagration or detonation of explosive vapors.

Other Considerations. This requirement and its accompanying guidance supports defense-in-depth by reducing the possibility of dangerous accumulations of gases, and by precluding the potential ignition of the gases. The DOE M 435.1-1 requirement and its guidance provides this greater margin of safety by requiring measures, in addition to the ventilation system itself, when conditions exist for the concentrations of gases which have accumulated in the headspace to approach the lower flammability/explosivity limits. The guidance suggests that these additional measures may consist of ventilation systems that employ a spark proof technology to preclude sources of ignition from within the ventilation system, or measures to control the concentration of the oxidant/oxygen.

II.P.(2) Facility Design

(e) Considerations of Decontamination and Decommissioning. Areas in new and modifications to existing high-level waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage, pretreatment, and treatment functions for constructing a new facility; the treatment function for closure of a pretreatment or treatment facility; and the decommissioning of all high-level waste facilities.

Safety and Hazard Analyses. The requirement addresses the need for incorporating waste generation reduction and minimization features or other design techniques, such as modular

approaches, into the design of new high-level waste management facilities. The condition identified in the safety and hazards analyses addressed by this requirement is managing the residuals from a pretreatment or treatment facility.

Requirements Analysis. The consideration of decontamination and decommissioning activities in the design of new facilities and modifications to existing facilities is an improvement to Chapter V, DOE 5820.2A, the requirement in DOE 5820.2A, Section I.3.a.(1)(b), and the requirement included in canceled DOE 6430.1A, *General Design Criteria*.

Other Considerations. This requirement was also added to promote best management practices for the entire life-cycle management of waste that will be generated from operating a high-level waste management facility. Preventing or minimizing the generation of waste is a top-level principle incorporated into DOE M 435.1-1.

II.P.(2) Facility Design

(f) Maintenance Exposure Reduction. Remote maintenance features and other appropriate techniques to maintain as low as reasonably achievable (ALARA) personnel exposures shall be incorporated into each high-level waste facility.

Basis:

Functions Evaluated. The functions evaluated which support this requirement are: operate monitor and maintain a waste storage system; transfer high-level waste to storage; transfer high-level waste to pretreatment; transfer high-level waste to treatment/immobilization facility; transfer calcined high-level waste to storage; transfer calcined high-level waste to pretreatment; transfer calcined high-level waste treatment; and prepare the facilities for closure as a low-level waste disposal site.

Safety and Hazard Analyses. The hazard and safety analyses identified numerous opportunities requiring maintenance personnel to enter high-radiation areas for operations, maintenance and inspections. The potential frequency and duration of access dictate that remote maintenance or other features necessary to minimize personnel exposures be incorporated in the design of high-level waste storage, treatment and pretreatment facilities where frequent access and/or long durations of access pose potential hazards to workers.

Requirements Analysis. This requirement is essentially the same as that contained in DOE 5820.2A, paragraph 1.3.c.(2)(g).

Other Considerations. This requirement supports the ALARA concept, and is considered a best management practice. The guidance points out that these design features must address both

internal and external sources of radiation, and that they must be controlled and tested to assure proper function.

II.P.(2) Facility Design

(g) Facilities for Receipt and Retrieval of High-Level Waste.

1. Designs for storage facilities shall incorporate features to facilitate retrieval capability.

2. High-level waste receipt and retrieval systems shall be designed to complement the existing storage facilities for safe storage and transfer of high-level waste.

Basis:

Functions Evaluated. This requirement is derived from the analyses for the following functions: operate and monitor retrieval system for pretreatment, and operate and monitor retrieval system for immobilization.

Safety and Hazard Analyses. The weakness in the analyses of both functions was an incorrect design specification that resulted in loss of confinement during retrieval.

Requirements Analysis. The origin of the requirement is taken from DOE 5820.2A, paragraph 1.3.a.(1)(c), which was expanded to include consideration of the integrity of the storage system. DOE 5820.2A, paragraph 1.3.a.(1)(c), required new storage facilities to incorporate features to facilitate retrieval capability, however, it did not require the retrieval systems to be operated and maintained for system integrity.

Other Considerations. This requirement addresses the need for a planned and integrated retrieval strategy prior to design, the design of new storage facilities to accommodate the structural loads necessary to implement the planned retrieval strategy, and the need to consider those loads in evaluating the integrity of individual storage systems. This requirement is a consideration in establishing the authorization basis for a specific storage facility, and is consistent with the requirement to employ systems engineering for decisions related to safety. These safety decisions involve containment, compatibility with interfacing equipment, structural integrity, and safe transfer operations. The requirement also supports defense-in-depth for protection of workers.

II.P.(2) Facility Design

(h) Structural Integrity. Designs for new tanks shall contribute to the confinement requirement at Section II.P.(2)(b) of this Manual by:

1. Incorporating features to avoid critical degradation modes at the proposed site where practicable, or minimize degradation rates for the critical modes; and

2. Incorporating features to facilitate execution of the Structural Integrity Program required by Section II.Q.(2) of this Manual.

Basis:

Functions Evaluated. This requirement was identified subsequent to the analysis of functions; however it is consistent with the function to maintain a safe storage envelope.

Safety and Hazard Analyses. The scenarios developed for use during the analyses did not identify medium range (or higher) consequences resulting from the loss of structural integrity, and producing minor leaks (as opposed to a more catastrophic loss of containment). Subsequently, however, actual events in the field indicated that long term releases at relative minor rates from underground storage tanks may have reached site groundwater. This would have increased the assigned risk if this information would have been known during the time the safety and hazard analyses were performed.

Requirements Analysis. This requirement and accompanying guidance are based on the work performed by Brookhaven National Laboratory and documented in their report, BNL-UC-406, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks*, January 1997. DOE 5820.2A, paragraphs 1.3.b.(3)(c), and 1.3.c.(3)(b) required that "a method for periodically assessing waste storage system integrity (e.g., coupons for corrosion testing, photographic and periscopic inspections, leak detectors, liquid level devices) shall be established, documented and reported as required in the management plan", but did not address design considerations to support structural integrity.

Other Considerations.

The DOE M 435.1-1 requirement in Section II.Q.(2) and the implementing guidance envisions a more quantitative analysis than that required by DOE 5820.2A. The new requirements require corrosion modes and rates to be identified, the remaining thickness of the tank wall to be assessed as well as the structural strength and stiffness of the concrete tanks or vaults, along with the steel shells and liners against collapse or failure from postulated normal (e.g., soil) and credible accident (e.g., earthquake, explosion) loads. Those activities are carried out after construction;

however, a knowledge of these activities are necessary to incorporate features into the design of new tanks to facilitate the in-service structural integrity program. This requirement contributes to defense-in-depth and is a best management practice.

II.P.(2) Facility Design

(i) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of high-level waste treatment, storage, pretreatment, and treatment facilities to provide volume inventory data and to prevent spills, leaks and overflows from tanks or confinement systems

Basis:

Functions Evaluated. Requirements for engineering controls stem from analyses of the following functions: transfer high-level waste to storage (slurry); and separate /reduce high-level waste fraction.

Safety and Hazard Analyses. The analyses identified two weaknesses: (1) absence of siphon break equipment, and (2) transfer line failure due to stress from expansion leading to a loss of confinement.

Requirements Analysis. This requirement is essentially the same as contained in DOE 5820.2A at paragraph 1.3.b.(2)(h), except that DOE O 435.1 also requires that these controls be part of the design of new facilities.

Other Considerations. The guidance for this requirement gives as examples of instrumentation and controls "...flowmeters, level sensing devices...anti-siphoning devices, overflow prevention features and any other ...controls that maintain sufficient freeboard within the storage unit". In addition, the guidance to this requirement states that it is invoked to support prompt detection and prevention of conditions which could lead to release of radioactive material. Thus, the requirement addresses implementation of controls that prevent the loss of confinement whereas the monitoring requirement in Section II.P.(2)(j), Volume Monitoring Systems, is intended to address detection of a loss of confinement. This requirement provides defense-in-depth for protection of workers, supports the ALARA principle, and supports the radioactive waste management basis.

II.P.(2) Facility Design

(j) Volume Monitoring Systems. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of high-

level waste storage, pretreatment, and treatment facilities to provide rapid detection of failed confinement and/or other abnormal conditions.

Basis:

Functions Evaluated. This requirement stems from an analysis of the following functions: maintain a safe storage envelope; operate, monitor, and maintain a high-level waste storage system; and maintain high-level waste pretreatment/treatment facility safe envelope.

Safety and Hazard Analyses. The analyses identified weaknesses involving failure to detect flammable gas build up in the tank dome headspace, failure to sample and test waste to establish ignition limits, and inadequate tank level monitoring. These are all weaknesses that lead to loss of confinement, and/or loss of confinement resulting from high-energy release scenarios, the most significant hazard identified in the safety and hazard analyses for high-level waste management functions.

Requirements Analysis. The requirement is based on the requirements in DOE 5820.2A at paragraph 1.3.b.(3)(a), and DRAFT DOE 5820.2B, Chapter II, paragraph 3.c.(5).

Other Considerations. The examples cited in the DOE 5820.2A requirement were deleted in keeping with the performance-based requirements concept. Examples were provided in guidance. This requirement addresses detection of system failures that could lead to the most significant consequences involving high-level waste management functions. This early detection capability is essential to mitigate the hazards and contributes to the defense-in-depth concept.

II. Q. Storage.

The following requirements are in addition to those in Chapter I of this Manual and also apply to facilities intended for management of high-level waste awaiting pretreatment, treatment or disposal, unless stated otherwise.

(1) Operation of Confinement Systems.

(a) Confinement systems shall be operated and maintained so as to preserve the design basis.

(b) Secondary confinement systems, where provided, shall be operated to prevent any migration of wastes or accumulated liquid out of the waste confinement systems.

Basis:

Functions Evaluated. This requirement is based on analyses of the following functions: prepare high-level waste facility/sites for closure as low-level waste disposal site; transfer calcined high-level waste to storage; maintain a safe storage envelope; and transfer high-level waste to storage (slurry).

Safety and Hazard Analyses. The analyses identified operational weaknesses that included failures due to aging, erosion, mechanical damage and other degradations due to failure to maintain the effectiveness of design capabilities, that could lead to loss of confinement.

Requirements Analysis. The requirements were developed, in part, from the DOE 5820.2A requirement in Section I.3.b.(2)(d), which requires secondary confinement systems to be capable of containing waste that leak in them, and, in part, to ensure the design basis for confinement systems are protected and also to maintain the radioactive waste management basis of the waste system.

Other Considerations. The key to maintaining the effectiveness of the features incorporated into the design of the confinement systems, is a knowledge of the operational assumptions incorporated into the design, and the development and use of operational procedures based on those assumptions. The guidance provides further details and examples. This requirement supports the defense-in-depth concept for worker protection.

II.Q.(2) Structural Integrity Program.

(a) Leak-Tight Tanks In-Service. **A structural integrity program shall be developed for each high-level waste storage tank site to verify the structural integrity and service life of each tank to meet operational requirements for storage capacity. The program shall be capable of:**

1. Verifying the current leak-tightness and structural strength of each tank in service;

2. Identifying corrosion, fatigue, and other critical degradation modes;

3. Adjusting the chemistry of tank waste, calibrating cathodic protection systems, wherever employed, and implementing other necessary corrosion protection measures;

4. Providing credible projections as to when structural integrity of each tank can no longer be assured; and

5. Identifying the additional controls necessary to maintain an acceptable operating envelope.

(b) In-Service Tanks that Have Leaked or Are Suspect. For each high-level waste storage tank in-service that is known to have leaked, or is suspect, a modified structural integrity program shall be developed and implemented to identify the safe operational envelope. The modified program shall be capable of:

1. Verifying the structural strength of each tank in-service which has leaked or is suspect;

2. Identifying corrosion, fatigue and other critical degradation modes;

3. Adjusting the chemistry of tank waste, calibrating cathodic protection systems, wherever employed, and implementing other necessary corrosion protection measures;

4. Determining which of the tanks that have leaked or are suspect may remain in service by identifying an acceptable safe operating envelope;

5. Providing credible projections as to when the acceptable safe operational envelope can no longer be assured; and

6. Identifying the additional controls necessary to maintain the acceptable safe operational envelope.

When physical activities, as part of a structural integrity program, pose additional vulnerabilities, alternative measures shall be implemented to provide an acceptable storage operational envelope.

(c) Other Storage Components. The structural integrity of other storage components shall be verified to assure leak tightness and structural strength.

Basis:

Functions Evaluated. This set of requirements is derived, in part, from the weaknesses identified during safety and hazard analyses of the following functions: transfer high-level waste to storage (slurry); transfer high-level waste (calcine); and maintain a safe storage envelope.

Safety and Hazard Analyses. The hazard is loss of confinement, and the weaknesses identified were aging due to corrosion, erosion and fatigue of the confinement structures.

Requirements Analysis. The requirement is based, in part, on several citations in DOE 5820.2A. These include:

> Section I.3.b.(3)(c), periodic assessments of system integrity;
> Section I.3.b.(7)(c), adjustment of waste chemistry to control corrosion;
> Section I.3.b.(2)(d), limits on the concentration of radionuclides in waste that could be transferred in singly contained pipelines;
> Section I.3.b.(2)(c), conditions for continued use of leaking storage tanks;
> Section I.3.b.(2)(g), requirements for facilities that employ cathodic protection;
> Section I.3.b.(4)(a), actions regarding tanks that have leaked;
> Section I.3.c.(2)(a), restrictions on the use of single shell tanks to receive fresh waste; and a number of complementary requirements in DOE 5820.2A under section I.3.c. for doubly contained storage systems.

The expanded set of requirements in DOE M 435.1-1 is based on the work performed by Brookhaven National Laboratory (BNL), and published in BNL-UC-406 *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks,* January, 1997. However, a significant number of high-level waste storage tanks are known to, or are suspected to leak, and cannot meet the requirements for leak tightness for the entire volume of the storage tank as envisioned in the BNL guidelines. Further, there are very limited alternatives to continuing to use some of these tanks. Therefore, the BNL derived program requirements were modified to apply to tanks that have leaked in the past, leak now, or are suspected to leak, to identify a safe operating envelope for these tanks; and to identify the controls necessary to maintain that envelope, as conditions for their continued limited use.

The authors of the BNL Document were consulted regarding the requirements for ascertaining the structural integrity for underground piping systems. They concurred that the program outlined in their report was not applicable to underground piping systems that could not be accessed. They agreed that since the piping systems are not continually in use, pressurization of the piping systems prior to each transfer provided an adequate means for implementing a structural integrity program for such systems.

The need for the requirement is based on actual occurrences where structural integrity (leak tightness, only) was lost for certain tanks. In most, if not all instances, the time period for which structural integrity of the tank could be assured was not predicted based on a formal structural integrity assessment program. Consequently, loss of containment was determined after the loss occurred, and/or the consequences were noticed. In those instances, management was placed in a reactive position to respond to a double crisis--correct the leaking situation and remediate the consequences.

The DOE M 435.1-1 requirement at Sections II.Q.(2)(a) and (b), and the implementing guidance envisions a more quantitative analysis than that required by DOE 5820.2A, in which corrosion modes and rates will be identified, tank waste chemistry is adjusted, and the time-point when structural integrity can no longer be assured is predicted. This projection affords an opportunity for management to be pro-active. In addition, the new requirement and its guidance includes an assessment of structural strength and stiffness of the concrete tanks or vaults, along with the steel shells and liners against collapse or failure from postulated normal (e.g., soil, operational, etc.,) and credible accident (e.g., earthquake, explosion, etc.) loads.

Finally, verification of leak-tightness and making credible projections as to when the acceptable safe operating envelope can no longer be assured for suspect leaking, single-shell tanks may be problematic at some sites due to their configuration, waste levels, or the risks posed in trying to do so. The requirement provides for the equivalent, necessary controls, e.g., periodic pumping to remove as much of the pumpable liquids as possible, until the waste can be removed.

Other Considerations. This requirement contributes to defense-in-depth and is a best management practice.

II.Q.(3) Waste Form Canister Storage. Canisters of immobilized High Level Waste awaiting shipment to a repository shall be:

(a) Stored in a suitable facility;

(b) Segregated and clearly identified to avoid commingling with low-level, mixed low level, or transuranic wastes; and

(c) Monitored to ensure that storage conditions are consistent with DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-level Waste Forms,* or DOE/RW-0351, *Waste Acceptance System Requirements Document,* for non-vitrified immobilized high-level waste. Facilities and operating procedures for storage of vitrified high-level waste shall maintain the integrity of the canistered waste form.

Basis:

Functions Evaluated. This requirement is based on an analysis of the following functions: operate and maintain immobilized high-level waste storage systems, and prepare immobilized high-level waste for shipment.

Safety and Hazard Analyses. The hazard is that the canistered waste will be determined to be unacceptable for shipment to the repository because it was exposed to storage conditions that would result in noncompliance with DOE/EM-0093, *Waste Acceptance Product Specification for Vitrified Waste Forms* or with DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for nonvitrified waste forms. The weakness is failure to store and maintain the canistered waste form properly, due either to equipment failure, environmental conditions or personnel errors. The safety and hazard analysis assumed that there was no facility to remediate canisters that were damaged during storage. Under this assumption the weakness also results in the creation of waste with no path forward to disposal**.**

Requirements Analysis. The origin of the requirement was section 3.c.(2)(b), Draft DOE 5820.2B.

Other Considerations. DOE 5820.2A, paragraph 1.3.d.1.b., also required the interim storage facility to comply with the requirements of DOE 5820.2A, paragraph 3b, which covers a variety of requirements related to design and construction of new facilities as well as operational requirements. However, the thrust of paragraph 3.b was not specifically to preserve the quality of the vitrified waste form. The DOE M 435.1-1 requirement supports the performance-based regulatory approach and supports EM capability to maintain the product so as to preserve its certification as meeting waste acceptance specifications contained in DOE/EM-0093.

II. R. <u>Treatment</u>.

> **Treatment shall be designed and implemented in a manner that will ultimately comply with DOE/EM–0093, *Waste Acceptance Product Specifications for Vitrified High-level Waste Forms,* or DOE/RW-0351P, *Waste Acceptance System Requirements Document,* for non-vitrified, immobilized high-level waste.**

Basis:

Functions Evaluated. This requirement is not based on functional analyses.

Safety and Hazard Analyses. This requirement is not based on safety and hazard analyses.

Requirements Analysis. This requirement is based on DOE/EM-0093, *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, and DOE/RW-0351P, *Waste Acceptance System Requirements Document*, for non-vitrified, immobilized high-level waste. Meeting the requirements contained in these two documents ensures the final waste form will be acceptable for disposal in the geologic repository managed by the Office of Civilian Radioactive Waste Management. DOE 5820.2A, paragraph 1.3.d.(1)(a), specified acceptance requirements based on 10 CFR Part 60, 10 CFR Part 71, and 40 CFR Part 191. Subsequent to the publication of DOE 5820.2A DOE/EM-0093 and DOE/RW-0351P were published. This requirement was invoked to ensure that any interim treatment step would be considered so as not to preclude the ability of the final treated waste form to comply with DOE/EM-0093 or DOE/RW-0351P.

Other Considerations. NRC has not published guides on how to interpret its waste product requirements contained in 10 CFR 60.113 or draft 10 CFR Part 63 in terms that can be applied to contracts. DOE has made its interpretation for use by the DOE high-level sites and its contractors in DOE/EM-0093 and DOE/RW-0351P. The external requirements and other DOE Orders necessary to ensure safety of treatment facilities and operations are identified and invoked in Chapter I, General Requirements and Responsibilities, of DOE M 435.1-1.

II. S. <u>Disposal</u>.

Disposal of high-level waste must be in accordance with the provisions of the *Atomic Energy Act of 1954,* as amended, the *Nuclear Waste Policy Act of 1982*, as amended, or any other applicable statutes.

Basis:

Functions Evaluated. This requirement is not based on functional analysis.

Safety and Hazard Analyses. This requirement is not based on weaknesses identified during safety and hazard analyses. Disposal of high-level waste in a geologic repository is outside the scope of DOE O 435.1.

Requirements Analysis. This requirement is based on the provisions of the *Atomic Energy Act of 1954*, as amended, and the Nuclear *Waste Policy Act of 1982*, as amended. DOE 5820.2A, paragraph I.3.D., required disposal to be in accordance with the provisions of the *Nuclear Waste Policy Act of 1982*, as amended.

Other Considerations. It is recognized that onsite disposal of high-level waste may be possible under the provisions of the *Atomic Energy Act of 1954*, as amended. However, the safety analysis and requirements analysis conducted to support DOE O 435.1 and M 435.1-1 did not evaluate disposal activities for high-level waste at a DOE site. DOE currently plans that high-

level waste be treated to meet the specifications for acceptance for disposal at a geologic repository. Onsite disposal of high-level waste is not considered consistent with that policy.

The repository is to be sited and operated by DOE, and regulated by NRC through 10 CFR Part 60. Draft 10 CFR Part 63, which will implement requirements of draft 40 CFR 197, is expected to replace 10 CFR Part 60. The NRC will license the disposal of such waste so additional requirements were not necessary.

II. T. Monitoring.

High-level waste pretreatment, treatment, storage, and transportation facilities shall be monitored for chemical, physical, radiological, structural, and other changes that could indicate failure of system confinement, integrity, or safety, and which could lead to abnormal events or accidents. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, flammable or explosive mixtures of gases, level and/or waste volume, and significant waste chemistry parameters for non-immobilized high-level waste. Facility monitoring programs shall also include physical inspections to verify that control systems have not failed.

Basis:

Functions Evaluated. The requirement is derived from the safety and hazards analysis that addressed the following functions: maintaining safe high-level waste pretreatment and storage envelopes, and operating, monitoring, and maintaining high-level waste storage systems.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of failing to detect flammable gas buildup in waste storage tanks, failing to sample and test waste storage tank contents to establish ignition limits, and inadequate waste tank level monitoring.

Requirements Analysis. The requirement is similar to the DOE 5820.2A, paragraph I.3.b.(3.)(a.), with the addition of a requirement to provide monitoring to prevent fires and explosions in pretreatment, treatment, storage and transportation facilities and the monitoring of related parameters, such as temperature and pressure, to prevent loss of confinement.

Other Considerations. These requirements address the risks of releasing radioactive materials to the environment by monitoring the conditions of the waste as well as contributing to worker protection by supporting the defense-in-depth concept. In addition, the requirement invokes RCRA requirements, for tank systems and ancillary equipment, to provide similar confinement, leak detection, and monitoring features as are required for hazardous waste. This requirement is

the operational aspect of monitoring. Specific design features that are to be incorporated in high-level waste facilities are contained in Section II.P.(2)(i).

II. U. Closure

The following requirements for closure of deactivated high-level waste sites are in addition to those in Chapter I of this Manual.

(1) Decommissioning. Deactivated high-level waste facilities/sites shall meet the decommissioning requirements of DOE O 430.1A, *Life-Cycle Asset Management* and the requirements of DOE 5400.5, *Radiation Protection of the Public and the Environment,* for release; or

(2) CERCLA Process. Deactivated high-level waste facilities/sites shall be closed in accordance with the CERCLA process as described in Section I.2.F.(5); or

(3) Closure. Deactivated high-level waste facilities/sites shall be closed in accordance with an approved closure plan as specified below. Residual radioactive waste present in facilities to be closed shall satisfy the waste incidental to reprocessing requirements of this Chapter.

(a) Facility/Site Closure Plans. A closure plan shall be developed for each deactivated high-level waste facility/site being closed that defines the approach and plans by which closure of each facility within the site is to be accomplished. This plan shall be completed and approved prior to the initiation of physical closure activities, and updated periodically to reflect current analysis and status of individual facility closure actions. The plan shall include, at a minimum, the following elements:

1. Identification of the closure standards/performance objectives to be applied from Chapter III or IV, as appropriate;

2. A strategy for allocating waste disposal facility performance objectives from the closure standards identified in the closure plan among the facilities/units to be closed at the site;

3. An assessment of the projected performance of each unit to be closed relative to the performance objectives allocated to each unit under the closure plan;

4. An assessment of the projected composite performance of all units to be closed at the site relative to the performance objectives and closure standards identified in the closure plan; and

5. Any other relevant closure controls including a monitoring plan, institutional controls, and land use limitations to be maintained in the closure activity.

Basis:

Functions Evaluated. The requirement is based, in part, on an analysis of the following functions: closure of deactivated high-level waste facilities/site as low-level waste disposal sites; and closure of deactivated high-level waste facilities/site for decontamination and decommissioning.

Safety and Hazard Analysis. The weaknesses and conditions associated with preparation of deactivated high-level waste facilities for closure include: spills of waste being removed, shipping containers leak due to poor sealing, worker exposure to high radiation while removing equipment, and release of contaminated air while backfilling systems and facilities, for closure in place. This requirement is based on the consideration that some wastes can be classified as non-high-level waste through the use of the waste incidental to reprocessing process (Section II.B). Waste that is found to be non-high-level waste can be managed and disposed in a manner that is more cost effective than management and disposal as high-level waste. While not analyzed in the hazards analysis and requirements analysis, the closure of deactivated high-level waste facilities, managed as transuranic waste disposal sites, is considered to be similar in operations and hazards.

Requirements Analysis. The first two requirements, decommissioning and use of the CERCLA process for closing deactivated high-level waste facilities, are already available and in use within the DOE Complex. The concept underlying the third requirement, Closure, is built on a related requirement that appears in DOE 5820.2A, Section I.3.d.(2), Disposal. That requirement addressed options for permanent disposal of wastes from reprocessing, such as single shell tank wastes (thought to be relatively low activity waste) by methods including in-place stabilization, especially for single tank waste that is not easily retrievable. In addition, DOE 5820.2A, Section I.3.b.(7)(b), discusses the need to develop programs that support the disposal of the separated waste from high-level waste as other waste categories, such as transuranic waste or low-level waste. In contrast, the new requirement in DOE M 435.1-1 is specifically focused on identifying waste incidental to reprocessing (DOE M 435.1-1, Section II.B) and providing for the management and disposal of those materials using processes appropriate to the relative hazard of the waste.

Other Considerations. These requirements recognize that closure of deactivated high-level waste facilities is an integral part of planning and operating a high-level waste facility and adds

defense-in-depth by providing minimal requirements for the closure actions and plans that support stability and minimization of maintenance activities. In addition, the use of the waste incidental to reprocessing determination process to allow certain waste streams to be managed as either transuranic waste or low-level waste, conserves disposal capacity for high-level waste. This requirement also supports the radioactive waste management basis requirement at Section II.F.

II.V. Specific Operations.

Specific requirements are provided for the operation of lifting devices and facilities for receipt and retrieval of high-level waste.

(1) Operation of Lifting Devices. Hoisting and rigging activities shall be conducted in accordance with the guidance provided in the DOE Standard "Hoisting and Rigging" (DOE-STD-1090-96).

Basis:

Functions Evaluated. This requirement is based on the analyses of the following functions: maintain a safe storage envelope; package immobilized high-level waste; operate and maintain a high-level waste immobilization facility; operate, monitor and maintain waste storage systems; and install retrieval equipment.

Safety and Hazard Analyses. The analyses identified the potential hazards to workers associated with the lifting and manipulation of heavy loads in areas with restricted space and reduced visibility in the presence of high-level radioactive waste, where collisions, and upset (tip-over of crane) could result in serious consequences to workers.

Requirements Analysis. These requirements are based on those contained in DOE-STD-1090-96, "Hoisting and Rigging", particularly those associated with the critical lift determinations (Section 2 of the Standard). This requirement has no predecessor requirement in DOE 5820.2A. They are mandated by this Order and Manual for high-level waste management facility operations.

Other Considerations. This requirement supports defense-in-depth, ALARA, and performance-based requirements, and waste authorization basis concepts.

II.V.(2) Operation of Facilities for Receipt and Retrieval of High-Level Waste. High-level waste receipt and retrieval systems shall be operated and maintained consistent with high-level waste system features incorporated in the facilities. Strategies for retrieval of waste shall be analyzed to ensure that structural and radiological impacts are consistent with the facility design basis.

Basis:

Functions Evaluated. The requirement is based on an analysis of the following functions: prepare facility/sites for closure as a low-level waste disposal site; transfer calcined high-level waste to storage; maintain a safe storage envelope; and transfer high-level waste to storage (slurry).

Safety and Hazard Analyses. The hazard is the potential loss of confinement. The analyses identified operational weaknesses that included failures due to aging, erosion and mechanical damage.

Requirements Analysis. The requirement is complementary to that contained in DOE M 435.1-1 Section II.P.(2)(b), and is intended to assure that features and operability capabilities incorporated into the design of confinement systems are maintained during the operational period. This requirement incorporates the requirement in DOE 5820.2A section I.3.b.(2)(d)**.**

Other Considerations. This requirement contributes to defense in depth, and supports ALARA, performance-based requirements, and waste authorization basis concepts.

BASIS FOR REGULATION OF TRANSURANIC WASTE

The Department of Energy DOE 5820.2A, *Radioactive Waste Management*, issued in September 1988, assumed that transuranic waste would be disposed at the Waste Isolation Pilot Plant (WIPP), except for the buried transuranic waste which would be managed in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act* and the *Superfund Amendments and Reauthorization Act*. Since the issuance of DOE 5820.2A, the need to comply with a series of regulatory requirements has contributed to the focus and content of the revised Radioactive Waste Management Order, DOE O 435.1. The primary paradigm shifts from 1988 to the present DOE O 435.1 requirements are the addition of significant external oversight and regulation, and a broader view of DOE transuranic waste management program rather than primarily on the WIPP.

In September 1988, the opening of WIPP for receipt of transuranic waste was assumed to be imminent. The WIPP had been authorized by Congress in 1979 for the purpose of providing a research and development facility to demonstrate the safe disposal of transuranic radioactive wastes resulting from defense program activities. The law specifically referred to defense wastes, thereby exempting involvement by the Nuclear Regulatory Commission in the project. In 1988, the WIPP facility had been constructed, procedures written, and waste was expected to be shipped to WIPP at that time.

DOE 5820.2A was written with a clear focus on WIPP requirements and on WIPP as the primary disposal facility for transuranic waste. It indicated that DOE would be the regulator to decide for or against permanent disposal at the end of the WIPP operations demonstration period. If the decision were against using WIPP as the permanent repository, the stored waste would be retrieved, repackaged, and handled as directed by DOE. The Order was very detailed in describing how the waste is to be packaged, characterized, certified, stored, and shipped to WIPP for disposal.

At the time the DOE order was issued in 1988, the WIPP was being delayed primarily because of issues regarding the *Federal Land Policy and Management Act* (FLPMA). The FLPMA of 1976 had been established to ensure that public lands are managed in a way that protects the quality of the environment. The WIPP site is on public land that at that time was under the jurisdiction of the Bureau of Land Management (BLM). The site validation investigations and construction of the WIPP were conducted by the DOE under two successive administrative land withdrawals, neither of which permitted the receipt and storage of transuranic waste or transuranic mixed wastes at WIPP. In 1987, the first of many bills that would permanently withdraw the WIPP site from the operations of the public land laws and transfer the administrative authority for the land from the Department of Interior (DOI) to DOE was introduced into Congress. However, as described below, the legislation required for land withdrawal became complicated by issues associated with compliance with the *Resource Conservation and Recovery Act* requirements (40 CFR Parts 260-280); Environment Radiation Protection Standards for Management and Disposal

of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes (40 CFR Part 191); and other issues. As a result, the *WIPP Land Withdrawal Act* enacted in 1992 became a vehicle establishing the regulatory framework for transportation and disposal of transuranic waste at WIPP.

The *Resource Conservation and Recovery Act* (RCRA), enacted in 1976, was to address the growing problems associated with solid waste disposal, specifically those wastes that are hazardous to public health and the environment. Until the mid 1980s, it had been believed that RCRA did not apply to radioactive wastes contaminated with hazardous constituents. The wastes destined for WIPP were not considered regulated under RCRA due to the byproduct material exemption. Under the definition of byproduct material in the *Atomic Energy Act of 1954*, as amended, both the hazardous and the radioactive components of transuranic waste were considered as a whole, to be byproduct material. In 1987, the DOE issued an interpretive rule that byproduct material includes only the radioactive portion of the wastes, thereby subjecting the hazardous waste components to RCRA requirements. The aspect of this decision that had the most impact on WIPP was the land disposal restrictions (40 CFR Part 268), enacted in 1980 through the *Hazardous and Solid Waste Amendments Act*, which prohibits the land disposal of hazardous waste unless the wastes meet treatment standards or if the owner/operator can demonstrate to a reasonable degree of certainty that there will be no migration of hazardous constituents from the disposal unit.

As a result of the *Nuclear Waste Policy Act of 1982*, as amended, the EPA promulgated 40 CFR Part 191, *Environment Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes,* in 1985. These requirements govern the performance of a repository for transuranic waste disposal. In 1987, the U.S. Court of Appeals for the First Circuit struck down a portion of the requirements because EPA had not adequately explained certain inconsistencies between the disposal standards and the agency's safe drinking water standards.

Since DOE 5820.2A, *Radioactive Waste Management*, was issued in 1988, the regulatory requirements for management of transuranic waste have significantly changed because of the resolution of these regulatory issues. In 1992, Congress passed the *WIPP Land Withdrawal Act* to withdraw the land for WIPP. Among other important features, the law transferred the land from the DOI to the DOE, established a test phase, required compliance with 40 CFR Part 191, and required the EPA Administrator to determine compliance with the disposal requirements. The Act mandated that EPA issue criteria for evaluating DOE's compliance demonstration with 40 CFR Part 191. The EPA met this requirement on February 9, 1996, with the publication of 40 CFR Part 194, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations.*

In 1992, Congress passed amendments to the *Solid Waste Disposal Act*, entitled the *Federal Facility Compliance Act*, which required DOE to prepare plans for developing treatment

capacities and technologies for mixed waste. Pursuant to this Act, DOE prepared site-specific treatment plans, and consent orders or agreements have been reached with the affected states and the EPA. These consent orders and agreements typically specify how and when transuranic wastes which also contain a RCRA-regulated hazardous component are to be retrieved, characterized, treated, certified to the WIPP waste acceptance criteria, and then stored or shipped for disposal at WIPP. This process has involved many stakeholder groups and different regulatory entities.

In 1996, Congress passed amendments to the 1992 *WIPP Land Withdrawal Act* which primarily deleted the test phase and removed the hazardous waste land disposal prohibitions of RCRA (no migration variance and treatment requirements). Consequently, transuranic waste containing hazardous waste constituents does not need to be treated in accordance with the treatment standards to allow its disposal. However, WIPP must still comply with the RCRA requirements of the state of New Mexico pursuant to the *New Mexico Hazardous Waste Act of 1978*.

The Transuranic Waste Requirements chapter of the *Radioactive Waste Management Manual*, DOE M 435.1-1, is consistent with the legislation and requirements associated with the certification and operation of WIPP. However, unlike DOE 5820.2A, the current requirements do not unduly focus on the details and requirements of WIPP-specific operations. Instead, the requirements for management of transuranic waste have been prepared to apply to a broader range of management functions, from generation, through treatment and storage, to disposal. The previously detailed requirements related to preparing and disposing of waste at WIPP are now addressed by higher level, performance-based requirements.

The following pages explain the basis for the transuranic waste management requirements included in DOE M 435.1-1.

CHAPTER III

TRANSURANIC WASTE REQUIREMENTS

III. A. Definition of Transuranic Waste.

Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for:

(1) High-level radioactive waste;

(2) Waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or

(3) Waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Basis:

Functions Evaluated. This requirement relates to the very top level function, that is, manage transuranic waste. All of the other functions, and therefore all of the transuranic waste management requirements apply only to the management of waste determined to meet the definition of transuranic waste.

Safety and Hazard Analyses. Although no specific safety or hazard was associated with identifying waste as transuranic waste, accurate determination of the waste type is necessary to ensure that it is managed and disposed of in accordance with the applicable requirements which are based on an analysis of safety and hazards associated with subordinate functions.

Requirements Analysis. The definition of transuranic waste was taken from the *Waste Isolation Pilot Plant Land Withdrawal Act,* as amended, and is consistent with the definition in 40 CFR Part 191, *Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*. The current definition is consistent with the basic elements of the definition in DOE 5820.2A, but differs in a couple of details. The previous definition specified that the determination of whether a waste was transuranic waste was made at the time of assay, but did not specify when the assay was to be performed. As a consequence, there was ambiguity regarding the type of waste if treatment changed the concentration after an assay had been performed. The current definition does not specify when the determination is to be made, but the supporting guidance clarifies that it is to be

made when the waste is certified as meeting the waste acceptance criteria of a facility to which it is being transferred. The past definition also allowed Heads of Field Elements to determine that other alpha contaminated wastes must be managed as transuranic waste. This provision no longer exists for the reason explained below.

Other Considerations. The Department is legislatively constrained by the *Waste Isolation Pilot Plant Land Withdrawal Act* to disposing only defense transuranic waste at the Waste Isolation Pilot Plant. The term transuranic waste is defined in the legislation, so there is no latitude for disposing of waste in the Waste Isolation Pilot Plant if it does not meet that definition. Since the legislation removes disposal at the Waste Isolation Pilot Plant as an option for Field Element Manager-proclaimed transuranic wastes, there is no waste management benefit of declaring them to be transuranic waste.

III. B. <u>Management of Specific Wastes</u>.

The following provide for management of specific wastes as transuranic waste in accordance with the requirements in this Chapter:

(1) Mixed Transuranic Waste. Transuranic waste determined to contain both a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, and a radioactive component subject to the *Atomic Energy Act of 1954,* as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) TSCA-Regulated Waste. Transuranic waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act,* as amended, DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(3) Pre-1970 Transuranic Wastes. Transuranic waste disposed of prior to implementation of the 1970 Atomic Energy Commission Immediate Action Directive regarding retrievable storage of transuranic waste is not subject to the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Basis:

Functions Evaluated. This requirement does not derive from the analysis of any specific functions. Mixed transuranic waste is a subset of transuranic waste and is thereby included in all of the waste management functions analyzed.

Safety and Hazard Analyses. The regulation of mixed transuranic waste in accordance with the applicable requirements of the *Resource Conservation and Recovery Act* (RCRA) was an underlying assumption in the safety and hazard analysis. Part of this assumption was that the applicable Federal or State requirements which implement RCRA provide adequate protection from the hazardous waste components. Similarly, the controls provided by *Toxic Substances Control Act* (TSCA) requirements for the management of polychlorinated biphenyls and other materials regulated by TSCA were assumed to be adequate.

Requirements Analysis. The Mixed Transuranic Waste requirement is comparable to the policy stated in DOE 5820.2A, Chapter II.1 with respect to management of mixed transuranic waste. Additional language has been added that specifies transuranic waste mixed with TSCA-regulated materials shall also be managed in accordance with the requirements implementing TSCA. The Pre-1970 Transuranic Waste requirement is consistent with how EPA applies disposal requirements in 40 CFR Part 191. The disposal standards do not apply to previously disposed waste unless it is retrieved.

Other Considerations. The additional language regarding management of certain wastes in accordance with TSCA was added as a result of a review identifying this as a gap in the requirements. The additional language was therefore added to the transuranic, high-level, and low-level waste management chapters of the Manual.

III. C. <u>Complex-Wide Transuranic Waste Management Program</u>.

A complex-wide program and plan shall be developed as described under *Responsibilities*, 2.B and 2.D, in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level functions of transuranic waste management, i.e., formulate, execute, and evaluate the transuranic waste management program.

Safety and Hazard Analyses. This requirement addresses the need for an integrated and documented complex-wide program for planning, executing, and evaluating the activities necessary to safely manage transuranic waste. The requirement addresses the potential

weaknesses and conditions associated with failure to prepare and document program assumptions and uncertainties, prepare a strategic plan, identify organizational roles and responsibilities, identify and provide a point of coordination for research and development, and evaluate program progress. All of these activities promote protection of the public, workers and the environment by enabling the Department to make the most effective use of its waste management resources.

Requirements Analysis. The requirement for a complex-wide transuranic waste management program and program plan has no equivalent requirement in DOE 5820.2A. Inclusion of a requirement for a complex-wide program and program plan is an improvement over DOE 5820.2A which assigned individual Program Secretarial Officers responsibility for managing waste under their purview, but required no coordination across the DOE sites and Headquarters Offices.

Other Considerations. Establishing a requirement for central coordination of the Transuranic Waste Management Program is consistent with the Department's present practice for managing transuranic waste. Under the current practice, Headquarters has delegated responsibility for planning and implementing the transportation to and disposal of waste at WIPP to a central organization, the Carlsbad Area Office. Consistent with this responsibility, the Carlsbad Area Office has prepared a Transuranic Waste Management Program Plan that focuses on the disposal of defense transuranic waste. Inclusion of this requirement will perpetuate the maintenance of a plan addressing this key element of the transuranic waste management program and ensure that the plans are developed for management of the balance of the transuranic waste.

III. D. <u>Radioactive Waste Management Basis</u>.

Transuranic waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, disposal authorization statement, waste acceptance requirements, and monitoring plan.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level waste management functions of Formulate, Execute, and Evaluate a waste management program.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions associated with a lack of or poor integration of documents, programs, and controls important to radioactive waste management (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or accountability at the highest management positions for ensuring the most important requirements for the safe management of waste will be met.

Requirements Analysis. The requirements for a radioactive waste management basis for transuranic waste management facilities and activities have no comparable requirements in DOE 5820.2A. The radioactive waste management basis for a facility or activity includes formal approval at the site level of transuranic waste management operations, and ensures that programs and activities established to meet other requirements are being coordinated and integrated as necessary with activities needed to meet DOE O 435.1 requirements. The radioactive waste management basis concept employs the same principles as the authorization basis for DOE facilities carried out under DOE 5480.21, facility licensing carried out by the NRC, facility permitting done by the EPA and state agencies. Whereas an EPA permit or NRC license application would be required to compile all necessary information in a single summary document, documentation of the controls which constitute the radioactive waste management basis do not need to be assembled in a single document. The intent is that the controls are documented and that the site personnel know what they are, where they are, and how they work together to provide protection of the public, workers, and the environment, but, it was decided that additional work for the sole purpose of compiling the information into a single, license application-like document was unwarranted.

Other Considerations. The concept for the radioactive waste management basis derives in part from the weaknesses or vulnerabilities identified as a result of the Defense Nuclear Facilities Safety Board Recommendation 94-2 addressing low-level waste management. The Board commented on the failure of the Department to complete the performance assessment review process for low-level waste disposal facilities. In addition, the Department performed a Complex-Wide Review of low-level waste management activities and identified conditions that would be improved (e.g., poor storage conditions) by requiring that a formal confirmation that the controls necessary for safe operations are in place. The concept of the radioactive waste management basis was extended to the other waste types as a best management practice. The radioactive waste management basis also provides a degree of defense in depth in the administration of waste management by requiring a confirmation that a facility or operation is adhering to applicable requirements. The radioactive waste management basis concept being employed is performance

based and uses the graded approach, so the rigor of documentation is commensurate with the hazards and safety implications of activities carried out at a given facility.

III. E. Contingency Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage. For off-normal or emergency situations involving liquid transuranic waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated transuranic waste contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of liquid waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Basis:

Functions Evaluated. This requirement was derived from hazards identified in the high-level waste safety and hazard analyses, and is based on evaluations of the functions to operate, monitor, and maintain storage systems.

Safety and Hazard Analyses. The analyses identified a weakness associated with the inability to take mitigative actions in the event of a leak from a facility processing or storing liquid potentially significant consequences from leaking storage tanks without adequate spare capacity and adequate transfer equipment.

Requirements Analysis. This requirement is based on high-level waste requirements contained in 5820.2A, paragraph 1.3.b.(4)(d), and draft 5820.2B, chapter II paragraph 3.c.(3)(g).

Other Considerations. During the review of draft DOE O 435.1, requirements were identified from other waste types that were considered relevant to the management of transuranic waste. The readily available capability to respond to emergency situations involving loss of confinement supports the defense-in-depth concept, protection of workers and the environment, and the radioactive waste management basis.

III. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual are met.

(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Basis:

Functions Evaluated. These requirements derive from the analysis of the top-level functions of Plan, Execute, and Evaluate the Transuranic Waste Management Program.

Safety and Hazard Analyses. The requirement addresses the need for conducting evaluations (oversight, inspections, reviews, etc.) of the transuranic waste management activities that are important to protection of the public, workers, and the environment, and for correcting situations which are not being conducted in accordance with Order and/or Manual requirements. This first subrequirement addresses a weakness of any requirement where lapses in attention result in a failure to implement requirements intended to provide protection of the public, workers, and the environment. The second subrequirement addresses the hazards associated with failure to operate facilities and conduct activities in accordance with an established set of controls, the radioactive waste management basis. Curtailing or shutting down operations provides interim controls of potential hazards until the corrective actions can be fully implemented. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor documentation or integration of documentation of the evaluations that demonstrate radioactive waste management controls are sufficient which collectively make up the radioactive waste management basis for a facility.

Requirements Analysis. Corrective actions were not explicitly required in DOE 5820.2, however, the Order did invoke DOE O 414.1, Quality Assurance which does have requirements for corrective actions. Similarly, existing requirements for corrective actions in quality assurance directives serve as a model for the current requirements. The authorization basis concept of DOE 5480.21 and its implementation were utilized as a basis for the concept of radioactive waste management basis. Corrective actions are used by the NRC in reactor licensing for dealing with situations that could be inimical to public health and safety, however, no additional essential requirement language was derived from those requirements.

Other Considerations.

The radioactive waste management basis, and the use of corrective actions to correct situations where the basis is not being met is partially derived from system engineering which was done for the low-level waste management program which showed the need for accountability to demonstrate requirements are being met. The requirement was invoked for transuranic waste management as a best management practice. The use of corrective actions is consistent with implementation of the Integrated Safety Management System and the use of feedback mechanisms to determine measurable improvement of programs.

III. G. <u>Waste Acceptance</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Technical and Administrative. Waste acceptance requirements for all transuranic waste storage, treatment, or disposal facilities, operations, and activities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides;

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal;

(c) Restrictions or prohibitions on waste, materials, or containers that may adversely affect waste handlers or compromise facility or waste container performance;

(d) Requirement to identify transuranic waste as defense or non-defense, and limitations on acceptance; and

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements, which shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Basis:

Functions Evaluated. This requirement derives from the functions for receiving waste for storage, treatment and disposal, and functions for establishing waste acceptance criteria and ensuring compliance with waste acceptance criteria.

Subrequirement (d) derives from the analysis of characterization and disposal functions related for transuranic waste.

Safety and Hazard Analyses. The requirement addresses the need for establishment of waste acceptance criteria by treatment, storage, and disposal facilities and it ensures that the requirements of the waste acceptance criteria are met at the receiving facility. The requirement was developed to mitigate hazards associated with receiving incompatible or unexpected waste types either through human error or method/information failure which could lead to exposure or injury to workers, loss of containment of waste, or operation of the facility beyond its authorization basis.

The subrequirement (d) reduces the potential for redundant handling of waste packages resulting from the inability to easily determine whether the waste is defense (eligible for disposal at WIPP) or non-defense waste.

Requirements Analysis. There are no similar requirements for developing waste acceptance criteria for transuranic waste in 5820.2A, however similar requirements are in the low-level waste section of 5820.2A, Chapter III.3.e.(1) through (5). Current DOE radioactive waste management facility waste acceptance criteria were evaluated for additional essential waste acceptance criteria.

There is no requirement in 5820.2A that specifically correlates with subrequirement (d) referring to defense or non-defense transuranic waste. However, 5820.2A, Chapter II.3.e.2 requires that certified waste not be commingled with noncertified waste. The requirement is similar since transuranic waste from defense related activities can be certified for disposal at WIPP, and non-defense waste cannot be certified for disposal at WIPP.

Other Considerations. The requirements found in 5820.2A and current DOE facility WAC were made performance-based and consolidated into requirements for acceptable waste. Implementation guidance includes discussions of the specific restrictions and allowances found in those other sources of requirements that were evaluated. Effective waste acceptance experience at DOE facilities establishes these criteria as best management practice for waste acceptance requirements.

Subrequirement (d) is derived from the *WIPP Land Withdrawal Act* limitation that WIPP only accept transuranic waste from defense related activities. The requirement is based on General

Counsel's review of Congressional legislation affecting WIPP and is referenced in the DOE G 435.1 guidance corresponding to this requirement.

III. H. Waste Generation Planning.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all transuranic waste streams.

(2) Waste With No Identified Path to Disposal. Transuranic waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for pre-certifying waste, providing forecast data, and approval of generator processes by the receiving facility.

Safety and Hazard Analyses. The requirement addresses the need for generators, and treatment, storage, and disposal facilities to know more about wastes requiring management prior to their generation, to prevent the generation of waste streams that may not have a path forward to disposal, and to implement an authorization for generation of no path forward waste. Specific weaknesses and conditions addressed are the generation of waste that cannot be certified or accepted at a management facility, with no disposal option, or that taxes the capacity of a waste management facility. The requirement addresses a weakness that parallels a vulnerability identified in the *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities*.

Requirements Analysis. The requirements have no direct predecessor transuranic waste requirements in DOE 5820.2A. DOE 5820.2A low-level waste requirement III.3.b.(2) calls for an overall waste management systems performance assessment and Chapter VI calls for a waste

management plan. These requirements and the concepts they embody have been significantly modified in DOE M 435.1-1 to clarify the focus of these activities on the life-cycle of transuranic waste streams rather than on information about facilities managing and achievements in characterization, treatment, storage, and disposal as separate activities. These requirements in DOE M 435.1-1 emphasize planning rather than an assessment of the system performance. The requirements of DOE O 430.1A were evaluated and determined to be adequate for life-cycle planning for radioactive waste management facilities and other assets, but not adequate with respect to planning for the management of the waste streams themselves.

Other Considerations. The concepts of life-cycle planning prior to generation and approval to generate provide defense-in-depth by ensuring that a generation process will be designed and/or modified such that the waste generated can be certified and can be managed at appropriate storage, treatment, and disposal facilities. The requirement addressing waste with no path to disposal is included to ensure that such waste is generated only after careful consideration and an explicit acknowledgment that the waste will be stored safely pending resolution of the issues preventing disposal.

III. I. <u>Waste Characterization</u>.

Transuranic waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions in the receipt, storage, treatment, and disposal of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of receiving poorly or un-characterized waste, waste requiring additional management as mixed or remotely-handled waste, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility because of its containment breach potential, and waste that would adversely affect the performance of a disposal facility.

Requirements Analysis. This requirement expands and improves on the requirement in 5820.2A, Chapter II.3.b.2, with the allowance that waste characteristics may be determined by non-destructive methods as long as positive correlation can be established between the non-destructive methods and the intrusive or direct methods. This requirement was derived from authors and comments on the draft which specified that the cost saving approach of non-destructive examination ought to be allowed and encouraged for characterization of waste.

Other Considerations. Use of indirect methods to characterize the waste significantly reduces the cost of any sites' certification program. This is a best management practice to reduce the overall cost to DOE and the generator. Correlation of indirect to direct methods is a measure of defense-in-depth for certification of waste to the acceptance criteria of the receiving facility.

III. I.(1) Data Quality Objectives. The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Basis:

Functions Evaluated. This requirement is based on an analysis of generator functions as they relate to the receipt, storage, treatment, and disposal of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of receiving poorly characterized waste, waste requiring additional management as mixed waste, waste exceeding waste acceptance criteria limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, and waste that would adversely affect the performance of a disposal facility. The requirement addresses potential weaknesses in transuranic waste characterization that are similar to those identified in the Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities.

Requirements Analysis. This requirement expands on the requirement in DOE 5820.2A, II.3.b.2, with the addition of the data quality objective (DQO) or a similar process to correctly establish a waste characterization program. Application of the DQO process yields data that are appropriate and commensurate with the decisions that are being made using the data. Guidance from the Environmental Protection Agency was used as a source for the elements of a DQO or similar process.

Other Considerations. The additional language is derived from language provided by commenters on draft versions of the requirements. Application of a data quality objectives or similar process is supportive of ALARA since the characterization design is established and optimized before effort is expended in acquiring characterization data. This avoids having to re-characterize waste or spend additional time in collecting unneeded information. It also provides a mechanism for ensuring information necessary to support the performance assessment evaluations that are used to demonstrate that disposal facility performance objectives are expected to be met. At DOE-complex sites where characterization requirements have been developed and refined, the use of data quality objectives and an appropriate quality assurance program were essential to its success.

III. I.(2) Minimum Waste Characterization. Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any stabilization or absorbent media;

(c) Weight of the container and contents;

(d) Identities, activities, and concentrations of major radionuclides;

(e) Characterization date;

(f) Generating source;

(g) Packaging date; and

(h) Any other information which may be needed to prepare and maintain the disposal facility performance assessment or demonstrate compliance with applicable performance objectives.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions in the receipt, storage, treatment, and disposal of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of receiving poorly or un-characterized waste, waste requiring additional management as mixed or remotely-handled waste, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility because of its containment breach potential, and waste that would adversely affect the performance of a disposal facility.

Requirements Analysis. This requirement expands on the requirement in 5820.2A, Chapter II.3.b.2, with the addition of specific minimum waste characteristics needed to manage transuranic waste during its life cycle.

Other Considerations. Specific minimum waste characteristics are provided by authors and commenters on drafts of the requirements that are interested in applying best management practices and in keeping radiation exposure as low as reasonably achievable. At DOE-complex sites where these life cycle phases of transuranic waste management are being executed or

planned, the waste characteristics listed have been determined to be the most important and useful to the successful management of the waste.

III. J. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving transuranic waste for storage, treatment, or disposal are met.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to ship only waste certified to meet the waste acceptance criteria of the receiving treatment, storage, or disposal facility. The requirement addresses weaknesses and conditions of receiving uncharacterized waste, waste exceeding WAC limitations, waste requiring additional management due to mis-certification, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility.

Requirements Analysis. The requirement is similar to part of the requirements in 5820.2A, Chapter II.3.C.1 and II.3.C.3., calling for waste to be certified to a prepared waste certification program. Specific reference to the Waste Isolation Pilot Plant (WIPP) has been removed and placed in guidance as a representative example. Current requirements established in the WIPP waste certification plan were used in the evaluation for essential requirements in waste certification.

Other Considerations. None.

III. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions that could arise from uncertified waste, poorly characterized waste, or waste containing unacceptable materials, particularly caused by poor certification documentation and recordkeeping.

Requirements Analysis. The requirement replaces authority and auditability requirements established in DOE 5820.2A, Chapter II.3.C.4 through II.3.C.10. The requirement removes specific involvement of the Waste Acceptance Criteria Certification Committee at WIPP, and the Environmental Evaluation Group with the State of New Mexico, as final certification authority for shipment of waste to WIPP. The requirement establishes recordkeeping requirements considered essential for waste certification activities.

Other Considerations. The requirement was derived from best management practices utilized in successful waste certification programs at DOE generator facilities, and from experience of DOE facilities receiving waste from many differing generators. The requirement provides defense-in-depth for waste certification documentation. Best management practices entail the identification of a single official and an alternate, who have the authority to certify that transuranic waste meets the acceptance criteria of the receiving facility. To ensure that proper documentation and recordkeeping are in place to retain waste characterization data at its origin is considered defense-in-depth.

III. J.(2) Certification Before Transfer. Transuranic waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions that could arise from allowing receipt of uncertified waste, poorly characterized waste, or waste containing unacceptable materials.

Requirements Analysis. This requirement did not originally exist in DOE 5820.2A for transfer of transuranic waste. The requirement was added from generator comments on the draft of DOE O 435.1. Comments specified that generators' waste be certified as meeting the receiving facility's waste acceptance criteria and that this certification take place prior to its transfer to the receiving facility.

Other Considerations. This requirement adds defense-in-depth to the controls over the most vulnerable part of the waste management system, namely when waste is transferred. This requirement appropriately places the burden on the generator to ensure that the waste meets the receiving facility waste acceptance criteria.

III. J.(3) Maintaining Certification. Transuranic waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses weaknesses and conditions of failing to manage the waste at a treatment or storage facility such that it will lose its certification prior to transfer to the next phase in its life cycle. These actions include: failing to monitor and inspect the waste such that release of radioactive or hazardous materials is allowed; abusive handling such that the containment boundary of the waste package is compromised and must be replaced; and failing to manage certification documentation such that records are lost or destroyed.

Requirements Analysis. The requirement is an expansion of 5820.2A, Chapter II.3.e.2., calling for management of transuranic waste in such a fashion that certified waste is not commingled with uncertified waste. In addition, the waste must be controlled, inventoried and records maintained such that its original certification may be preserved.

Other Considerations. None.

III. K. Waste Transfer.

A documented process shall be established and implemented for transferring responsibility for management of transuranic waste and for ensuring availability of relevant data. The following requirements are in addition to those in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement is based on analyses of all functions associated with waste management. All of these functions require an individual to have responsibility for knowing what is in a waste container and maintaining control over what happens to the container.

Safety and Hazards Analysis. The requirement addresses the weakness or condition of maintaining inadequate controls over waste containers for which one is responsible. This can result in unallowable materials being introduced into a waste container and not being acknowledged on the information passed along when the container is transferred. The result is a potential hazard from receiving and managing containers with unknown waste contents. This could result in excess exposure to workers or in releases which could affect workers, the public, or the environment.

Requirements Analysis. This requirement is one of several which improve on DOE 5820.2A, Chapter II.3.e.3. This requirement, along with I.1.E.(16) and III.J.(3) of DOE M 435.1-1, more thoroughly address the need to prevent unauthorized access to transuranic waste when in storage.

Other Considerations. None.

III.K.(1) Authorization. Transuranic waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal. The requirement also derives from the function that the waste must be verified that it meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a process for assuring that generators meet waste acceptance criteria of storage, treatment, and disposal facilities and that receiving facilities verify that the acceptance criteria are met before the waste is

received. Specific weaknesses and conditions addressed are receipt of uncertified waste, poorly characterized waste, or waste containing unacceptable materials.

Requirements Analysis. The requirement is an improvement to DOE 5820.2A Chapter II.3.c.5. which addresses specific authorization by the Waste Acceptance Criteria Certification Committee for waste transfers to WIPP. This requirement no longer specifies WIPP but generically identifies the generator and receiving facility.

Other Considerations. Authorization by receiving facilities for transfer provides defense-in-depth when waste is transferred, which is the most vulnerable period in the waste's life cycle.

III. K.(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for transuranic waste shall be transferred with or be traceable to the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of all functions in the transuranic waste management system. Waste data were required input into every subsequent function from the previous function.

Safety and Hazard Analyses. The requirement addresses the need for maintaining accurate characterization data at all stages of the waste management process for transuranic waste from generation through post-disposal. Specific weaknesses and conditions include losing knowledge about waste at any step of the waste management process. Particularly vulnerable stages of the process include transfers, transportation, when treatment changes the waste form, when repackaging occurs, and when storage lasts longer than anticipated.

Requirements Analysis. The requirement is one of several which improve the requirement identified in DOE 5820.2A, Chapter II.3.f.(3), on shipping papers and waste manifests. The analysis of the waste manifest requirement indicated that it was too restrictive (language limited use of manifests to when there was a package). The requirement needed to ensure that maintaining characterization and packaging data, applies to all functions. The manifesting requirements of 10 CFR Part 20 were evaluated, and found to be too restrictive since it was limited to offsite disposal of transported waste.

Other Considerations. The requirement reflects a change to a performance based requirement that applies to all functions rather than a limited set. The principle of ALARA is supported by this requirement in preventing re-certification or re-characterization of waste, or doing unnecessary sampling and analysis, if all characterization data are properly maintained and transferred.

III. L. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging.

(a) Transuranic waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste is removed from the container.

(b) Vents or other mechanisms to prevent pressurization of containers or generation of flammable or explosive concentrations of gases shall be installed on containers of newly-generated waste at the time the waste is packaged. Containers of currently stored waste shall meet this requirement as soon as practical unless analyses demonstrate that the waste can otherwise be managed safely.

Basis:

Functions Evaluated. These requirements are based on evaluations of the packaging and transportation functions (called waste disposition in the functions analysis) associated with waste generation, characterization, treatment, storage, off-site transportation, and disposal.

Safety and Hazard Analyses. In the safety and hazards analyses the loss of container integrity and the subsequent exposure of workers or the public and releases to the environment are associated with using an inappropriate container for the type of waste being packaged. These hazards could result from weaknesses or conditions associated with lack of systematic processes, lack of personnel training, and radiological decomposition of materials within waste containers.

Requirements Analysis. The requirements for packaging are improvements, updates, consolidations, and additions to packaging requirements in DOE 5820.2A, requirement II.3.d.3. This DOE M 435.1-1 requirement refers to Chapter I, General Requirements and Responsibilities, which invokes DOE O 460.1A, *Packaging and Transportation Safety*, and DOE O 460.2, *Departmental Materials Transportation and Packaging Management*, which address transportation of radioactive materials. These two DOE orders in turn refer to the Department of Transportation requirements addressing packaging and labeling of materials (including radioactive materials) for transport on public roadways. Through the safety and hazards analysis, requirements analysis, and subsequent analyses in the development of DOE M 435.1-1, the packaging requirements were identified as either not adequately covered in existing requirements or warranting emphasis in the Manual.

Other Considerations. The final language in the requirement is partially in response to comments received on draft versions of DOE O 435.1 and DOE M 435.1-1. Venting of transuranic waste packages is required for transportation in TRUPACT II. However, DNFSB comments on the draft Manual noted that the hazards associated with pressurization during transportation can also occur in storage or other waste management steps. Therefore, venting of containers was added as a requirement with the allowance that a facility may, through a technical evaluation such as its safety analysis report, demonstrate that vents are not necessary for safe storage of the waste.

III. L.(1)(c) When transuranic waste is packaged, defense waste shall be packaged separately from non-defense waste, if feasible.

Basis:

Functions Evaluated. This requirement is based on the analysis of storage functions as they related to final disposition of transuranic waste.

Safety and Hazard Analyses. The requirement reduces the potential for redundant handling of waste packages resulting from unclear markings as to being defense (eligible for disposal at WIPP) or non-defense waste.

Requirements Analysis. There is no requirement in DOE 5820.2A specifically referring to segregation of defense or non-defense transuranic waste. However, DOE 5820.2A, requirement II.3.e.2 requires that WIPP-certified waste not be commingled with noncertified waste. The requirement is similar since transuranic waste from defense related activities can be certified for disposal at WIPP, and non-defense waste cannot be certified for disposal at WIPP.

Other Considerations. A key source of requirements affecting transuranic waste management is the *Waste Isolation Pilot Plant Land Withdrawal Act*, as amended. This legislation authorizes WIPP, upon receiving the necessary certification, to dispose of defense transuranic waste. Consistent with this legislation, a requirement was added to the Manual to require that defense and non-defense waste be packaged separately when waste is packaged. This requirement is consistent with the DOE Office of General Counsel's review and interpretation of Congressional legislation affecting WIPP (Memorandum, R.R. Nordhaus to A. Alm and G. Dials, *Interpretation of the Term "Atomic Energy Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, September 9, 1996). This interpretation was distributed to DOE sites by a memorandum from S. Cowan to Distribution, *Implementation Guidance Concerning "Atomic Energy Defense Activities" as Used in the Waste Isolation Pilot Plant Land Withdrawal Act*, October 17, 1996.

III. L.(1)(d) Containers of transuranic waste shall be marked such that their contents can be identified.

Basis:

Functions Evaluated. This requirements is based on an evaluation of the functions for generation, treatment, storage, off-site transportation, and disposal of transuranic waste. Proper marking of containers is necessary for safe handling of transuranic waste during all phases of the waste management life cycle.

Safety and Hazard Analyses. The requirement addresses the conditions and weaknesses of having inaccurate or incomplete information about a waste container at essentially any stage of waste management. The condition may be the inability to discern information directly from marking or labeling on a container or may be that marking or labeling does not support correlation to records regarding the container contents. As a result of not being able to ascertain information about a waste, workers are potentially exposed to unexpected high dose rates, airborne contamination, or other hazards associated with a waste.

Requirements Analysis. The requirement for marking and labeling reflects improvements, updates, consolidations, and additions to packaging requirements in DOE 5820.2A, requirement II.3.d.3. The current DOE M 435.1-1 requirement refers to DOE O 460.1A and DOE O 460.2, DOE orders covering transportation of radioactive materials, which in turn detail or refer to specific DOT, DOE, and NRC requirements necessary to ensure proper packaging and labeling of transuranic waste packages. This requirement expands on the transportation requirements for marking and labeling such that they apply at any stage in waste management.

Other Considerations. Marking and labeling are considered ALARA and best management practices and are employed for radioactive and hazardous waste. Proper marking and labeling also encourages a graded approach to the handling and management of mixed and non-mixed transuranic waste by providing information that allows safety features and controls to be commensurate with the hazard associated with each waste container.

III. L.(2) Transportation. To the extent practical, the volume of waste and number of transuranic waste shipments shall be minimized.

Basis:

Functions Evaluated. This requirement relates primarily to the transuranic waste generation function, but is also relevant to transporting waste to and managing waste at storage, treatment, and disposal facilities.

Safety and Hazard Analyses. The requirement addresses the condition of loading and unloading transport vehicles, securing waste on transport vehicles, and transporting waste. Hazards associated with radiological exposure, industrial accidents, and highway accidents are expected to be proportional to the number of waste containers handled. This is supported by other studies (e.g., Waste Management Programmatic Environmental Impact Statement) that indicate that transportation is a relatively high hazard activity in radioactive waste management. Consequently, reducing the amounts of waste and the number of containers is expected to result in a lower incidence of the above-mentioned hazards.

Requirements Analysis. This requirement did not previously exist in the transuranic waste chapter of DOE 5820.2A, and is similar to a DOE 5820.2A low-level waste requirement and to the more general requirements for waste minimization. However, because of the documented increased risk associated with transportation, this requirement was added to minimize risk to workers, the public and the environment by consolidating and reducing the number of radioactive materials shipments.

Other Considerations. The requirement adds defense-in-depth to the requirements of 460.1A (invoked in the General Requirements and Responsibilities Chapter) for transportation of transuranic waste. It accounts for possible consequences associated with transportation as identified during the safety and hazard analysis. The requirement was developed in support of the guiding principles for minimizing numbers of shipments to result in ALARA total radiation doses and the best management practice of making the most cost-effective use of the shipment.

III. M. <u>Site Evaluation and Facility Design</u>. The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for transuranic waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

(a) Each site proposed for a new transuranic waste facility or expansion of an existing transuranic waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Basis:

Functions Evaluated. This requirement relates to the functions of acquiring storage or treatment facilities and/or capabilities for management of transuranic waste.

Safety and Hazard Analyses. This requirement addresses the need for site characteristics to be appropriately incorporated into the design of transuranic waste management facilities (storage, treatment, and disposal). The requirement addresses the weaknesses and conditions associated with poor facility siting, inadequate designs of facilities, and inadequate data for performance assessment calculations for disposal facilities. Some of the consequences resulting from failures evaluated in this part of the analysis were high because of catastrophic failures of radioactive material containment that could occur due to environmental and geotechnical characteristics such as flooding, earthquakes, and severe weather events.

Requirements Analysis. This requirement is a combination of DOE 5820.2A requirements II.3.e.(5) and II.3.g.(2), with significant modifications and expansion. The wording is modified such that it addresses characterization of all transuranic waste management facilities rather than focusing only on site selection for a potential new transuranic waste storage or interim storage facility. This requirement supplements those in DOE O 420.1 *Facility Safety* and DOE O 430.1A, *Life Cycle Asset Management*. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced. Additional information is contained in DOE G 435.1-1, which details portions 6430.1A as guidance.

Other Considerations. This requirement is based the safety and hazard analyses performed for low-level waste, but are applicable to transuranic waste.

III. M.(2) Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Transuranic waste systems and components shall be designed to maintain waste confinement.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions for placing and monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need for some transuranic waste management facilities to provide additional confinement barriers in addition to packaging. The requirement addresses the specific weaknesses and conditions of managing liquid transuranic

waste, and containers in storage leaking or breaking during handling, and waste being in storage longer than planned. Weaknesses identified in the high-level waste safety and hazard analyses included failures due to aging, corrosion and mechanical damage.

Requirements Analysis. The requirement is partially derived from the DOE 5820.2A Requirements I.3.b.(2)(a) requiring double containment for all new high-level waste facilities, but is improved and applied to transuranic waste treatment and storage facilities. The requirement is also based on an evaluation of *Resource Conservation and Recovery Act* requirements at 40 CFR Part 264, Subpart J and 40 CFR Part 265 Subpart J, and evaluation of DOE 6430.1A.

Other Considerations. This requirement is based the safety and hazard analyses performed for high-level waste, but are applicable to transuranic waste.

III. M.(2)(b) Ventilation.

1. Design of transuranic waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations in treatment or storage facilities, ventilation or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Basis:

Functions Evaluated. This requirement derives from the analysis of the storage function for monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need to include ventilation systems as appropriate in facilities that treat and store transuranic waste due to the receipt of waste in gaseous form, or waste which degrades and creates gases in the container. The requirements address the weaknesses of receiving waste with incorrect characterization information or which contains an unknown material and of having to open containers to verify the contents. Requirement (d)2. specifically addresses the weakness associated with the receipt of a container that includes a gas or an explosive agent. Processing a container of transuranic waste with a gas

or an explosive was identified as a high hazard activity due to potentially large consequences in the safety and hazard analysis conducted on transuranic waste treatment.

Requirements Analysis. The requirements are similar to the requirement in 5820.2A, I.3.b.(2)(f) requiring ventilation systems to maintain radionuclide release within published guidelines at high-level waste tanks, but it is applied to transuranic waste management treatment and storage facilities. The requirement is partially derived from requirements in 10 CFR Part 835 *Occupational Radiation Protection, DOE Order 5400.5 Radiation Protection of the Public and Environment,* and 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants.*

Other Considerations. This requirement is based the safety and hazard analyses performed for high-level waste, but are applicable to transuranic waste.

III. M.(2)(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing transuranic waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage and treatment functions for constructing a new facility and the treatment function for closure of a treatment facility.

Safety and Hazard Analyses. The requirement addresses the need for incorporating waste generation reduction and minimization into the design of new management facilities. The condition identified in the safety and hazards analyses being addressed by this requirement is managing the residuals from a treatment facility.

Requirements Analysis. This requirement improves on DOE 5820.2A requirements III.3.c on waste generation minimization and reduction, and on the policies in III.2.a. and 2.b. that no legacies requiring remedial action should remain after transuranic waste operations are terminated and that transuranic waste should be managed in a systematic way that includes waste generation reduction. DOE O 430.1A was evaluated during the development of planning requirements for radioactive waste, and it was found to be sufficient for management of radioactive waste management facilities and other assets of the transuranic waste management system, but it did not adequately discuss planning of waste streams to be generated by facilities, including radioactive waste management facilities.

Other Considerations. This requirement was added to promote best management practices to include consideration of the entire life-cycle of the management of waste that will be generated from operating a transuranic waste management facility. Preventing or minimizing the generation of waste is a top-level principle that is incorporated into DOE M 435.1-1 wherever possible.

III. M.(2)(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of transuranic waste treatment and storage facilities to provide volume inventory data and to prevent spills, leaks, and overflows from tanks or confinement systems.

III. M.(2)(e) Monitoring. Monitoring and/or leak detection capabilities shall be incorporated in the design and engineering of transuranic waste storage, treatment, and disposal facilities to provide rapid identification of failed confinement and/or other abnormal conditions.

Basis:

Functions Evaluated. These requirements derive from the analysis of storage functions for monitoring waste in storage and maintaining the storage facility, and treatment functions for providing interim storage at the treatment facility, processing waste, and maintaining the facility.

Safety and Hazard Analyses. Requirement (b) addresses the need to detect system failures that could lead to significant consequences such as a leak in a tank containing liquid transuranic waste. Requirement (c) addresses the need to provide instrumentation and other engineered items to allow for control of the storage and transfer of waste in tanks and processing lines to prevent loss of containment of liquid transuranic waste. The requirements address the weaknesses and conditions of liquid transuranic waste tanks breaching or being overfilled, containers in storage leaking or breaking during handling, or liquid transuranic waste lines in treatment facilities breaching. Potentially high hazards were identified due to large consequences of an undetected liquid transuranic waste storage tank breach or overfill, or of a treatment facility process line breaking without detection or because adequate controls were not designed in the facility. The high-level waste safety and hazard analyses identified weaknesses involving failure to detect flammable gas build up, failure to sample and test waste to establish ignition limits, inadequate storage tank level monitoring, and waste transfer line failure.

Requirements Analysis. The requirements are based on the DOE 5820.2A requirements I.3.b.(3)(a) and I.3.b.(2)(h) for high-level waste tanks. The requirements are expanded to apply to transuranic waste treatment and storage facilities and the controls are required to be part of the design of new facilities. This requirement supplements those in DOE O 420.1 *Facility Safety* and

DOE O 430.1A, *Life Cycle Asset Management*. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities,* that were canceled when DOE 6430.1A was replaced. Additional information is contained in DOE G 435.1-1, which details portions DOE 6430.1A as guidance.

Other Considerations. This requirement is based the safety and hazard analyses performed for high-level waste, but are applicable to transuranic waste.

III. N. Storage.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Transuranic waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Basis:

Functions Evaluated. This requirement is based on analyses of functions associated with the storage of transuranic waste. The specific functions affecting this requirement include developing waste acceptance criteria for receiving waste for storage and placing waste into storage.

Safety and Hazard Analyses. The safety and hazards analysis identified weaknesses or conditions associated with a lack of thorough analysis or a failure to integrate all pertinent data (e.g., safety analysis report) in the development of waste acceptance criteria for the storage facility. The resultant hazard is that containers with incompatible materials or energy sources (e.g., explosives, reactive material) are received that can cause releases that endanger workers or release radioactivity to the environment.

Requirements Analysis. This requirement is similar to DOE 5820.2A requirement, II.3.g.(2)(e) requiring incompatible wastes to be packaged and stored separately. A number of existing internal and external requirements require consideration of hazards that need to be considered in decisions about what can be safely put into a container and placed in storage. These requirements are included in RCRA, DOE 5480.21, *Unreviewed Safety Questions,* 5480.22, *Technical Safety Requirements,* 5480.23, *Nuclear Safety Analysis Report*s, and 420.1, *Facility Safety*. These more general requirements are encompassed in the Manual requirements for developing waste acceptance requirements and for establishing a radioactive waste management basis.

Other Considerations. Based on DNFSB comments on the draft DOE M 435.1-1, specific requirements for prohibiting certain types of material from storage were added to the Manual. Incorporation of language that specifically identifies materials that are not to be stored mitigates the weaknesses related to not conducting a sufficiently rigorous analysis when developing waste acceptance requirements. The current requirement is a best management practice which will prevent practices which have been reported or observed in waste management or materials management at DOE sites.

III. N(2) Storage Integrity. Transuranic waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Basis:

Functions Evaluated. This requirement is derived from the transuranic waste function of placing waste into storage and a similar function for low-level waste of placing waste in storage and monitoring waste while in storage.

Safety and Hazard Analyses. The safety and hazards analysis for transuranic waste identified weaknesses and conditions associated with storing incompatible wastes together and of waste containers in storage being damaged by outside forces (e.g., damaged by a forklift). These weaknesses and conditions can lead to releases to the environment and present an inhalation hazard to workers, and to a lesser extent, the public. In the low-level waste safety and hazards analysis, weaknesses and conditions associated with waste being in storage for longer periods of time than planned, of poor emplacement of waste within a storage facility, and of inadequate storage containers were identified. This requirement also addresses vulnerabilities similar to those for Low-Level Waste in Storage and Inadequate Low-Level Waste Storage Conditions as identified in the *Complex-Wide Review of DOE's Low-Level Waste Management ES&H Vulnerabilities*.

Requirements Analysis. The requirement has a predecessor requirement in DOE 5820.2A requirements II.3.e.(7) and II.3.g.(2)(f). RCRA storage requirements for hazardous waste were evaluated for assistance in defining a storage approach, with associated time frames, if appropriate, for protecting the integrity of waste in storage.

Other Considerations. The current performance-based requirement to provide protection of the integrity of waste containers in storage was derived independently from any existing requirements. Early draft language for this requirement included protecting stored waste from prolonged exposures to the elements, such as rain and sun, and suggested that covers, temperature controls, and secondary containment were acceptable ways to do this. The final wording resulted partially from ensuring the requirement did not include items which were more appropriately addressed in

guidance, and partially from ensuring consistency between waste type chapters. It also addresses a concern raised in DNFSB comments that waste storage should not result in exposure to workers involved in activities unrelated to maintaining the stored waste, i.e., workers involved in other activities should not have waste stored in their work area.

III. N.(3) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of transuranic waste to ensure container integrity is not compromised.

Basis:

Functions Evaluated. This requirement is derived from the analysis of the storage functions of maintaining waste storage and monitoring waste containment and configuration.

Safety and Hazard Analyses. The safety and hazards analysis identified a potential hazard associated with the failure of a waste container and the subsequent release of radioactivity. The hazard was associated with weaknesses associated with undetected degradation of containers while in storage. The identified weaknesses were in supervision, operator performance, and failure to detect problems.

Requirements Analysis. The requirement is essentially the same as the DOE 5820.2A requirement II.3.e.4. In evaluating requirements, a worker training program developed in accordance with DOE O 360.1, *Training*, was determined to be adequate to address the one aspect of the operator performance weakness. The DOE M 435.1-1 requirement to establish a radioactive waste management basis, which would include operating procedures for the storage facility also addresses the weaknesses. This requirement makes inspection of the containers a necessary part of those procedures.

Other Considerations. In addition to the DOE 5820.2A requirement to monitoring the condition of waste containers, in the development of DOE M 435.1-1 it was recognized that it was also necessary to take action when a problem was identified. Consequently, this requirement includes a process for maintaining containers so that deficiencies are corrected if they are found during inspections.

III. N.(4) Retrievable Earthen-Covered Storage. Plans for the removal of transuranic waste from retrievable earthen-covered storage facilities shall be established and maintained. Prior to commencing waste retrieval activities, each waste storage site shall be evaluated to determine relevant information on types, quantities, and location of

radioactive and hazardous chemicals as necessary to protect workers during the retrieval process.

Basis:

Functions Evaluated. This requirement is based on the analysis of generator functions for retrieval of buried waste, but was also applied to retrieval from earth-covered or bermed transuranic waste storage sites since the hazards would be similar.

Safety and Hazard Analyses. The requirement addresses conditions or weaknesses associated with recovering waste that has been stored in earth-covered configurations. Information on the stored waste may be incomplete and conditions in the storage configuration may have resulted in container degradation and release of radioactive or hazardous materials. This situation present an unknown hazard to the environment and to workers involved in recovering the waste for characterization, processing, and disposal.

Requirements Analysis. DOE 5820.2A did not have an equivalent requirement addressing waste in earth-covered storage. However, DOE 5820.2A requirements II.3.i.(2) and II.3.i.(3), addressing buried transuranic-contaminated waste were similar in that they required characterization and development of a closure plan.

Other Considerations. In 1970, the Department established a policy that waste meeting the definition of transuranic waste was to be stored pending a decision on appropriate disposal. A number of DOE sites established earth-covered storage configurations, some with an intended 20-year service life. Many of these facilities have waste in storage well beyond the originally-planned 20 years. This requirement was written to encourage the development of plans and retrieval of waste from these facilities since it is recognized that greater numbers of containers will fail the longer they remain in earth-covered storage. The requirements of DOE 5820.2A were modified to apply to earth-covered storage instead of buried transuranic waste (which is addressed under CERCLA and is outside the scope of the current order). Therefore, rather than addressing the preparation of a closure strategy, the requirement calls for the development and maintenance of a plan for retrieval of the waste.

III. O. <u>Treatment</u>.

Transuranic waste shall be treated as necessary to meet the waste acceptance requirements of the facility receiving the waste for storage or disposal.

Basis:

Functions Evaluated. This requirement derives from the analysis of treatment functions which change the physical or chemical characteristics of liquid or solid, contact-handled or remote-handled transuranic waste.

Safety and Hazard Analyses. The requirement addresses the condition where operator error, procedural error, or equipment/system failure leads to fire or explosion in a treatment facility, loss of containment of waste, exposure to workers, public and environment.

Requirements Analysis. There are numerous existing requirements which will mitigate the hazards associated with treating transuranic waste such as RCRA (for mixed waste), the 5480 series of DOE orders, and safety and design requirements in DOE O 420.1, *Facility Safety*, and 430.1A, *Life Cycle Asset Management*. DOE 5820.2A, Chapter II.3.b.3 required that mixed waste be treated where feasible and practical, to destroy the hazardous component. The requirement is now performance based to allow treatment to the receiving facility waste acceptance criteria, which are selected based on a facility safety analysis report among other requirements.

Other Considerations. The external requirements and other DOE Orders necessary to ensure safety of treatment facilities and operations are identified and invoked in the General Requirements section of DOE O 435.1.

III. P. <u>Disposal</u>.

Transuranic waste shall be disposed in accordance with the requirements of 40 CFR Part 191, *Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes*.

Basis:

Functions Evaluated. This requirement is based on the analysis of the disposal performance requirements necessary to protect the public and the environment.

Safety and Hazard Analyses. This function was not specifically analyzed during the Safety and Hazard Analysis process since external requirements exist which address the performance requirements for transuranic waste disposal.

Requirements Analysis. There was no similar disposal requirement in 5820.2A. The EPA disposal and ground water protection requirements of 40 CFR Part 191 address the performance requirements for transuranic waste disposal.

Other Considerations. The *WIPP Land Withdrawal Act* authorized EPA to certify WIPP's compliance with the requirements of 40 CFR Part 191. The EPA issued criteria for the certification of compliance under 40 CFR Part 194. For other transuranic waste disposal (e.g. Greater Confinement Disposal at Nevada Test Site), DOE retains the authority to approve compliance with 40 CFR Part 191.

III. Q. <u>Monitoring.</u>

The following requirements are in addition to those in Chapter I of this Manual.

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

(2) Stored Wastes. All transuranic wastes in storage shall be monitored, as prescribed by the appropriate facility safety analysis, to ensure the wastes are maintained in safe condition.

(3) Liquid Waste Storage Facilities. For facilities storing liquid transuranic waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions, maintaining transuranic waste in storage, monitoring waste containment and configuration.

Safety and Hazard Analyses. The requirement addresses the condition where failure to monitor waste results in a release of waste due to a human, equipment or method/information failure. Additionally, during the review of the order, requirements were identified in other waste type chapters that were considered relevant to the management of transuranic waste. The requirements address the weaknesses and conditions of failing to detect flammable gas buildup in waste storage tanks, failing to sample and test waste storage tank contents to establish ignition limits, and inadequate waste tank level monitoring.

Requirements Analysis. A similar requirement exists in 5820.2A, Chapter II.3.g.2.(c) for having environmental monitoring systems in place to detect any release of radioactive and hazardous components, with the addition of a requirement to provide monitoring to prevent fires and explosions in pretreatment, treatment, storage and transportation facilities and the monitoring of related parameters, such as temperature and pressure, to prevent loss of confinement. General Requirements invokes compliance with DOE 5400.1 and DOE 5400.5 which provide environmental monitoring requirements.

Other Considerations. The requirement allows a performance based approach utilizing the facility safety analysis so that the monitoring system will be based on the hazards pertinent to that facility. These requirements address the risks of releasing radioactive materials to the environment by monitoring the conditions of the waste as well as contributing to worker protection by supporting the defense-in-depth concept. In addition, the requirements invoke RCRA requirements, for tank systems and ancillary equipment, to provide similar confinement, leak detection, and monitoring features as for hazardous waste.

BASIS FOR REGULATION OF LOW-LEVEL WASTE

DOE O 435.1 establishes a performance-based system for the regulation of low-level waste. A waste management systems analysis was performed to establish the functions involved in all phases of waste management from generation to disposal. With the Complex-Wide Review and Vulnerability Assessment having been completed previously, a safety and hazards evaluation of each function was performed that identified those activities with safety and health significance in need of requirements. Weaknesses and conditions warranting attention in developing requirements were also identified. Each function was considered for its potential impact on workers, the public, and the environment using health-based limits as measures. Following the safety and hazards analyses, the requirements to be incorporated into DOE O 435.1 were identified by examining all existing orders, rules, requirements and policies which relate to the management of low-level waste. Requirements were identified which addressed the needs, weaknesses, and conditions determined from the safety and hazards analyses, and the justification for each requirement was documented. The requirements for DOE O 435.1 and DOE M 435.1-1 were then written with the intent of setting overall requirements and criteria for developing a performance envelope for each facility on a site-specific basis. Each field element is required by DOE M 435.1-1 to perform an appropriate level of analysis (e.g., performance assessment and composite analysis for a disposal facility) to establish facility specific limits and requirements for design, construction, startup, operation, monitoring, and closure.

The results of the Complex-Wide Review and Vulnerability Assessment, waste management systems analysis, safety and hazards analyses, and requirements analysis established that short-term risks and issues related to near-term worker safety and protection of public health and the environment were being addressed with only a few important exceptions. However, long-term risks and issues related to protecting public health and the environment had not been fully addressed in the implementation of DOE 5820.2A. The results of the analyses performed for DOE O 435.1 clearly identified that the predominant impact to public health and the environment in the future is associated with the disposal of low-level wastes. Also, the actions taken in the generation, treatment, and storage of wastes prior to disposal are the predominant contributors to potential impacts from disposal in the future. The requirements included in the DOE O 435.1 and DOE M 435.1-1 are written with the recognition of these findings and with the intent of requiring sites to develop site-specific criteria and procedures which lead to acceptable disposal facility performance.

The regulation of low-level waste at DOE facilities, as developed in DOE O 435.1, differs from the more generic but prescriptive approach taken by the NRC in developing requirements for commercial facilities in 10 CFR Part 61 and other rules. 10 CFR Part 61 was developed with several known conditions that are specific to commercial waste and are not necessarily appropriate for DOE low-level waste. These differences include (1) NRC has a formal licensing process while DOE uses the Directives process; (2) NRC requirements are for generic but unknown facilities and locations; (3) commercial waste streams are well defined; (4) DOE

processed spent fuel for spent nuclear material; (5) DOE disposes of low-level waste onsite, where practical, at facilities which have been operating for many years; (6) land use controls for DOE low-level waste disposal facilities are likely to extend into the distant future; and (7) the management structure for DOE complex-wide low-level waste management is well established. These factors lead to differences in waste management regulation and practices for DOE and NRC low-level waste disposal; however, the required level of health protection is essentially identical.

One specific result of the differences in the process used by DOE to regulate low-level waste is the approach to waste classification. The NRC developed a generic waste classification system for application to all facilities and all locations, which was based on a well-developed understanding of the characteristics of commercial low-level waste. The waste classification limits were developed from a performance assessment of generic low-level waste disposal facilities in various locations that was included in the Environmental Impact Statement for 10 CFR Part 61. The DOE approach places greater emphasis on site-specific decisions for site-specific conditions, and requires a site-specific performance assessment to develop limits, on the basis of criteria for radiation protection (dose limits) that are similar to the NRC. This approach recognizes that the locations for the disposal of wastes are well known, but the waste characteristics are not as well understood. DOE M 435.1-1 requires the development of waste acceptance criteria for each waste management facility to ensure justified limitations are placed on wastes to be disposed of. Sites may establish waste classifications as needed for operation of specific facilities, but they must establish waste acceptance criteria. This approach leads to the development of site-specific systems which take into account the environmental characteristics of the site and the characteristics of the wastes being disposed of, such as the Category 1 and 3 designations at Hanford, which are similar to the NRC classes A and C.

1. FORMAL LICENSING AS COMPARED TO DIRECTIVES FOR FACILITIES

The NRC process includes formal rulemaking to establish requirements and licensing directly by NRC or through agreement states as appropriate. This process involves publication and formal reviews, and sometimes judicial intervention. The requirements must anticipate what might be done in unspecified facilities and locations and must provide a means to control future actions through rules and license conditions, which can be changed (but not easily) when updating, corrections, and expansion are needed.

The DOE process includes DOE Orders and Manuals and local operating policies and procedures, which can be updated and expanded within the DOE system. If expansions are needed, a directive can simply be issued from DOE-HQ to the Operations Office, or from the Operations Office to the contractor, whereas the NRC might have to go through a detailed process of amending the license. Thus the DOE system has less anticipatory information regarding future conditions that might or might not be needed. In addition, Operations Offices have substantial local authority,

which can simplify changes that may become necessary. Because missions, environmental conditions, and waste characteristics vary widely within the DOE system, the Orders give generally applicable requirements that recognize the need to consider site-specific conditions in setting requirements for specific facilities by the Operations Offices. Consequently, specific requirements for a given low-level waste management facility are likely to vary across the DOE system, but reasonable assurance is provided that the generally applicable requirements for the protection of workers, public health, and the environment are met.

2. NRC AND DOE FACILITIES AND LOCATIONS

The NRC rules for low-level waste disposal were developed for nationwide application at a wide variety of facilities which have geological and environmental settings that are largely unknown until a specific facility is proposed. In contrast, DOE disposal sites are already known and owned by the federal government; and extensive descriptions of the geology, hydrology, ecology, and other environmental conditions are available. The NRC rules have been developed to guide the selection of disposal sites to areas that meet the basic siting criteria in 10 CFR Part 61. As a result of sites being selected to meet criteria associated with prescribed site characteristics, the rules include a minimum of specific facility and waste form requirements. These generally amount to a waste classification system, waste form stability requirements for Classes B and C, and extra disposal depth for Class C waste. These requirements apply to all sites, including both humid and arid sites. The rules provide for the advantages of arid disposal sites for the disposal of low-level waste by setting site-specific limits under 10 CFR 61.41 for protection from releases, but any advantages associated with arid sites are not included in the waste classification system. Additional basic criteria for waste disposal have to be met, along with the requirement to provide reasonable assurance that performance objectives will be met.

The DOE approach, where the disposal sites are known but the waste characteristics are not as well known, is to set basic performance objectives, which are substantially the same as those of the NRC. Each site is then required to prepare a site-specific performance assessment of the total disposal system (site, design features, waste form, radionuclide content, and operating practices, and closure plans) to provide reasonable assurance the performance objectives will be met. The basic difference is that the DOE system allows for more consideration of site-specific characteristics in siting, design, waste form, and radionuclide limits in the demonstration of reasonable assurance the performance objectives are met. Engineered features (vaults, caissons, tumuli, containers, and multi-layer surface barriers) are important contributors to performance at DOE facilities, especially at humid sites.

DOE regulation of low-level waste also must take into account that DOE facilities are frequently co-located with reactors, fuel cycle facilities, historical disposal facilities, and facilities which are in the process of being remediated or decommissioned. Commercial low-level waste disposal sites are typically isolated from other nuclear facilities. Thus, commercial low-level disposal sites

are relatively small (waste disposal zone plus a buffer zone), while the DOE disposal sites can range up to many square miles and may include several disposal facilities. As a result, interactions between disposal facilities may become an important consideration in regulating low-level waste, as well as interactions with other nuclear facilities, in order to ensure overall radiation protection of workers, the public health and the environment.

Every DOE site presents a large and complex physical and environmental setting for the disposal of low-level waste that is not readily comparable to the physical and environmental settings associated with the disposal of commercial low-level waste. Some of the NRC siting requirements, while very appropriate for relatively small disposal facilities, are not appropriate for the entire area of a DOE site. Furthermore, the combination of site-specific analyses, procedures, engineered design features, waste acceptance criteria, and waste treatment used by DOE for the regulation of low-level waste has been demonstrated to provide reasonable assurance that rigorous performance objectives can be achieved at disposal facilities which may not be ideal with respect to the siting requirements in 10 CFR Part 61.

3. NRC COMMERCIAL WASTES ARE MORE EASILY DEFINED

Commercial reactor and fuel-cycle waste comes almost entirely from two similar types of water-cooled reactors. This leads to a relatively small number of waste streams, with relatively well-known and consistent compositions. The typically uniform characteristics of these waste streams supported the development of a waste classification system based on inadvertent intrusion scenarios that resulted in relatively large volumes of low-activity waste (Class A), and a small volumes of higher-activity waste (Classes B and C). A review of the set of waste classification limits demonstrated the commercial waste streams segregated relatively easily into the waste classes, and most of the variations in the composition of commercial waste streams did not lead to major changes in classification of wastes or waste volumes.

Wastes generated by DOE nuclear activities are much more variable than commercially generated wastes in all respects. The distribution of radionuclides and their concentrations in DOE-generated wastes is almost continuous, with no natural breakdowns into specific waste classes or concentration ranges. Thus, waste classification of DOE wastes for the entire complex is somewhat arbitrary at best. Waste characteristics of wastes generated by individual DOE sites vary widely from site to site. For DOE sites engaged in production-like operations (e.g., weapons production, isotope production), the wastes generated do have relatively uniform characteristics and can be classified into specific waste streams for the purpose of waste management and disposal. However, the uniformity of production-like waste streams at one DOE site is not likely to be shared with other DOE sites. For DOE sites engaged in research and development, the characteristics of the wastes generated are highly variable and often change as research programs begin and end. For research and development sites, the identification of generated wastes with a fixed waste classification system does not lead to the optimal use of resources in waste

management either for the DOE complex or individual research and development facilities. As a result, the adoption of site-specific waste acceptance criteria, supported by site-specific analyses, is the most appropriate and effective method for regulating the disposal of DOE low-level wastes.

4. REPROCESSING OF SPENT FUEL BY DOE

Spent fuel generated by commercial nuclear activities is not reprocessed. Consequently, commercially generated radioactive wastes consist of spent fuel and several low-level waste streams from non-reprocessing sources. Most of the volumes of low-level wastes generated by commercial activities are relatively low in radionuclide concentrations.

Spent fuel generated by DOE nuclear activities was assumed to be reprocessed. Reprocessing of spent fuel generates additional waste streams which are difficult to manage and dispose of. The first solvent extraction cycle waste generated by reprocessing spent fuel is defined as high-level waste, but wastes from other cycles are not defined as high-level waste, unless sufficiently concentrated so that they become the equivalent of the wastes generated by the first solvent extraction cycle. Although the concentrations of radionuclides in wastes generated from other solvent extraction cycles of reprocessing spent fuel may be less than first solvent extraction cycle waste, the concentrations of radionuclides can be very high, and require special handling in management and disposal.

DOE also produces transuranic (TRU) waste from cladding removal of spent fuel rods, further reprocessing of plutonium as a product, isotope production, and high-energy neutron research and development. TRU wastes are not typically produced in commercial nuclear activities licensed by NRC, as they are in DOE nuclear activities. Consequently, the NRC waste classification system does not have a separate class for TRU waste. Any TRU waste which may be generated by NRC-licensed facilities is simply included as a subclass of greater-than-Class C (GTCC) waste.

The discussion in this section and the previous section illustrates that commercial wastes licensed by the NRC consist of (1) very high-concentration, low-volume high-level wastes associated with spent fuel; (2) several low-concentration waste streams of low-level waste which can be subdivided into Class A, B, and C waste; and (3) a few high-concentration, low-volume waste streams associated with non-fuel core components, resins, sludge, and sealed sources that are subdivided as GTCC waste. This segregation of concentration and volume ranges of wastes provides a very natural division of disposal technologies into repository disposal for spent fuel and near-surface disposal for almost all other waste as low-level waste. GTCC waste can be considered separately as waste appropriate for disposal in a repository or some other type of engineered disposal system that provides a greater degree of isolation than near-surface disposal.

In contrast, reprocessing of DOE spent fuel has resulted in a substantial increase in generated low-level waste volumes as inert chemicals become part of the liquid waste stream. These

additional waste streams have a wide range of radionuclide concentrations. In addition, the liquid waste is frequently subjected to further processing for radionuclide separation of uranium and other useful byproducts and for volume reduction by evaporation. Thus, DOE low-level wastes consist of a wide range of radionuclides, concentrations, and volumes that are not naturally segregated as waste streams which correspond to disposal technologies.

5. DISPOSAL OF DOE WASTE ONSITE

The disposal of low-level waste by DOE and its predecessors has always been at the site where the waste is generated if practicable. This practice for DOE disposal of low-level waste was adopted to reduce the hazard and cost of packaging, handling, and shipping low-level waste. The disposal of nearly all commercially generated low-level waste, however, is performed after the waste is shipped a substantial distance to a few centralized disposal facilities. This practice of shipping across public roads prior to disposal at NRC-licensed facilities results in more robust waste forms and packages for shipping, with shielding oftentimes needed for the shipment of higher-activity wastes.

The disposal of low-level waste generated by DOE nuclear activities at the site where the waste is generated is a matter of long standing policy. This policy has led large DOE sites to develop disposal practices and requirements tailored to specific waste characteristics, and to the capabilities of each site. The onsite DOE disposal facilities are limited to six disposal sites across the DOE complex, with small DOE sites shipping low-level wastes a relatively short distance for disposal at the larger DOE sites. Each DOE site with a low-level waste disposal facility is required to prepare a performance assessment of the onsite disposal system and a composite analysis for pre-1988 waste and other interacting source terms.. Based on the analysis presented in the performance assessment and other required documents (e.g., safety analysis report), each site is then required to develop waste acceptance criteria, design and build engineered features, and utilize operating procedures to provide protection of workers, the public, and the environment. This approach makes optimal use of the capacity of the disposal facility to accept waste and of the available knowledge of the disposal facility, site characteristics, and waste characteristics.

Because the disposal of commercial wastes using 10 CFR Part 61 applies to all NRC-licensed sites anywhere, the procedures to be followed for the disposal of low-level wastes are derived from a generic systems analysis and environmental impact statement that were prepared as part of the rulemaking. As a result of being necessarily much more generic, the NRC requirements tend to be more restrictive in order to provide the same degree of reasonable assurance the performance objectives in the rule are met. This system does not accommodate site-specific variations in site characteristics, waste characteristics, or disposal facility characteristics as easily.

6. DIFFERENT PLANS FOR FUTURE CONTROL

Commercial waste disposal facilities licensed by NRC are intended to be closed once the disposal capacity at the facility has been filled. Following closure of the disposal facility, only minor custodial care and monitoring are required. Additionally this care is anticipated to last for only a relatively short period of 100 years of active institutional control. Disposal sites which have been closed are to be owned by the Federal or a State government, with state sites eventually transferred to the Federal government.

In contrast, a DOE disposal facility may be closed once the disposal capacity has been filled, and a new disposal facility may be opened on the same site. Consequently, low-level waste disposal may be a continuous process for a DOE site, rather than a one-time activity with a specific period of operations. Institutional control of a DOE disposal facility may continue for an extended period of time beyond the relatively short period of institutional control associated with commercial low-level waste disposal facilities.

Since DOE low-level waste disposal facilities are associated with DOE sites having stated missions and objectives that are intended to be long lasting, the duration of future control of DOE disposal facilities may extend well beyond the license period for any commercial disposal facility, particularly if the DOE site continues to be used for nuclear activities. Commercial disposal facilities received from the states would also be under Federal control, but would be less likely to be part of a site with continuing nuclear activities. Consequently, decisions regarding the disposal of low-level waste at DOE sites need to consider the possibility of extended periods of Federal control, providing justified commitments for future control of DOE sites have been made.

7. EXISTING MANAGEMENT STRUCTURE

The formal licensing process used by NRC and the agreement states for the disposal of low-level radioactive waste is intended for private corporations, but could be applied to public consortiums or other organizations. The management structure of an applicant for a license is closely scrutinized in the licensing process and is reviewed periodically. Ultimately, the financial and custodial responsibilities of an NRC-licensed low-level waste disposal facility are transferred to the Federal government. The periodic review of the license by the NRC ensures the licensee operates the disposal facility according to the conditions incorporated into the license. Reports, inspections, and audits are included in the operation of low-level waste disposal facility by NRC to provide additional assurance the requirements for the disposal of low-level waste are met.

The authorization basis concept used by DOE for the disposal of low-level radioactive waste in DOE O 435.1 and DOE M 435.1-1 takes advantage of the formalized management structure of DOE with responsibilities for oversight at DOE Headquarters and responsibilities for operations at DOE Field Offices. The existing system of checks and balances between DOE Headquarters,

DOE Field Offices, and DOE contractors is a structured management system which is subject to review and oversight as part of normal operations. This existing management system has a division of responsibilities and authority that can be relied upon to fulfill the responsibilities associated with low-level waste disposal providing a documented record and basis for operations is maintained. This system provides assurance that the necessary conditions for the proper disposal of low-level waste will be performed with the protection of workers, the public health, and the environment.

8. SUMMARY

This discussion addresses the regulation of low-level waste by DOE, and compares the approach contained in DOE O 435.1 and DOE M 435.1-1 to the approach taken in 10 CFR Part 61. The discussion identifies seven significant points of contrast between DOE and NRC regulation of low-level waste. The discussion of these points of contrast includes the justification for the approach taken by DOE. While there are differences between 10 CFR Part 61, DOE O 435.1/DOE M 435.1-1, the performance objectives for protection of workers, the public, and the environment for both are justified and adequate.

CHAPTER IV

LOW-LEVEL WASTE REQUIREMENTS

IV. A. Definition of Low-Level Waste.

Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or byproduct material (as defined in section 11e.(2) of the *Atomic Energy Act of 1954*, as amended), or naturally occurring radioactive material.

Basis:

Functions Evaluated. This requirement does not derive from the analysis of any specific functions. The definition of low-level waste was included as an assumption in the Functions Analyses.

Safety and Hazard Analyses. The definition of low-level waste was also included as an assumption in the Safety and Hazard Analyses.

Requirements Analysis. The definition of low-level waste is essentially equivalent to the first sentence of the low-level waste definition in Attachment 2 of DOE 5820.2A. (The 5820.2A definition was the definition assumed in the Functions Analysis and Safety and Hazard Analyses). The wording of the definition is from the *Nuclear Waste Policy Act of 1982*, as amended, in order that definitions are consistent with current legislative drivers for DOE radioactive waste management.

Other Considerations. Additional language is included that was derived from language provided by commenters on draft versions of the requirements that ensures it is clear that naturally - occurring radioactive material is not included in the definition of low-level waste.

IV. B. Management of Specific Wastes.

The following provide for management of specific wastes as low-level waste in accordance with the requirements in this chapter:

(1) Mixed Low-Level Waste. Low-level waste determined to contain both source, special nuclear, or byproduct material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component subject to the *Resource Conservation and Recovery Act* (RCRA), as amended, shall be managed in accordance with the requirements of RCRA and DOE O 435.1, *Radioactive Waste Management*, and this Manual.

(2) TSCA-Regulated Waste. Low-level waste containing polychlorinated biphenyls, asbestos, or other such regulated toxic components shall be managed in accordance with requirements derived from the *Toxic Substances Control Act,* as amended, DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(3) Accelerator-Produced Waste. Radioactive waste produced as a result of operations of DOE accelerators is low-level waste and shall be managed in accordance with DOE O 435.1, *Radioactive Waste Management,* and this Manual, and all applicable Federal or State requirements.

(4) 11e.(2) and Naturally Occurring Radioactive Material. Small quantities of 11e.(2) byproduct material and naturally occurring radioactive material may be managed as low-level waste provided they can be managed to meet the requirements for low-level waste disposal in Section IV.P of this Manual.

Basis:

Functions Evaluated. This requirement does not derive from the analysis of any specific functions. Mixed low-level waste was assumed to be an interface to the management of low-level waste in the Functions Analyses.

Safety and Hazard Analyses. The inclusion of mixed low-level waste was an assumption in the Safety and Hazard Analyses, consistent with its role of interface in the Functions Analysis. The Analysis considered all wastes managed currently as low-level waste in the evaluations of scenarios and weaknesses and conditions that could occur in managing radioactive waste, including some accelerator-produced, naturally-occurring, and byproduct materials.

Requirements Analysis. The inclusion of managing mixed low-level waste in accordance with the low-level waste requirements of the Order is equivalent to the policy stated in Requirement III.2.d of DOE 5820.2A. The inclusion of managing small quantities of 11e.(2) and naturally occurring radioactive materials in accordance with the low-level waste requirements of the Order is equivalent to the policy stated in Requirement IV.2 of DOE 5820.2A. Additional language is added that specifies low-level waste mixed with polychlorinated biphenyls shall also be managed in accordance with the *Toxic Substances Control Act* to distinguish the requirements it must meet from RCRA requirements. The inclusion of managing accelerator-produced radioactive materials in accordance with the low-level waste requirements of the Order is also equivalent to the policy stated in Requirement IV.2 of DOE 5820.2A.

Other Considerations. The additional language is derived from language provided by commenters on draft versions of the requirements and through ensuring that waste type chapters were consistent. The additional language ensures that certain radioactive wastes will be managed as low-level waste that are the responsibility of the Department but which have not been sufficiently accounted for in current legislative drivers for management of DOE's radioactive waste.

IV. C. Complex-Wide Low-Level Waste Management Program.

A complex-wide program and plan shall be developed as described under *Responsibilities,* 2.B and 2.D, in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top-level functions of low-level waste management; Formulate, Execute, and Evaluate the low-level waste management program.

Safety and Hazard Analyses. This requirement addresses the need for a documented complex-wide integrated program for planning, executing, and evaluating the activities necessary to safely manage low-level waste. The requirement addresses the potential weaknesses and conditions of lack of, or poor: strategic planning; identification of needed research and development; data collection and management; review of other low-level waste regulatory programs, and; development of necessary management requirements, guidance, and procedures, and lack of or poor: strategic planning documentation; identification of roles and responsibilities; documentation of program assumptions and uncertainties; documentation of facility utilization and plans; process for issue identification and resolution; and documentation of program evaluation activities. The requirement for a complex-wide low-level waste management program also addresses the need for integration of program activities as demonstrated by the results of the Complex-Wide Review and the recommendations made in Defense Nuclear Facilities Safety Board Recommendation 94-2.

Requirements Analysis. The requirement for a complex-wide low-level waste management program has no predecessor requirements in DOE 5820.2A. The requirement is considered an improvement to the requirement for a waste management plan in Chapter VI of DOE 5820.2A because it provides for integration and coordination at the Headquarters level of the planning done at the site-level (Site-wide radioactive waste planning is still required by Chapter I of the Manual).

Other Considerations. Facility optimization, configuration management, cost-savings, and other goals of the low-level waste management system evaluated in the system engineering of low-level waste conducted in response to Defense Nuclear Facilities Safety Board Recommendation 94-2

are best accomplished by an integrated program at the headquarters level that includes documented milestones and measures of accomplishment. The Department has been operating with a waste type manager for low-level waste, and this requirement improves on that practice by assigning the duties and responsibilities of managing the low-level waste program to the Deputy Assistant Secretary for Waste Management.

IV.D. Radioactive Waste Management Basis.

Low-level waste facilities, operations, and activities shall have a radioactive waste management basis consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. The following specific waste management controls shall be part of the radioactive waste management basis:

(1) Generators. The waste certification program.

(2) Treatment Facilities. The waste acceptance requirements and the waste certification program.

(3) Storage Facilities. The waste acceptance requirements and the waste certification program.

(4) Disposal Facilities. The performance assessment, composite analysis, disposal authorization statement, closure plan, waste acceptance requirements, and monitoring plan.

Basis:

Functions Evaluated. This requirement derives from the analysis of the top level low-level waste management functions: Formulate, Execute, and Evaluate a low-level waste management program.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions lack of or poor integration of documents, programs, and controls important to radioactive waste management (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or accountability at the highest management positions for ensuring the most important requirements for the safe management of waste will be met. This requirement partially addresses the Complex-Wide Vulnerability concerning performance assessments not being approved by including the performance assessment and composite analysis as part of the radioactive waste management basis requiring approval for a low-level waste disposal facility.

Requirements Analysis. The requirements for a radioactive waste management basis for low-level waste management facilities have no predecessor requirements in DOE 5820.2A. DOE 5820.2A did include review of performance assessments, but only implied that performance assessments required approval, and did not include any kind of authorization for generation, treatment, or disposal of low-level waste. The radioactive waste management basis for a facility or activity includes formal approval at the site level of low-level waste management operations and ensures that programs and activities established to meet other requirements are being coordinated and integrated as necessary with activities needed to meet DOE O 435.1 and DOE M 435.1-1 requirements. The Department's System Engineering of the Low-Level Waste Management System, conducted in response to Recommendation 94-2, indicated the need for facility evaluations to demonstrate requirements are being met. The radioactive waste management basis concept employs the same principles as the authorization basis for DOE facilities carried out under DOE 5480.23, and facility licensing carried out by the U.S. Nuclear Regulatory Commission and facility permitting done by the U.S. Environmental Protection Agency and state agencies. (Based on DOE M 435.1-1 and other Directive's documentation requirements, information will not need to be pulled together into a summary document, such as a license or permit application, as required by NRC and EPA).

Other Considerations. The radioactive waste management basis concept is implementation of the Department's system engineering of low-level waste management, which indicated the need for facility evaluations to demonstrate requirements are being met. The radioactive waste management basis concept being employed is performance based and uses the graded approach, so the rigor of documentation is commensurate with the hazards and safety implications of activities carried out at a given facility. The radioactive waste management basis is also consistent with the Department's integrated Safety Management System, as this allows tailoring of specific requirements to specific hazards at a certain facility that gets reviewed and approved, as opposed to a rigid approach that implements requirements that might not be needed, but are enforced because review and approval of a basis is not conducted. Final wording of the requirement results from specific comments on draft versions of the requirement, and ensures that it is clear that the radioactive waste management basis includes both physical and administrative controls to provide protection of the public, workers, and the environment.

IV. E. <u>Contingency Actions.</u>

The following requirements are in addition to those in Chapter I of this Manual:

(1) Contingency Storage. For off-normal or emergency situations involving high activity or high hazard liquid low-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of liquid contained in any one storage tank or treatment facility. Tanks or other facilities that are designated low-level waste contingency storage shall be maintained in an operational condition when waste is present

and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

(2) Transfer Equipment. Pipelines and auxiliary facilities necessary for the transfer of high activity or high hazard liquid low-level waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, *Radioactive Waste Management,* and this Manual.

Basis:

Functions Evaluated. These requirements were derived from the analysis of Treatment functions for providing interim storage at the treatment facility, processing waste, and maintaining the treatment facility. The requirements are also partially derived from analysis of the high-level waste storage functions for operating, monitoring, and maintaining storage systems.

Safety and Hazard Analyses. The requirement addresses the need for spare capacity in tanks storing liquid low-level waste and keeping transfer lines operational in treatment facilities. The specific weaknesses and conditions addressed were management of high activity or other high hazard liquid low-level waste at treatment facilities, a breach of an interim storage at treatment, breach of transfer lines for liquid waste at treatment facilities, and the need for contingency storage space if operations cease abruptly. The safety and hazard analyses indicated a potential high hazard to workers associated with treatment of high activity liquid low-level waste if an accident occurred. The high-level waste safety and hazard analyses identified potential significant consequences, particularly to the environment, from leaking storage tanks without adequate spare capacity and adequate transfer equipment.

Requirements Analysis. This requirement is partially derived from high-level waste tank requirements contained in DOE 5820.2A, paragraph I.3.b.(4)(d), with improvements and with changes so it applies to low-level waste storage tanks.

DOE O 420.1 was evaluated and found insufficient to cover all essential design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is consistent with requirements in DOE 6430.1A, Section D13, *Special Facilities,* that were canceled when DOE 6430.1A was replaced.

Other Considerations. This requirement was partially derived from the efforts to ensure DOE M 435.1-1 requirements were consistent across the waste type chapters. The high hazards associated with treatment of high activity or other high hazard liquid low-level waste were addressed by the requirements developed by the high-level waste requirements analysis, so these were adopted for the low-level waste situation. The readily available capability to respond to emergency situations involving loss of confinement supports the defense-in-depth concept. The

final wording of the requirement addresses a specific concern of the Defense Nuclear Facilities Safety Board that the contingency storage and transfer equipment must not just be available, but that it also must meet the applicable requirements of DOE O 435.1 and DOE M 435.1-1.

IV. F. Corrective Actions.

The following requirements are in addition to those in Chapter I of this Manual:

(1) Order Compliance. Corrective actions shall be implemented whenever necessary to ensure the requirements of DOE O 435.1, *Radioactive Waste Management*, and this Manual are met.

(2) Operations Curtailment. Operations shall be curtailed or facilities shut down for failure to establish, maintain, or operate consistent with an approved radioactive waste management basis.

Basis:

Functions Evaluated. These requirements derive from the analysis of the top-level functions, Develop, Execute, and Evaluate the low-level waste program.

Safety and Hazard Analyses. The requirement addresses the need for conducting evaluations (inspections, reviews, etc.) of the most important activities of low-level waste management associated with the protection of the public, workers, and the environment, and for correcting situations which are not being conducted in accordance with Order and/or Manual requirements. This addresses the weaknesses and conditions of reliance on performance based requirements (rather than design and operations specifications, for example) and the use of assumptions in calculations used to determine the necessary radioactive waste management controls, especially for disposal which relies on calculations over long times for establishment of necessary controls. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor documentation or integration of documentation of the evaluations that demonstrate radioactive waste management controls are sufficient which collectively make up the radioactive waste management basis for a facility. Hazards that were identified included potential for detrimental effects on the long-term performance of a disposal facility.

This requirement partially addresses the Complex-Wide Review Vulnerability on Lack of Approved Site Performance Assessments. The Defense Nuclear Facilities Safety Board Recommendation 94-2 also pointed out the lack of approved performance assessments as an integral problem in DOE low-level waste management. These concerns are addressed by requiring operations to be consistent with an approved radioactive waste management basis, which in the case of disposal, includes controls derived from an approved performance assessment, and allowing operations to be curtailed or ceased if there is not an approved basis.

Requirements Analysis. The requirement for corrective actions has no predecessor requirements in DOE 5820.2A. The authorization basis concept of DOE 5480.21 and its implementation was utilized as a basis for the concept of radioactive waste management basis. Corrective actions are used by the NRC in reactor licensing for dealing with situations that could be inimical to public health and safety, however, no additional essential requirement language was derived from those requirements.

Other Considerations. The radioactive waste management basis, and the use of corrective actions to correct situations where the basis is not being met, is partially derived from the system engineering of the low-level waste management system, which showed the need for accountability to demonstrate requirements are being met. The use of Corrective Actions is consistent with implementation by the Department of an integrated Safety Management System and the use of feedback mechanisms to determine measurable improvement of programs.

IV. G. <u>Waste Acceptance</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) <u>Technical and Administrative</u>. Waste acceptance requirements for all low-level waste storage, treatment, or disposal facilities shall specify, at a minimum, the following:

(a) Allowable activities and/or concentrations of specific radionuclides.

(b) Acceptable waste form and/or container requirements that ensure the chemical and physical stability of waste under conditions that might be encountered during transportation, storage, treatment, or disposal.

(c) Restrictions or prohibitions on low-level waste, materials, or containers that may adversely affect low-level waste handlers or compromise facility or waste container performance.

Basis:

Functions Evaluated. This requirement derives from the analysis of treatment, storage, and disposal functions for establishing waste acceptance criteria and ensuring waste acceptance criteria are complied with.

Safety and Hazard Analyses. The requirement addresses the need for establishment of waste acceptance criteria by receiving treatment, storage, and disposal facilities and for ensuring that the requirements of the waste acceptance criteria are met at the receiving facility and weaknesses and conditions of receiving poorly characterized waste, waste requiring additional management as a

mixed waste, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. Also, the waste acceptance criteria for disposal facilities is the document in which limitations or other requirements are imposed as a result of the Performance Assessment, linking the waste to the long-term performance of the facility and ensuring the disposal performance objectives are met. Specific hazards identified include high-hazards to the workers and the environment in the short-term from acceptance of waste containing unacceptable materials, and potential for impacts in the long-term to the disposal facility performance. This also addresses the Complex-Wide Review Vulnerability for Generation of No-Path Forward Waste because with all storage, treatment, and disposal waste acceptance criteria specified and available, generators will know all management options available and what process steps to add at the generator site to make acceptable waste. These requirements also partially address the Complex-Wide Review Vulnerability on Waste Characterization by establishing the receiving facility as the determinator of specific radionuclide concentrations and other characterization requirements.

Requirements Analysis. The requirements are improvements to 5820.2A Requirements III.3.e.(5)(a) through (5)(e). 10 CFR Part 61 waste acceptance requirements and current DOE radioactive waste management facility waste acceptance criteria were evaluated for additional essential waste acceptance criteria.

Other Considerations. The requirements found in 5820.2A, 10 CFR Part 61, and current DOE facility WAC were made performance-based and consolidated into these three essential requirements for acceptable waste. Implementation guidance includes discussions of the specific restrictions and allowances found in those other sources of requirements that were evaluated. Effective waste acceptance experience at DOE facilities establishes these criteria as best management practice for waste acceptance requirements.

IV.G.(1) <u>Technical and Administrative</u>.

(d) The following are additional waste acceptance requirements that shall be specified in low-level waste disposal facility waste acceptance requirements:

1. Low-level waste must contribute to and not detract from achieving long-term stability of the facility, minimizing the need for long-term active maintenance, minimizing subsidence, and minimizing contact of water with waste. Void spaces within the waste and, if containers are used, between the waste and its container shall be reduced to the extent practical.

2. **Liquid low-level waste or low-level waste containing free liquid must be converted into a form that contains as little freestanding liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the container volume when the low-level waste is in a disposal container, or 0.5 percent of the waste volume after it is processed to a stable form.**

3. **Low-level waste must not be readily capable of detonation or of explosive decomposition or reaction at anticipated pressures and temperatures, or of explosive reaction with water. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.**

4. **Low-level waste must not contain, or be capable of generating by radiolysis or biodegradation, quantities of toxic gases, vapors, or fumes harmful to the public or workers or disposal facility personnel, or harmful to the long-term structural stability of the disposal site.**

5. **Low-level waste in a gaseous form must be packaged such that the pressure does not exceed 1.5 atmospheres absolute at 20 C.**

Basis:

Functions Evaluated. This requirement derives from the analysis of treatment and storage functions for ensuring disposal WAC are complied with, Treatment functions for packaging waste for storage and disposal, and for Disposal of low-level waste.

Safety and Hazard Analyses. This requirement addresses the need for waste accepted at disposal facilities from generators, treatment, and storage facilities to contribute to the long term performance of the disposal facility. The specific hazard identified was the potential impact to the long-term performance of the disposal facility. The requirement addresses the potential conditions and weaknesses of receiving waste that has poor stability properties, that requires special handling or treatment, or that would adversely affect the performance of the disposal facility. Specific weaknesses of disposed low-level wastes addressed by these requirements include: liquid wastes or wastes containing significant amounts of liquid; waste disposed with voids in the package; waste containing explosives, reactives and pyrophorics; gaseous waste, and; waste in weak packages. The requirement partially addresses Defense Nuclear Facilities Safety

Board Recommendation 94-2 that DOE implement more requirements, guidance, and standards based on the requirements covering commercial low-level waste disposal facilities.

Requirements Analysis. The requirements are improvements to the DOE 5820.2A, Chapter III.3.i.(5) Requirements. The requirements are updates to 5820.2A requirements, and they are cast as minimum waste acceptance criteria for disposal facilities as opposed to minimum waste form requirements. They are also enhancements to the 5820.2A requirements by including protection of the public and the environment into the goals of the requirements rather than limiting it to protection of workers and consideration of long-term stability of disposal site. The criteria are derived from 10 CFR Part 61 and contain only minor changes to be consistent with DOE low-level waste management and disposal conditions and operations.

Other Considerations. These criteria promote significant defense-in-depth for protecting the performance of the disposal facility by eliminating known detrimental conditions of disposed waste which have been determined from years of experience in both commercial and DOE low-level waste management.

IV. G.(1) <u>Technical and Administrative</u>. Waste acceptance requirements for all low-level waste storage, treatment, or disposal facilities shall specify, at a minimum, the following:

(e) The basis, procedures, and levels of authority required for granting exceptions to the waste acceptance requirements shall be contained in each facility's waste acceptance documentation. Each exception request shall be documented, including its disposition as approved or not approved.

Basis:

Functions Evaluated. The requirement derives from the analysis of treatment, storage, and disposal functions for establishing WAC and ensuring WAC are complied with.

Safety and Hazard Analyses. The requirement addresses the need for establishment of waste acceptance criteria by receiving treatment, storage, and disposal facilities and for ensuring that the requirements of the waste acceptance criteria are met at the receiving facility. This requirement partially addresses the Complex-Wide Review Vulnerability on No Disposal Path Forward Waste by allowing a mechanism for approval for disposal of low-level wastes that have special considerations not covered in the waste acceptance criteria, but for which additional analysis can demonstrate that disposal can be done safely. The potential impacts to the long-term performance of the disposal facility is the critical hazard area addressed by this requirement concerning receipt and disposal of waste not covered in the waste acceptance criteria.

Requirements Analysis. This requirement for exceptions to waste acceptance criteria has no predecessor requirement in DOE 5820.2A. The requirement was derived from specific criteria for exemptions that appear in DOE site-specific waste acceptance criteria documents. Exception provisions are common in performance-based requirements documents, as long as the basis for exceptions is identified and the authorizing process to avoid unjustified exceptions is provided. The NRC performance-based disposal requirement, 10 CFR Part 61, permits exceptions to many parts of the rule, where justified (61.6 and elsewhere). For the waste characteristics requirements of Part 61, exceptions are allowed, based on a case-by-case evaluation. Of specific significance to this DOE M 435.1-1 requirement, 10 CFR 61.7.(b)(5) and 61.55(a)(2)(iv) indicate that waste above Class C may be acceptable for near-surface disposal with special processing or design.

Other Considerations. This requirement is a performance based requirement that institutes a best management practice for accepting wastes for treatment, storage, and disposal used at commercial and DOE low-level waste disposal facilities providing the reasons the waste does not meet the acceptance criteria are known and evaluated, and adequate additional controls are in place to protect the public, workers, and the environment based on the knowledge and evaluation of the waste.

IV. G <u>Waste Acceptance</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(2) Evaluation and Acceptance. The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and administrative requirements have been met. A process for the disposition of non-conforming wastes shall be established.

Basis:

Functions Evaluated. This requirement derives from the analysis of Waste Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a confirmation step for assuring that generators meet waste acceptance criteria of storage, treatment and disposal facilities and that the receiving facility inspects the waste to verify that the acceptance criteria are met before the waste is accepted. The requirement addresses hazards especially to workers, and the potential weaknesses and conditions that could arise from the storage, treatment, or disposal facility receiving poorly characterized waste, waste containing unacceptable materials, waste that was packaged incorrectly or which has paperwork problems, or waste damaged in transport. The requirement also partially addresses the Complex-Wide Review

Vulnerability on weaknesses in Waste Characterization by providing additional evaluations and acceptance determinations by receiving facilities on top of certification by generators.

Requirements Analysis. The requirement for receiving facility evaluation and acceptance is an improvement to DOE 5820.2A Requirement III.3.e.(4) which required audits of waste certification programs. Current waste acceptance documents and practices were evaluated for essential requirements to address the weaknesses and conditions identified.

Other Considerations. The requirement adds defense-in-depth to the waste certification and waste acceptance process by adding an evaluation and acceptance step by the receiving facility. The language was developed from the Best Management Practices of current DOE and commercial disposal facilities and is performance-based. The wording allows for flexibility in implementation and the use of the graded approach to address the different controls needed for simple waste storage facilities handling a few waste streams to multi-site and multi-program waste management facilities, such as regional disposal facilities.

IV. H. <u>Waste Generation Planning</u>.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Life-Cycle Planning. Prior to waste generation, planning shall be performed to address the entire life cycle for all low-level waste streams.

(2) Waste With No Identified Path to Disposal. Low-level waste streams with no identified path to disposal shall be generated only in accordance with approved conditions which, at a minimum, shall address:

(a) Programmatic need to generate the waste;

(b) Characteristics and issues preventing the disposal of the waste;

(c) Safe storage of the waste until disposal can be achieved; and

(d) Activities and plans for achieving final disposal of the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for pre-certifying waste, providing forecast data, and approval of generator processes by the receiving facility.

Safety and Hazard Analyses. The requirement addresses the need for generators, and treatment, storage, and disposal facilities to know more about wastes requiring management prior to their generation, to prevent the generation of waste streams that may not have a path forward to disposal, and to implement an authorization for generation of no path forward waste. Specific weaknesses and conditions addressed are the generation of waste that can not be certified or accepted at a management facility, with no disposal option, or that taxes the capacity of a waste management facility. The requirement directly addresses the Complex-Wide Vulnerability of Generation of No Path Forward Waste.

Requirements Analysis. The requirements have no direct predecessor requirements in DOE 5820.2A. DOE Order Requirement III.3.b.(2) calls for an overall waste management systems performance assessment and Chapter VI calls for a waste management plan. These requirements and the concepts they embody have been significantly modified in DOE M 435.1-1 to clarify the focus of these activities on the life-cycle of low-level waste streams rather than on information about facilities managing and achievements in characterization, treatment, storage, and disposal as separate activities. These requirements in DOE M 435.1-1 emphasize planning rather than an assessment of the system performance. The requirements of DOE O 430.1A were evaluated and determined to be adequate for life-cycle planning for radioactive waste management facilities and other assets, but not adequate with respect to planning for the management of the waste streams themselves.

Other Considerations. The concepts of life-cycle planning prior to generation and approval to generate provide defense-in-depth by ensuring that a generation process will be designed and/or modified such that the waste generated can be certified and can be managed at appropriate storage, treatment, and disposal facilities. The requirement for no path forward waste directly addresses the Complex-Wide Vulnerability be providing upper management with the responsibility for approving the generation of waste which cannot be directly disposed. The final requirement language results from comments on draft versions of the requirements by specifying the four elements of the planning for no path forward waste that must be addressed in order for its generation to be approved.

IV. I. <u>Waste Characterization</u>.

Low-level waste shall be characterized using direct or indirect methods, and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance requirements of the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for characterizing waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to only ship properly characterized waste to treatment, storage, and disposal facilities. The requirement addresses the potential conditions and weaknesses of receiving poorly characterized waste, waste requiring additional management as a mixed waste, waste exceeding WAC limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. Hazards of particular concern for waste characterization weaknesses include potential impacts to workers and the environment in the short term, and to the long-term performance of the disposal facility. The requirement also addresses the Complex-Wide Review Vulnerability on Waste Characterization.

Requirements Analysis. The requirement is essentially equivalent to the requirements at DOE 5820.2A, Chapter III.3.d.(1) and 3.d.(3) calling for waste to be characterized for proper segregation, treatment, storage and disposal, and that this characterization can be done using direct or indirect methods. The wording is modified to clarify that waste should be characterized so it can be properly handled at all times and for the purpose of meeting the receiving facilities' acceptance criteria, and that this information is to be properly documented.

Other Considerations. The final wording of this requirement is partially derived from addressing comments on previous drafts of the Manual. The requirement adds defense-in-depth by including characterization to support safe handling at all times, and not just for meeting a receiving facilities acceptance requirements. Draft versions of the characterization requirements named specific indirect methods of characterization that could be used (scaling factors, accountability, and process knowledge), and that correlations had to be derived that would tie the indirect measurements to results of direct measurements. These discussions were moved to guidance as acceptable and correct methods of the use of indirect characterization. The use of indirect methods for characterization is consistent with best management practices in commercial industry, especially at nuclear power plants, and the use of correlations to tie indirect measurements to results of direct measurements is also best management practice. These topics are addressed in the USNRC Technical Position on Waste Classification, which is referred to in guidance. This requirement is performance based to allow for flexibility in providing correlations, and the use of indirect methods for characterization supports the principle of ALARA.

IV. I.(1) Data Quality Objectives.

The data quality objectives process, or a comparable process, shall be used for identifying characterization parameters and acceptable uncertainty in characterization data.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for characterizing waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to ship properly characterized waste in accordance with needs of treatment, storage, and disposal facilities. The requirement addresses the potential conditions and weaknesses of receiving poorly characterized waste, waste requiring re-characterization, waste exceeding WAC limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. The requirement also addresses the Complex-Wide Review Vulnerability on Waste Characterization.

Requirements Analysis. The requirement is an improvement to the first sentence of Requirement 5820.2A, III.3.d.(1) which required waste to be characterized "with sufficient accuracy to permit proper segregation, treatment, storage, and disposal." The use of the data quality objectives process implements a known and tested process for defining the acceptable accuracy of characterization data. The use of the data quality objectives process has been directed in policy from the Office of Environmental Management for some radioactive waste management problems, and this requirement maintains this policy.

Other Considerations. The final wording of the requirement to allow for the use of a comparable process to the data quality objectives process is derived from responses to comments. Best management practices utilized at some DOE facilities are similar to the data quality objectives process, and this wording allows for flexibility in continuing to implement those processes.

IV. I.(2) Minimum Waste Characterization.

Characterization data shall, at a minimum, include the following information relevant to the management of the waste:

(a) Physical and chemical characteristics;

(b) Volume, including the waste and any stabilization or absorbent media;

(c) Weight of the container and contents;

(d) Identities, activities, and concentrations of major radionuclides;

(e) Characterization date;

(f) Generating source; and

(g) Any other information which may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with applicable performance objectives.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for characterizing waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to only ship properly characterized waste to treatment, storage, and disposal facilities and specifies the minimum requirements for that characterization. Specific hazards of concern included impacts to the long-term performance of the disposal facility, and impacts in the short term to workers from unplanned exposures. The requirement addresses potential conditions and weaknesses of receiving poorly characterized waste, waste requiring additional management as a mixed waste, waste exceeding WAC limitations, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. The requirement also addresses the Complex-Wide Review Vulnerability on Waste Characterization.

Requirements Analysis. These requirements are improvements to requirements in 5820.2A, Chapter III.3.d.(2)(a) through 3.d.(2)(e). An additional requirement is included which requires that other characterization information needed for preparing or maintaining the performance assessment or otherwise demonstrating the performance objectives are met is also to be provided. NRC minimum waste characterization requirements in Appendix F of 10 CFR Part 20 were evaluated for essential requirements, and these are similar to the requirements of Part 20. The NRC rules specifically require the activities of H-3, C-14, Tc-99, I-129, and masses of uranium, thorium, and plutonium be reported on all low-level waste manifests. However, the variability of

DOE waste streams compared to those analyzed in development of Part 61 requires determination of safety-significant nuclides to be done through the safety analysis and performance assessment on a facility-specific basis, rather than by providing a list of specific radionuclides derived from a generic analysis. Such a list could be either too restrictive or too lenient to achieve its purpose in the DOE system with its diverse waste streams.

Other Considerations. The minimum characterization information needs are partially derived from best management practices and experiences with waste acceptance at DOE sites, and the requirements provide for defense-in-depth by ensuring minimum characterization data is developed on all waste generated, including waste with uncertain future management steps (which cannot use a facility-specific set of waste acceptance criteria to determine the exact characterization requirements to meet).

IV. J. Waste Certification.

A waste certification program shall be developed, documented, and implemented to ensure that the waste acceptance requirements of facilities receiving low-level waste for storage, treatment, and disposal are met.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for generator facilities to only ship certified waste and for treatment, storage, and disposal facilities to accept only waste certified to meet the waste acceptance criteria. The requirement addresses weaknesses and conditions of receiving uncharacterized waste, waste exceeding WAC limitations, waste requiring additional management steps, waste containing unacceptable materials, waste that may prove to be a hazard in a treatment or storage facility, or waste that would adversely affect the performance of the disposal facility. Specific hazards identified in the analysis of concern with this activity are unplanned exposures of workers, potential impacts to the environment from acceptance of waste that does not meet WAC, and a potential for long-term impacts to the performance of the disposal facility. The requirement also partially addresses the Complex-Wide Review Vulnerability for weaknesses in Waste Characterization due to inadequate waste certification.

Requirements Analysis. The requirement is an improvement to part of the requirements in 5820.2A, Chapter III.3.e.(3) calling for a waste certification program. The parts of the 5820.2A, III.3.e.(3) requirements for joint responsibility for performing waste certification and generator

financial responsibility have been moved to guidance. Current waste certification requirements in existing DOE facility waste acceptance programs were evaluated for essential requirements in waste certification.

Other Considerations. None.

IV. J.(1) Certification Program. The waste certification program shall designate the officials who have the authority to certify and release waste for shipment; and specify what documentation is required for waste generation, characterization, shipment, and certification. The program shall provide requirements for auditability, retrievability, and storage of required documentation and specify the records retention period.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions that could arise from uncertified waste, poorly characterized waste, or waste containing unacceptable materials, especially from poor certification documentation and record keeping. This requirement addresses hazards identified impacting the long-term performance of the disposal facility. The requirement also partially addresses the Complex-Wide Review Vulnerability in Waste Characterization due to inadequate waste certification programs.

Requirements Analysis. The requirement has no predecessor requirement in DOE 5820.2A. The requirement improves on the recordkeeping requirements that are in DOE 5820.2A, Chapter III, Section M, specifically for waste certification activities.

Other Considerations. The requirement was derived from best management practices utilized at successful waste generator certification programs at DOE generator facilities, and from experience of DOE facilities receiving waste from many differing generators. The requirement provides for defense-in-depth for waste certification by ensuring: the officials who have the authority to state that low-level waste is properly certified and meets the waste acceptance criteria of the facility to which it is being sent is specifically identified and: proper documentation and recordkeeping are in place in order to retain important waste characterization data at its place of origin, the generator.

IV. J.(2) Certification Before Transfer. Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the facility receiving the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a process that ensures generators meet waste acceptance criteria of storage, treatment, and disposal facilities. The requirement addresses the weaknesses and conditions that could arise from uncertified waste, poorly characterized waste, or waste containing unacceptable materials. The requirement also partially addresses the Complex-Wide Review Vulnerability in Waste Characterization due to inadequate waste certification programs.

Requirements Analysis. This requirement is a modification of part of 5820.2A, Chapter III.3.g.(3) that waste must be certified to meet the receiving facilities acceptance criteria and that certification must take place prior to transfer to the receiving facilities.

Other Considerations. This requirement adds defense-in-depth to the controls over the most vulnerable part of the waste management system, namely when waste is transferred. This requirement places the main burden on the generator to ensure that the waste meets the waste acceptance criteria of the facility to which it is being transferred.

IV. J.(3) Maintaining Certification. Low-level waste that has been certified as meeting the waste acceptance requirements for transfer to a storage, treatment, or disposal facility shall be managed in a manner that maintains its certification status.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste to be transferred to a receiving facility for storage, treatment, and/or disposal and Treatment, Storage and Disposal functions that the waste must be verified that it meets waste acceptance criteria evaluated in the transuranic waste analysis

Safety and Hazard Analyses. The requirement addresses weaknesses and conditions, identified in the transuranic waste safety and hazard analyses, of failing to manage the waste at a treatment or storage facility such that it will lose its certification prior to transfer to the next phase in its life cycle. These actions include: failing to monitor and inspect the waste such that release of

radioactive or hazardous materials is allowed; abusive handling such that the containment boundary of the waste package is compromised and must be replaced; and failing to manage certification documentation such that records are lost or destroyed. The hazards identified included potential impacts to workers due to damaged or degraded containers. The requirement also partially addresses the Complex-Wide Review Vulnerability in Waste Characterization due to inadequate waste certification programs.

Requirements Analysis. The requirement is an expansion of part of the transuranic waste requirement at DOE 5820.2A, II.3.e.(2) to the management of low-level waste. The transuranic waste requirement is improved by expanding the control of certified waste to all activities rather than restricting it to just storage.

Other Considerations. This requirement is included in the low-level waste chapter as a result of achieving consistency across the waste type chapters. The requirement was not originally identified as an essential requirement in the analysis of low-level waste management, but was recognized as good management practice in transuranic waste that should be adopted for management of low-level waste. The requirement supports the ALARA concept by trying to protect certified waste so that no additional characterization or packaging must take place at a later time to re-certify waste.

IV. K. <u>Waste Transfer</u>.

> **A documented process shall be established and implemented for transferring responsibility for management of low-level waste and for ensuring availability of relevant data.**

Basis:

Functions Evaluated. This requirement derives from the analysis of all functions in the low-level waste management system, as information about waste was identified as an input into every function from the previous function.

Safety and Hazard Analyses. The requirement addresses the need for maintaining accurate characterization data at all stages of the waste management process for low-level waste from generation through post-disposal. Specific weaknesses and conditions being addressed include losing knowledge about waste at any step of the waste management process where particularly vulnerable stages of the process include transfers and transportation, and loss of container integrity during transfer. Hazards of particular concern included impacts to workers from exposures due to loss of knowledge of waste characteristics and the long-term impact on the disposal facility performance. This requirement also partially addresses the Complex-Wide Review Vulnerability concerning Waste Characterization.

Requirements Analysis. This DOE M 435.1-1 requirement is a significant modification and improvement to requirements in DOE 5820.2A, Chapter III.3.m(1) on record keeping and III.3.h.(2) and III.3.f.(4)(d) regarding records for storage and treatment facilities. The DOE M 435.1-1 requirement consolidates the concept of the three requirements to ensure that records are kept for all low-level waste management steps and functions, and expands it to include the concept of maintaining the integrity of the waste package as well as the information on the waste. Requirements used for chain-of-custody of waste management samples at DOE and commercial facilities were evaluated to help derive this essential requirement. Record keeping requirements of DOE O 200.1 were evaluated and found to be adequate for the maintenance of written records such as waste manifests and transfer papers and are invoked in the General Requirements chapter of the Manual.

Other Considerations. Proper maintenance of information and integrity of waste packages contributes to cost-effectiveness and ALARA by minimizing the need for re-certification, re-characterization, repackaging, or doing unnecessary sampling and analysis.

IV. K. <u>Waste Transfer</u>.

The following requirements are in addition to those listed in Chapter I of this Manual.

(1) Authorization. Low-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer.

Basis:

Functions Evaluated. This requirement derives from the analysis of Generator functions for certifying waste, and treatment, storage, and disposal functions for waste receipt and verifying waste meets waste acceptance criteria.

Safety and Hazard Analyses. The requirement addresses the need for establishing a process for assuring that generators meet waste acceptance criteria of storage, treatment, and disposal facilities and that these receiving facilities verify that the acceptance criteria are met before the waste is received. Specific weaknesses and conditions addressed are from the possible receipt of uncertified waste, poorly characterized waste, or waste containing unacceptable materials. This requirement addresses a specific hazard to workers from exposures from receipt of waste without proper notifications and authorizations. The requirement also addresses the Complex-Wide Review Vulnerability for weaknesses in Waste Characterization which may be due to inadequate waste certification programs.

Requirements Analysis. The requirement is an improvement to DOE 5820.2A Requirement III.3.g.(3) This requirement is a modification and improvement to part of 5820.2A, Chapter III.3.g.(3) that waste must be certified to meet the receiving facilities acceptance criteria and that this must take place prior to transfer to the receiving facilities.

Other Considerations. Authorization by receiving facilities for transfer provides defense-in-depth at the most vulnerable time for radioactive waste management, when waste is transferred.

IV. K. <u>Waste Transfer</u>.

The following requirements are in addition to those listed in Chapter I of this Manual.

(2) Data. Waste characterization data, container information, and generation, storage, treatment, and transportation information for low-level waste shall be transferred with or be traceable to the waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of all functions in the low-level waste management system, as information about waste was identified as an input into every function from the previous function.

Safety and Hazard Analyses. The requirement addresses the need for maintaining accurate characterization data at all stages of the waste management process for LW from generation through post-disposal. Specific weaknesses and conditions being addressed include losing knowledge about waste at any step of the waste management process where particularly vulnerable stages of the process include transfers, transportation, when waste is treated in a way that the form is changed or repackaging occurs, and when storage lasts longer than anticipated. Worker exposures were identified as a specific hazard needing to be addressed through this requirement, as well as impacts to the long-term performance of the disposal facility due to loss of information about disposed waste. Also, this requirement partially addresses the Complex-Wide Review Vulnerability concerning Waste Characterization.

Requirements Analysis. The requirement is an improvement to Requirement DOE 5820.2A, Chapter III.3.m.(2) on waste manifests. The analysis of the 5820.2A waste manifest requirement indicated that it was too restrictive (language limited use of manifests to when there was a package of waste; the function of transfer in the evaluations conducted in developing DOE M 435.1-1 had a broader definition and application). The requirement needed to ensure that maintaining characterization data, and packaging data when applicable, applies to all functions, not just to packages, or transfer of packages. The manifesting requirements of 10 CFR Part 20 were evaluated, and found to be too restrictive since it was limited to offsite disposal of

transported waste, where manifesting documentation was the state-of-the-art. Much of the specific items and directions for manifest use from DOE 5820.2A and Part 20 is now in implementation guidance, and addresses the specific cases when waste is to be transported off of a DOE site to another site or to a commercial waste management facility.

Other Considerations. The requirement is a performance based requirement that applies to all functions of low-level waste management, and not just to a limited set for transportation of waste to a large waste management facility. The principle of ALARA is supported by this requirement by preventing re-certification or re-characterization steps or doing unnecessary sampling and analysis if all characterization data are properly maintained and transferred.

IV. L. <u>Packaging and Transportation</u>. The following requirements are in addition to those in Chapter I of this Manual.

(1) Packaging. If containers are used:

(a) Low-level waste shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container.

(b) When waste is packaged, vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container.

(c) Containers of low-level waste shall be marked such that their contents can be identified.

Basis:

Functions Evaluated. These requirements derive from the analysis of the Generator function for packaging low-level waste, the Treatment function for packaging processed waste, the storage function for monitoring waste in storage, and the Disposal function for handling waste prior to disposal.

Safety and Hazard Analyses. The requirement addresses the need for proper packaging, venting of waste containers, when necessary, and marking and labeling of waste containers for appropriate treatment, storage, and disposal. The requirement addresses the potential conditions and weaknesses of receiving inadequately packaged waste, waste not meeting WAC requirements, waste requiring repackaging, waste with improper or missing marking and/or labeling, wastes without adequate relationship to its shipping papers, and waste in storage longer than anticipated

or in inadequate storage conditions. Potential high hazards were identified to workers due to improper labeling of high-activity low-level waste, and hazards to the environment and workers were identified if waste was not packaged correctly. The requirement also addresses the Complex-Wide Vulnerability concerning Waste in Inadequate Storage Conditions by requiring adequate containers that will endure the expected storage period, and requiring a vent in the event containers become pressurized or contain gaseous waste or waste that could generate gases. Specific incidents in the DOE complex have been reported over recent years concerning over-pressurization of low-level waste containers, and the potential this has raised for dispersal of radioactive material if rapid depressurization of the containers were to occur.

Requirements Analysis. The requirements for packaging are improvements, updates, and additions to packaging requirements in DOE 5820.2A, Chapter III.3.g.(4). DOE O 1540.1, referred to in DOE 5820.2A, is replaced by DOE O 460.1A. DOE O 460.1A, which is required to be complied with in Chapter I, General Requirements, invokes Title 49 CFR Department of Transportation (DOT) requirements for packaging and shipping radioactive material. Therefore, a reference to the DOE Orders on transportation, or to the DOT requirements, is no longer needed in the waste type chapter. DOE Orders covering transportation of radioactive materials (DOE O 460.1A and 460.2) were evaluated and found to be sufficient in providing controls for packaging of low-level waste, except for long-term storage and for packaging prior to shipment or where shipment (transfer) is not clearly under DOE O 460.1A. Requirements included cover these two circumstances.

NRC transportation requirements at 10 CFR Part 71 were also evaluated, but found to have no additional essential requirements to be considered. The additions to DOE 5820.2A in the DOE M 435.1-1 requirement are to provide containment for the storage period or until the waste is removed from the packaging, and for packages to have proper marking, and labeling.

Other Considerations. The final language in the requirement is partially derived from responses to comments on draft versions of DOE M 435.1-1. The requirement adds defense-in-depth to storage requirements by requiring adequate packaging in addition to the improved storage conditions specified in the storage section of the Manual. Venting of packages addresses recent incidents that have been reported in the DOE complex and represents a Best Management Practice. Venting also represents the efforts to be consistent across waste type chapters, as venting for TRU waste containers is required. Marking and labeling are considered best management practices and are employed for radioactive and hazardous waste. The requirements are included in DOE M 435.1-1 to ensure marking and labeling is utilized for the entire life-cycle of the waste. Minimum characteristics for packaged waste following treatment were also identified and these are incorporated in Manual in the form of waste acceptance requirements for disposal, Requirements IV.G.(1)(d).

IV. L. Packaging and Transportation.

The following requirements are in addition to those in Chapter I of this Manual.

(2) Transportation. To the extent practical, the volume of waste and number of low-level waste shipments shall be minimized.

Basis:

Functions Evaluated. This requirement derives from the analysis of generator, treatment, and storage functions for transporting waste to receiving storage, treatment, and disposal facilities.

Safety and Hazard Analyses. The requirements contained in 460.1A and in this Manual address the potential conditions and weaknesses of handling waste on and off transport vehicles, securing waste on transport vehicles, and consequences from waste in transport in the event of transportation incidents. The Safety and Hazard Analysis indicated that these weaknesses and conditions result in a high risk activity for management of low-level waste. Also, other studies (e.g., PEIS) also have indicated that transportation is one of the higher risk activities of management of radioactive waste.

Requirements Analysis. The requirement is essentially equivalent to Requirement 5820.2A, III.3.g.(1). The DOE Orders covering transportation of radioactive materials (DOE O 460.1A and 460.2) were evaluated and found to be sufficient in providing controls for transportation of low-level waste. This conclusion was supported also by the specification in DOE O 460.1A that offsite transportation had to meet 49 CFR, DOT requirements for transport of radioactive materials. This requirements for transportation are the only components needed to address the potential conditions and weaknesses not addressed by the requirements of O 460.1. Specifically, waste shipment minimization addresses the risks of adding unnecessary shipments of radioactive materials on the road.

Other Considerations.

The requirement adds defense-in-depth to the requirements of 460.1A (invoked in the General Requirements Chapter) for transportation of Low-level waste to account for possible consequences associated with transportation as indicated in the Safety and Hazard Analysis. The requirement was developed in support of the guiding principles for managing radioactive waste to result in doses As Low as Reasonably Achievable and for cost-effectiveness.

IV. M. Site Evaluation and Facility Design.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Site Evaluation. Proposed locations for low-level waste facilities shall be evaluated to identify relevant features that should be avoided or must be considered in facility design and analyses.

Basis:

Functions Evaluated. This requirement derives from the analysis of Disposal functions for constructing a new disposal facility, closing and monitoring all disposal facilities, and Storage and Treatment functions for constructing a new facility.

Safety and Hazard Analyses. This requirement addresses the need to acquire meteorologic, topographic, geotechnical, and other environmental data to support decisions about the acceptability of a site for a storage, treatment, and disposal facility, and to provide necessary input to the design of the facility, and specifically to the performance assessment of a disposal facility. This requirement addresses the condition of disposal of waste at sites with poor waste containment characteristics without adequate adjustments to the rest of the disposal system (e.g., limiting radionuclides accepted, supplementing with engineered barriers). The specific hazard addressed by this requirement is the potential for impacts to the long-term performance of the disposal facility. This requirement partially addresses the recommendation of Defense Nuclear Facilities Safety Board Recommendation 94-2 that modeling capability of the Department needs improvement by establishing a requirement for site evaluations that will lead to acquiring sufficient data for use in performance assessments of new or modified disposal facilities.

Requirements Analysis. This requirement is a combination of DOE 5820.2A requirements III.3.i.(7)(b) and 3.i.(8)(a), with significant modifications and expansion. The wording is modified such that it addresses characterization of all low-level radioactive waste management facility locations rather than focusing only on site selection for a potential new low-level waste disposal facility.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. The initial language of site evaluation requirements applied only to disposal facilities. The final wording of the requirement that expanded it to apply to all facilities was in response to achieving consistency with waste type chapters, in responding to comments on draft versions, and to address the needs recognized in the shortcomings of DOE O 420.1.

IV.M.(1) Site Evaluation.

(a) Each site proposed for a new low-level waste facility or expansion of an existing low-level waste facility shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities, including for a low-level waste disposal facility, the capability of the site to demonstrate, at a minimum, whether it is:

1. Located to accommodate the projected volume of waste to be received;

2. Located in a flood plain, a tectonically active area, or in the zone of water table fluctuation; and

3. Located where radionuclide migration pathways are predictable and erosion and surface runoff can be controlled.

(b) Proposed sites with environmental characteristics, geotechnical characteristics, and human activities for which adequate protection cannot be provided through facility design shall be deemed unsuitable for the location of the facility.

Basis:

Functions Evaluated. This requirement derives from the analysis of Disposal functions for constructing a new disposal facility, closing and monitoring all disposal facilities, and Storage and Treatment functions for constructing a new facility.

Safety and Hazard Analyses. This requirement addresses the need for sites for low-level waste management facilities to be selected carefully, especially disposal facilities, and for site characteristics to be appropriately incorporated into the design of low-level waste management facilities (storage, treatment, and disposal). The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the weaknesses and conditions associated with poor facility siting, inadequate designs of facilities, and inadequate data for performance assessment calculations for disposal facilities. Some of the consequences resulting from failures evaluated in this part of the analysis were high, because of catastrophic failures of radioactive material containment that could occur due to environmental and geotechnical characteristics, such as flooding, earthquakes, and severe weather events.

Requirements Analysis. Requirement (a) is an improvement and re-working of the concepts in DOE 5820.2A Requirements III.i.(8)(b) and III.i.(7)(c), III.i.(7)(d), and III.i.(7)(e). Requirement (b) has no predecessor requirement in DOE 5820.2A, although Requirement III.i.(8)(a) referred to ensuring that the requirements of the Order could be met through the site design. The requirement is an improvement to DOE 5820.2A by making these concepts applicable to all low-level radioactive waste management facilities, not just disposal facilities, and by expanding and improving those site characteristics that must be specifically evaluated for a low-level waste disposal facility. The requirement is improved also by requiring that a site shall be avoided if adequate protection from severe natural events cannot be achieved by a facility design in order to adequately protect the public, workers, or the environment.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A for site evaluations and incorporating their results in facility design that were canceled when DOE 6430.1A was replaced.

10 CFR Part 61 was evaluated for essential low-level waste disposal site evaluation and facility design requirements. 10 CFR Part 61 contains site suitability requirements that specify characteristics of disposal sites that must be avoided in selecting a site for a new facility. Since the DOE M 435.1-1 requirement is for all low-level waste management facilities, not just disposal facilities, and siting of facilities will take place only at existing DOE sites and reservations, the requirement is worded to cover all management facilities, and the Part 61 requirements, changed to fit the DOE situation, added for applicability to disposal facilities only. Requirement (a) calls for site selection criteria (derived from Part 61) specifically addressing DOE needs to be considered in site selection and site evaluations, and included as part of a site's demonstration that it can contribute to an adequate disposal system. Requirement (b) is attempting to address the stricter concept embodied in the site suitability requirements of 10 CFR Part 61 for eliminating sites which have an environmental or geotechnical characteristics which needs to be avoided, based on there being no ability to design against the characteristic. The specific site characteristics that are to be avoided in Section 61.50 are discussed in the guidance on DOE M 435.1-1.

Other Considerations. The requirements are performance based to accommodate the selection of sites for new DOE low-level waste management facilities, which are restricted to the existing DOE reservations. (It may be preferable to choose the location for a new facility adjacent to a currently operating facility, even if geotechnical and environmental characteristics are not ideal). Therefore the approach is for these characteristics to be incorporated into the design of the facility, and the site should be avoided when the design cannot appropriately compensate for an environmental or geotechnical characteristic in a way that will provide adequate protection.

The requirement adds defense-in-depth to the regulation of storage and treatment facilities for low-level waste as avoidance of sites with inferior environmental and/or geotechnical characteristics has not been specifically required by DOE in past Orders for these facilities. Defense-in-depth for low-level waste disposal facilities is also provided, in a comparable way as in 10 CFR Part 61, except the specific geotechnical and environmental characteristics of this DOE M 435.1-1 requirement are not framed as exclusionary criteria. The use of the performance assessment in support of the design, operation, closure, monitoring, and establishment of site-specific waste acceptance criteria, with consideration of site-specific geotechnical and environmental characteristics, can compensate for the lack of exclusionary site selection criteria in the DOE regulatory scheme of Chapter IV of DOE M 435.1-1. The final wording of these two requirements is partially based on making the waste type chapters of the Manual consistent, and in response to specific concerns of the Defense Nuclear Facilities Safety Board on draft versions of the Manual requirement, the final wording partially addresses Defense Nuclear Facilities Safety Board Recommendation 94-2 that additional requirements, guidance, and standards similar to commercial facilities be incorporated into the low-level waste essential requirements.

IV.M.(1) Site Evaluation.

(c) Low-level waste disposal facilities shall be sited to achieve long-term stability and to minimize, to the extent practical, the need for active maintenance following final closure.

Basis:

Functions Evaluated. This requirement derives from the analysis of Disposal functions associated with design, construction, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for the disposal system (e.g., site location, design, waste emplacement, packaging, closure) to result in a stable site that will perform in a manner which is protective of workers, the public and the environment. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the weakness associated with an unstable site which could result in failures over time and would release radioactivity. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. This requirement has no direct predecessor in DOE 5820.2A. However, Requirement 5820.2A, III.3.f.(2) focused on treatment of waste to provide a stable waste form, and Requirement 5820.2A, III.3.i.(5) implied that disposal site stability was necessary. This DOE M 435.1-1 requirement makes it clear that the site chosen and developed for low-level waste disposal facilities must promote site stability.

10 CFR Part 61 was evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be " . . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the siting element of the Part 61 performance objective.

Other Considerations. The requirement is performance-based to allow flexibility in determining characteristics of the site and design which can be utilized to promote site stability after closure, rather than specifying characteristics that must be achieved.

IV.M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Low-level waste systems and components shall be designed to maintain waste confinement.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions for placing and monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need for some low-level waste management facilities to provide additional confinement barriers in addition to packaging. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the specific weaknesses and conditions of managing liquid low-level waste, and containers in storage leaking or breaking during handling, and waste being in storage longer than planned. Weaknesses identified in the high-level waste safety and hazard analyses included failures due to aging, erosion and mechanical damage.

Requirements Analysis. The requirement is partially derived from the DOE 5820.2A Requirements I.3.b.(2)(a) requiring double containment for all new high-level waste facilities, but is improved and applied to low-level waste treatment and storage facilities. The requirement is also based on an evaluation of *Resource Conservation and Recovery Act* requirements appearing at 40 CFR Part 264, Subpart J and 40 CFR Part 265 Subpart J, and evaluation of DOE 6430.1A.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. The confinement requirement was partially derived from the achievement of consistency between the waste type chapters. The high-level waste chapter has several minimum design requirements specified, and this requirement in the high-level waste chapter addressed some weaknesses and conditions identified in some low-level waste functions. Defense-in-depth is provided for low-level waste treatment and storage facilities by requiring certain minimum design specifications to protect against known hazards in radioactive waste management.

IV.M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(b) Ventilation.

1. Design of low-level waste treatment and storage facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in applicable requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Basis:

Functions Evaluated. This requirement derives from the analysis of Treatment functions for verifying waste meets waste acceptance criteria, providing interim storage at the treatment facility, and processing waste, and the storage function for monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need to include ventilation systems as appropriate in facilities that treat and store low-level waste due to the receipt of waste in gaseous form, or waste which degrades and creates gases in the container. The requirements address the weaknesses of receiving waste with incorrect characterization information or which contains an unknown material and of having to open containers to verify the contents. Potential impacts to workers is the specific hazard addressed through this requirement. Requirement (b)2. specifically addresses the weakness associated with the receipt of a container that includes a gas or an explosive agent. Processing a container of low-level waste with a gas or an explosive was identified as a high hazard activity due to potentially large consequences in the safety and hazard analysis conducted on low-level waste treatment.

Requirements Analysis. The requirements are similar to the requirement in 5820.2A, I.3.b.(2)(f) requiring ventilation systems to maintain radionuclide release within published guidelines at high-level waste tanks, but it is applied to low-level waste treatment and storage facilities. The requirement is partially derived from requirements in 10 CFR Part 835 *Occupational Radiation Protection,* DOE 5400.5 *Radiation Protection of the Public and Environment,* and 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

Other Considerations. These requirements were partially derived from the achievement of consistency between the waste type chapters. Defense-in-depth is provided for low-level waste treatment and storage facilities by requiring certain minimum design specifications to protect against known hazards in radioactive waste management.

IV. M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(c) Consideration of Decontamination and Decommissioning. Areas in new and modifications to existing low-level waste management facilities that are subject to contamination with radioactive or other hazardous materials shall be designed to facilitate decontamination. For such facilities a proposed decommissioning method or a conversion method leading to reuse shall be described.

Basis:

Functions Evaluated. This requirement derives from the analysis of Storage and Treatment functions for constructing a new facility and the Treatment function for closure of a treatment facility.

Safety and Hazard Analyses. The requirement addresses the need for incorporating waste generation reduction and minimization into the design of new management facilities. The condition identified in the safety and hazards analyses being addressed by this requirement is managing the residuals from a treatment facility.

Requirements Analysis. This requirement improves on DOE 5820.2A requirements III.3.c on waste generation minimization and reduction, and on the policies in III.2.a. and 2.b. that no legacies requiring remedial action should remain after low-level waste operations are terminated and that low-level waste should be managed in a systematic way that includes waste generation reduction. DOE O 430.1A was evaluated during the development of planning requirements for radioactive waste, and it was found to be sufficient for management of radioactive waste management facilities and other assets of the low-level waste management system, but it did not adequately discuss planning of waste streams to be generated by facilities, including radioactive waste management facilities.

Other Considerations. This requirement was added to promote best management practices to include consideration of the entire life-cycle of the management of waste that will be generated from operating a low-level waste management facility. Preventing or minimizing the generation of waste is a top-level principle that is incorporated into DOE M 435.1-1 wherever possible.

IV.M.(2) Low-Level Waste Treatment and Storage Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(d) Instrumentation and Control Systems. Engineering controls shall be incorporated in the design and engineering of low-level waste treatment and storage facilities to provide volume inventory data and to prevent spills, leaks, and overflows from tanks or containment systems.

(e) Monitoring. Monitoring and leak detection capabilities shall be incorporated in the design and engineering of low-level waste treatment and storage facilities to provide rapid identification of failed containment and/or other abnormal conditions.

Basis:

Functions Evaluated. These requirements derive from the analysis of storage functions for monitoring waste in storage and maintaining the storage facility, and the Treatment functions for providing interim storage at the treatment facility, processing waste, and maintaining the facility.

Safety and Hazard Analyses. Requirement (b) addresses the need to detect system failures that could lead to significant consequences. Requirement (c) addresses the need to provide instrumentation and other engineered items to allow for control of the storage and transfer of waste in tanks and processing lines. Possible hazards addressed by this requirement include unplanned exposures of workers, and impacts to the public and environment due to loss of control of a treatment process. The requirements address the weaknesses and conditions of liquid low-level waste tanks breaching or being overfilled, containers in storage leaking or breaking during handling, or liquid low-level waste lines in treatment facilities breaching. Potentially high hazards were identified due to large consequences of an undetected liquid low-level waste storage tank breach or overfill, or of a treatment facility process line breaking without detection or because adequate controls were not designed in the facility.

The high-level waste safety and hazard analyses identified weaknesses involving failure to detect flammable gas build up, failure to sample and test waste to establish ignition limits, inadequate storage tank level monitoring, and waste transfer line failure.

Requirements Analysis. The requirements are based on the DOE 5820.2A requirements I.3.b.(3)(a) and I.3.b.(2)(h) for high-level waste tanks. The requirements are expanded to apply to low-level waste treatment and storage facilities and the controls are required to be part of the design of new facilities.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from requirements in DOE 6430.1A, Section D13, *Special Facilities*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. The requirements were partially derived from the achievement of consistency between the waste type chapters. The high-level waste chapter has several minimum design requirements specified, and these requirement in the high-level waste chapter addressed some weaknesses and conditions identified in some low-level waste functions. Defense-in-depth is provided for low-level waste treatment and storage facilities by requiring certain minimum design specifications to protect against known hazards in radioactive waste management. The requirements also support the ALARA principle by attempting to detect and control hazardous situations through design of instrumentation, providing a layer of protection to workers.

IV.M.(3) Low-Level Waste Disposal Facility Design. The following facility requirements and general design criteria, at a minimum, apply:

(a) Confinement. Low-level waste systems and components shall be designed to maintain waste confinement.

Basis:

Functions Evaluated. This requirement derives from the analysis of the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. The requirement addresses the need for the low-level waste disposal facility to provide confinement barriers in addition to the confinement of waste provided by waste containers. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the specific weaknesses and conditions of poorly designed containers, the breaching of containers during operations, containers failing over time, inadequate waste processing, and inadequate characterization of waste. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. Principal design considerations and the specific design requirements for a low-level waste disposal facility in 10 CFR Part 61 were evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a design objective (61.51(a)(1)) calling for disposal facility design features to " . . . be directed towards long-term isolation (of waste) . . ." There are no requirements in Part 61 that specifically require confinement to be provided by the design of the facility. DOE 6430.1A contained modified versions of Part 61 requirements, and other requirements, for the design of low-level waste disposal facilities.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from several requirements in DOE 6430.1A, Section D13, *Special Facilities,* that were canceled when DOE 6430.1A was replaced.

Other Considerations. This is a performance based requirement that reflects the compilation of some design requirements that used to be in DOE 6430.1A, Section D13, *Special Facilities,* Section 1324-5.3, *Low-Level Waste Disposal Facility Confinement.* These were planned for inclusion in the guidance document for implementation of DOE O 420.1. Instead, these requirements were considered essential low-level waste disposal facility design requirements, and are included in this performance based requirement in DOE M 435.1-1, and not the guidance on DOE O 420.1. The requirement is performance-based to allow flexibility in determining characteristics of the design which can be provide for waste confinement, both during operations and after closure, rather than specifying design characteristics that must be used. The requirement provides defense-in-depth for confinement of waste which may escape from its waste disposal container, but also an initial confinement barrier for wastes disposed in bulk, uncontainerized fashion.

IV.M.(3)(b) Ventilation.

1. Design of low-level waste disposal facilities shall include ventilation, if applicable, through an appropriate filtration system to maintain the release of radioactive material in airborne effluents within the requirements and guidelines specified in requirements.

2. When conditions exist for generating gases in flammable or explosive concentrations, ventilation systems or other measures shall be provided to keep the gases in a non-flammable and non-explosive condition. Where concentrations of explosive or flammable gases are expected to approach the lower flammability limit, measures shall be taken to prevent deflagration or detonation.

Basis:

Functions Evaluated. This requirement derives from the analysis of Treatment functions for verifying waste meets waste acceptance criteria, providing interim storage at the treatment facility, and processing waste, and the storage function for monitoring waste in storage.

Safety and Hazard Analyses. The requirement addresses the need to include ventilation systems, where applicable, in disposal facilities due to the receipt of waste which contains a gas or which may degrade and create gases in the container. This requirement addresses hazards to workers due to unplanned exposures. The requirements address the weaknesses of receiving waste with incorrect characterization information or which contains an unknown material. Requirement (b)2. specifically addresses the weakness associated with the receipt of a container that includes a gas or an explosive agent, even though waste accepted at disposal facilities are not supposed to include untreated explosive agents.

Requirements Analysis. The requirements are similar to the requirement in 5820.2A, I.3.b.(2)(f) requiring ventilation systems to maintain radionuclide release within published guidelines at high-level waste tanks, but it is applied to low-level waste disposal facilities, where applicable. The requirement is partially derived from requirements in 10 CFR Part 835 *Occupational Radiation Protection,* DOE 5400.5 *Radiation Protection of the Public and Environment,* and 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants*.

Other Considerations. These requirements were partially derived from the achievement of consistency between the waste type chapters. Defense-in-depth is provided for certain designs of low-level waste disposal facilities by requiring minimum design specifications to protect against

known hazards in radioactive waste management. The design requirement is meant to be applicable for the operational period of the facility, and not for post-closure considerations. Not all low-level waste disposal facilities require ventilation during operations; the requirement was considered necessary when considering above-ground, or highly-engineered below-ground facilities, like vaults, that are more confined spaces than open trench disposal facilities.

IV.M.(3)(c) Stability. Low-level waste disposal facilities shall be designed to achieve long-term stability and to minimize to the extent practical, the need for active maintenance following final closure.

Basis:

Functions Evaluated. This requirement derives from the analysis of the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for the disposal system (e.g., site location, design, waste emplacement, packaging, closure) to result in a stable site that will perform in a manner which is protective of the public, workers and the environment. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement. The requirement addresses the weakness and conditions of poorly designed waste containers, containers failing over time, inadequate waste processing, poor characterization of site features, or the necessary selection of a site with some site characteristic flaws. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. This requirement has no direct predecessor in DOE 5820.2A. However, Requirement 5820.2A, III.3.f.(2) focused on treatment of waste to provide a stable waste form, and Requirement 5820.2A, III.3.i.(5) implied that disposal site stability was necessary. This DOE M 435.1-1 requirement makes it clear that the design of the low-level waste disposal facility must promote site stability following closure.

Principal design considerations and the specific design requirements for a low-level waste disposal facility in 10 CFR Part 61 were evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be " . . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as

necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the design element of the Part 61 performance objective.

Other Considerations. This is a performance based requirement that reflects the compilation of some design requirements that used to be in DOE 6430.1A, Section D13, *Special Facilities.* These were planned for inclusion in the guidance document for implementation of DOE O 420.1. Instead, these requirements were considered essential low-level waste disposal facility design requirements, and are included in this performance based requirement in DOE M 435.1-1, and not the guidance on DOE O 420.1. The requirement is performance-based to allow flexibility in determining characteristics of the design which can be utilized to promote site stability after closure, rather than specifying characteristics that must be achieved.

IV.M.(3)(d) Control of Water. Low-level waste disposal facilities shall be designed to minimize to the extent practical, the contact of waste with water during and after disposal.

Basis:

Functions Evaluated. This requirement derives from the analysis of the Disposal functions for design, construction, operation, and closure of the low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for the disposal system (e.g., site location, design, waste emplacement, packaging, closure) to minimize the contact of water with waste, both during and after disposal, so that the site will perform in a manner which is protective of workers, the public and the environment. The hazards associated with impacts to the long-term performance of the disposal facility are partially addressed by this requirement, as well as short-term impacts to the environment due to contact of waste and water during operations. The requirement addresses the weakness associated with water contacting waste which could result in movement of radionuclides away from the facility; containers failing over time and releasing radioactivity; covers being poorly designed; site characteristics being poorly understood, and; over-reliance on performance assessment modeling for facility design. The requirement partially addresses the recommendation in the Defense Nuclear Facilities Safety Board Recommendation 94-2 that DOE include additional requirements, guidance, and standards based on the requirements covering commercial low-level waste facilities.

Requirements Analysis. Principal design considerations and the specific design requirements for a low-level waste disposal facility in 10 CFR Part 61 were evaluated for essential requirements for DOE low-level disposal facilities. A principal concept embodied in Part 61 is that the disposal siting, design, operations, and closure should all be directed at minimizing the contact of waste with water. Part 61 requirements 61.51(a)(4), (a)(5), and (a)(6) all require specific design features to achieve this principal goal. These requirements, in a modified form, were included in DOE's design requirements in DOE 6430.1A.

DOE O 420.1 was evaluated and found insufficient to cover all essential site evaluation and design requirements for radioactive waste management facilities, therefore, the Order which it replaced, DOE 6430.1A was evaluated. This requirement is partially derived from several requirements in DOE 6430.1A, Section D13, *Special Facilities,* Section 1324-5.3, *Low-Level Waste Disposal Facility Confinement*, that were canceled when DOE 6430.1A was replaced.

Other Considerations. This is a performance based requirement that reflects the compilation of some design requirements that used to be in DOE 6430.1A, Section D13, *Special Facilities.* These were planned for inclusion in the guidance document for implementation of DOE O 420.1. Instead, these requirements were considered essential low-level waste disposal facility design requirements, and are included in this performance based requirement in DOE M 435.1-1, and not the guidance on DOE O 420.1. This provides defense-in-depth to the reliance on the use of the performance assessment modeling for disposal facility design.

The performance based requirement essentially reflects the concept in the three specific 10 CFR Part 61 requirements, but at a higher level. The discussions of those requirements is in the DOE M 435.1-1 guidance documentation. The requirement is performance-based to allow flexibility in determining characteristics of the design which can be utilized to minimize contact of water with waste, rather than specifying characteristics that must be achieved.

IV. N. <u>Storage and Staging.</u>

The following requirements are in addition to those in Chapter I of this Manual.

(1) Storage Prohibitions. Low-level waste in storage shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water. Prior to storage, pyrophoric materials shall be treated, prepared, and packaged to be nonflammable.

Basis:

Functions Evaluated. This requirement is based on analyses of functions associated with the storage of transuranic waste. The specific functions affecting this requirement include developing waste acceptance criteria for receiving waste for storage and placing waste into storage.

Safety and Hazard Analyses. The safety and hazards analysis identified weaknesses or conditions associated with a lack of thorough analysis or a failure to integrate all pertinent data (e.g., safety analysis report) in the development of waste acceptance criteria for the storage facility. The resultant hazard is that containers with incompatible materials or energy sources such as explosives or reactives are received that can cause releases that endanger workers or release radioactivity to the environment.

Requirements Analysis. The requirements analysis determined that a number of existing internal and external requirements require evaluations of hazards that should be considered in decisions about what can be safely put into a container and placed in storage. These requirements are included in RCRA, DOE 5480.21, *Unreviewed Safety Questions*, 5480.22, *Technical Safety Requirements*, 5480.23, *Nuclear Safety Analysis Report*s, and 420.1, *Facility Safety*. Guidance on developing waste acceptance requirements and for establishing a radioactive waste management basis discusses how results of hazards evaluations based on these other DOE Directives and external requirements should be factored into those documents. These other Directives and requirements are invoked in Chapter I of the Manual

Other Considerations. Based on Defense Nuclear Facilities Safety Board comments on draft versions of DOE M 435.1-1, specific requirements for prohibiting certain types of material from storage were added to the Manual. Incorporation of language that specifically identifies materials that are not to be stored adds defense-in-depth by specifically addressing the weaknesses related to not conducting a sufficiently rigorous analysis when developing waste acceptance requirements. The current requirement is a best management practice which will prevent or minimize instances of occurrences which have been reported or observed in waste management at DOE sites.

IV. N.(2) Storage Limit. Low-level waste that has an identified path to disposal shall not be stored longer than one year prior to disposal, except for storage for decay, or as otherwise authorized by the Field Element Manager.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage of low-level waste.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of loss of characterization data and waste certified for disposal degrading during a storage period longer than anticipated. The most significant hazard addressed by this requirement is potential exposure to workers. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement has no predecessor requirements in DOE 5820.2A, except for storage for decay. This requirement continues the storage for decay policy in DOE 5820.2A, III.h.(4). RCRA storage requirements were also evaluated, however, the approach and time frames in the EPA requirements for hazardous waste were not used as a basis for the storage limitation. Storage for decay is allowed in NRC requirements at 10 CFR Part 20.

Other Considerations. This requirement is a performance based requirement to address the storage vulnerabilities identified at many sites during the Complex-Wide Review. Defense-in-

depth is provided in limiting the allowable storage period to one year for waste with a disposal path to prevent loss of package integrity and characterization information on the waste. The one year period was chosen to provide a reasonable period of time for storage if needed, but which will not result in damage to waste forms or containers, or loss of information. Additionally, studies have demonstrated the cost-effectiveness of disposing of waste in a timely manner following its generation. Comments on draft versions of the Manual resulted in continuance of the storage-for-decay policy in DOE M 435.1-1, which has proven an effective and safe methodology for management of radioactive waste

IV. N.(3) Storage Integrity. Low-level waste shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage functions for low-level waste of placing waste in storage and monitoring waste while in storage.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions associated with waste being in storage for longer periods of time than planned, for poor emplacement of waste within a storage facility, and for poor storage containers. The most significant hazard addressed by this requirement is potential exposure to workers. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement has predecessor requirements in the Transuranic Waste Chapter of DOE 5820.2A, Requirements II.3.e.(7) and II.3.g.(2)(f). Also, RCRA storage requirements for hazardous waste were evaluated for assistance in defining a storage approach, with associated time frames if appropriate, for protecting the integrity of low-level waste in storage.

Other Considerations. The current performance based requirement to provide protection of the integrity of waste containers in storage was derived independently from any existing requirements. Original language included protecting stored waste from prolonged exposures to the elements, such as rain and sun, and suggested that covers, temperature controls, and secondary containment were acceptable ways to do this. The final wording resulted partially from ensuring the requirement did not include items which were more appropriately addressed in guidance, and partially from ensuring consistency between waste type chapters. It also addresses a concern raised in comments on draft versions of the Manual from the Defense Nuclear Facilities Safety Board that waste storage should not result in exposure to workers involved in activities unrelated to maintaining the stored waste, i.e., workers involved in other activities should not have stored waste in their work area.

IV.N.(4) Waste Characterization for Storage

(a) Low-level waste that does not have an identified path to disposal shall be characterized as necessary to meet the data quality objectives and minimum characterization requirements of this chapter and to facilitate disposal.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage of low-level waste, and for treatment and storage functions for ensuring disposal waste acceptance criteria are complied with.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of loss of characterization data for waste in storage for long periods of time, and for acceptance of waste at a disposal facility with inadequate characterization information. The potential impacts to the long-term performance of the disposal facility is the most significant hazard addressed by this requirement. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement has no predecessor requirements in DOE 5820.2A. RCRA storage requirements were also evaluated, however, the approach and time frames in the EPA requirements for hazardous waste were not used as a basis for storage limitations on waste with no path forward.

Other Considerations. This requirement is a performance based requirement to address the storage vulnerabilities identified at many sites during the Complex-Wide Review. Defense-in-depth is provided by implementing the data quality objectives process for this waste, which will account for the longer expected storage time in determining what characterization information is needed.

IV.N.(4)(b) Characterization information for all low-level waste in storage shall be maintained as a record in accordance with the requirements for Records Management in Chapter I of this Manual.

Basis:

Functions Evaluated. This requirement derives from the analysis of storage of low-level waste, and for treatment and storage functions for ensuring disposal waste acceptance requirements are complied with.

Safety and Hazard Analyses. The requirement addresses the weaknesses and conditions of loss of characterization data for waste in storage, (especially for waste stored longer than expected)

and for acceptance of waste at a disposal facility with inadequate characterization information. The potential impacts to the long-term performance of the disposal facility is the most significant hazard addressed by this requirement, especially as it concerns disposal of waste that has been in storage for a very long time. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement is an improvement to DOE 5820.2A, III.3.h.(2). The current DOE Orders on records management were evaluated and determined to implement adequate controls to ensure characterization information on waste in storage would not be lost, therefore, reference is made in the requirement to the General Requirements chapter where these Orders are invoked.

Other Considerations. Defense-in-depth is provided by specifically implementing the records management requirements on stored waste to ensure characterization information is not lost.

IV.N.(5) Container Inspection. A process shall be developed and implemented for inspecting and maintaining containers of low-level waste to ensure container integrity is not compromised.

Basis:

Functions Evaluated. This requirement derives from the analysis of transuranic waste management functions for maintaining waste storage, and monitoring waste containment and configuration.

Safety and Hazard Analyses. The requirement addresses the need to monitor the conditions of packages in storage to identify problems with stored waste, so that problems are minimized when the waste is transferred for disposal, or if waste is in storage longer than anticipated. The weaknesses and conditions identified in the transuranic waste safety and hazard analyses included of failure of waste packages and releases to the environment and public. The hazards addressed by this requirement include possible releases that could harm workers or damage the environment. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement is derived from the Requirements DOE O 5820.2A, II.3.e.(4) for having a process for package inspection and maintenance for transuranic waste in storage, extended to storage of low-level waste.

Other Considerations. This requirement was derived from the achievement of consistency between the waste type chapters. The transuranic waste chapter contained more prescriptive requirements for stored waste due to the experience of transuranic waste storage, and this

requirement was incorporated into the low-level waste requirements because of the desire to improve the storage of low-level waste in response to the Complex-Wide Review Vulnerabilities.

IV.N.(6) Storage Management. Low-level waste storage shall be managed to identify and segregate low-level waste from mixed low-level waste.

Basis:

Functions Evaluated. This requirement derives from the analysis of transuranic waste storage functions related to disposition of transuranic waste.

Safety and Hazard Analyses. The requirement addresses the need to provide separate storage for mixed low-level and low-level wastes so that different requirements for the hazardous component of mixed waste can be efficiently implemented. The weaknesses and condition identified in the analysis that addressed by this requirement is the additional management steps required for mixed low-level. The hazard addressed by this requirement is the potential additional exposures to workers from additional management steps for complying with RCRA requirements for mixed waste. This storage requirement also addresses the Complex-Wide Review Vulnerabilities on Low-Level Waste in Storage and on Inadequate Low-Level Waste Storage Conditions.

Requirements Analysis. The requirement is an improvement on Requirement DOE 5820.2A, III.3.c.(3), and an extension of the segregation concepts in transuranic waste Requirement DOE 5820.2A, II.3.e.(2) to low-level waste management. DOE M 435.1-1 does not address uncontaminated material, so this part of the DOE 5820.2A, Chapter III requirement is dropped. RCRA storage requirements were evaluated to determine the necessity and approach for storage segregation, but no essential requirements were found to specifically address the needs identified.

Other Considerations. The requirement was not originally in the essential low-level waste requirements and was partially derived when consistency between waste type chapters in the Manual was being addressed. Also, segregation of mixed from non-mixed low-level waste is considered a best management practice at many sites, and has proven to be cost-effective. It also supports the ALARA principle, as non-mixed low-level waste does not have to undergo rigorous hazardous waste management inspection regimes.

IV.N.(7) Staging. Staging of low-level waste shall be for the purpose of the accumulation of such quantities of waste as necessary to facilitate transportation, treatment, and disposal. Staging longer than 90 days shall meet the requirements for storage above and in Chapter I of this Manual.

Functions Evaluated. This requirement derives from the analysis of interim storage activities for treatment of low-level waste and emplacement at disposal facilities.

Safety and Hazard Analyses. This requirement addresses the need for safe interim storage at generator, treatment, and storage facilities prior to treatment, long-term storage, or disposal, and safe staging prior to shipment. The requirement addresses the weaknesses and conditions of having waste stored at staging locations for longer periods of time than planned. Also, this requirement partially addresses the Complex-Wide Vulnerability for storing waste in inadequate storage conditions.

Requirements Analysis. Requirements for staging have no predecessor requirements in DOE 5820.2A. RCRA requirements were evaluated and used as a basis for the staging period of 90 days so that there is a consistent time frame allowable for all low-level waste (including mixed) in a staging location. Also, consistent with RCRA requirements, if the waste is to stay in staging for longer than the 90 day period, the storage requirements of DOE M 435.1-1 must be met.

Other Considerations. The requirement is worded to be performance based, and allowing staging promotes cost-effective operation of the waste management facility because of economies of scale, batching, emplacement of waste in groups, etc. By not invoking the requirements of storage on staging, treatment and disposal facilities can apply facility specific requirements necessary for safe management of the waste during interim operations.

IV.O. <u>Treatment</u>.

> **Low-level waste treatment to provide more stable waste forms and to improve the long-term performance of a low-level waste disposal facility shall be implemented as necessary to meet the performance objectives of the disposal facility.**

Basis:

Functions Evaluated. This requirement derives from the analysis of the Treatment function for processing low-level waste.

Safety and Hazard Analyses. This requirement addresses the need for operations conducted at low-level waste treatment facilities to produce waste forms that support disposal site stability and which support meeting the performance objectives. The requirement addresses the weaknesses and conditions of poor waste forms being produced by treatment. The hazards associated with the long-term performance of the disposal facility is addressed by this requirement.

Requirements Analysis. This DOE M 435.1-1 requirements for treatment of waste improves upon the requirements in DOE 5820.2A, Chapter III.3.f (1) thru (3). The part of the requirement for treating waste to facilitate meeting performance objectives is a clarification of DOE 5820.2A that treatment augments the ability to meet the <u>disposal</u> performance objectives. The wording of the requirement is simplified so that references to how treatment can increase the life of the disposal facility (i.e., improved site stability and reduction of infiltrating water) are not specified.

In addition, III.3.f.(3) for development of large scale treatment facilities is addressed by other requirements in the General Requirements Chapter for meeting the existing DOE Orders covering design, construction, environmental and safety documentation. Also, the part of the requirement from III.3.f.(3) requiring a study justifying the need for treatment is deleted. The concepts embodied in the requirement are consistent with the major objectives of 10 CFR Part 61 for site stability after disposal and meeting the performance objectives for disposal of waste.

Other Considerations. The wording of the requirement is performance based, and includes the essential concept that low-level waste produced by all methods of waste is to support the stability and performance of the disposal facility to which it is sent.

IV. P. Disposal.

Low-level waste disposal facilities shall meet the following requirements.

(1) Performance Objectives. Low-level waste disposal facilities shall be sited, designed, operated, maintained, and closed so that a reasonable expectation exists that the following performance objectives will be met for waste disposed of after September 26, 1988:

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment, and the closure of a disposal facility.

Safety and Hazards Analyses. This requirement partially addresses the need to ensure that low-level waste disposal facilities are designed, constructed, operated, and closed in a manner that does not impose an unacceptable dose to current or future members of the public. The requirement addresses potential weaknesses and conditions that could occur if consideration was not given to the potential impacts, including long-term impacts, of waste disposal.

Requirements Analysis. This requirement is a slight modification of the DOE 5820.2A requirement III.3.a. The modification is to remove the date reference (instead it is now part of DOE M 435.1-1, IV.P.(2) which requires a performance assessment), and reference to an implementation plan. Since DOE 5820.2A was issued in 1988, the requirement for compliance with this aspect of the manual should no longer require an implementation schedule. Additionally, the reference to the disposal of waste has been replaced with the functions to be addressed by the performance objectives that follow. 10 CFR Part 61 was evaluated and the concept of performance objectives introduced in 10 CFR Part 61 and used in DOE 5820.2A was retained in DOE M 435.1-1. The performance objectives were revised to more clearly address the performance of a disposal facility in terms of recognized standards for protection of individually exposed members of the public.

The performance objectives for the individual facility are augmented by other DOE M 435.1-1 requirements for preparation of a performance assessment IV.P.(2), the requirement that low-level waste disposal facilities are to be controlled by DOE until they can be released in accordance with DOE 5400.5 IV.Q.(2)(c), and the requirement to develop a composite analysis that assesses the potential collective impact on future members of the public from the low-level waste disposal facility along with other radioactive sources IV.P.(3).

Other Considerations. The final wording in this requirement reflects the responses to comments made by DOE-EH, and more closely reflects the concepts included in 10 CFR Part 61 for the regulation of low-level waste.

IV. P.(a) Dose to representative members of the public shall not exceed 25 mrem (0.25 mSv) in a year total effective dose equivalent from all exposure pathways, excluding the dose from radon and its progeny in air.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that DOE low-level waste disposal does not result in unacceptable doses to the public. The requirement addresses potential weaknesses and conditions that could occur if consideration was not given to the potential impacts, including long-term impacts, of waste disposal.

Requirements Analysis. This requirement is a modification of a portion of the performance objective in 5820.2A, III.3.a.(2). Modifications were made to improve clarity, technical accuracy, and to be consistent with standards for radiological protection. The wording was revised to make it clear that the dose limit is all pathways and to avoid the implication in 5820.2A that there is an allowance of 10 mrem/yr via the air pathway. Changes were made to make the requirement clear that the dose calculation is to be consistent with ICRP 26/30 methodology by specifying that the dose is the total effective dose equivalent. Additionally, consistent with the practice in the National Emission Standards for Hazardous Air Pollutants, the dose from radon and progeny is not included in the all-pathways limit.

This requirement is consistent with established radiation protection practice that allocates a fraction of the 100 mrem/yr public dose limit to a particular practice or activity. It is also consistent with the regulatory practice of the NRC to require an all-pathways assessments, and thus is consistent the NRC low-level waste disposal facility licensing requirements at 10 CFR Part 61.

Other Considerations. The final wording of this requirement resulted from the development of responses to comments on the 2/28/97 draft of the Order and Defense Nuclear Facilities Safety Board Recommendation 94-2 deliverables.

IV. P.(b) Dose to representative members of the public via the air pathway shall not exceed 10 mrem (0.10 mSv) in a year total effective dose equivalent, excluding the dose from radon and its progeny.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility and maintenance of a performance assessment and the closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that low-level waste disposal does not cause doses to members of the public in excess of those established in other requirements and DOE Orders (DOE 5400.5). The requirement addresses potential weaknesses and conditions that could occur if consideration was not given to the potential impacts, including long-term impacts, of waste disposal.

Requirements Analysis. This requirement is a modification of a portion of the performance objective in 5820.2A, III.3.a.(2). Modifications were made to improve clarity, technical accuracy, and to be consistent with standards for radiological protection. Changes were to made to make the requirement clear that the dose calculation is to be consistent with ICRP 26/30 methodology by specifying that the dose is the total effective dose equivalent. Additionally, consistent with the practice in the National Emission Standards for Hazardous Air Pollutants (NESHAPs), the dose from radon and progeny is not included in the air-pathway limit. In addition, rather than refer to the NESHAPs requirements, the specific dose limit for the air pathway is given in the performance objective.

Other Considerations. The final wording of this requirement is in response to comments and the development of Defense Nuclear Facilities Safety Board Recommendation 94-2 deliverables.

IV. P.(c) Release of radon shall be less than an average flux of 20 pCi/m^2/s (0.74Bq/m^2/s) at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/l (0.0185 Bq/l) of air may be applied at the boundary of the facility.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for establishing a practically applicable measure for the disposal of radon-emitting waste at Department of Energy sites. The standard addresses a weakness associated with the disposal of quantities of waste that emit radon and weaknesses in disposal facility design (cover design or depth of burial) necessary to ensure adequate protection from this type of waste.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. The Environmental Protection Agency has recognized in its National Emission Standards for Hazardous Air Pollutants that there is a practical need for a separate standard for radon. Consequently, the requirements of 40 CFR Part 61 Subpart H have a limit for dose via the air pathway from DOE facilities that excludes radon and its progeny. Similarly, the EPA and NRC have established a performance standard for uranium mill tailings, in recognition of the special situation with mill tailings having high levels of radon, that would preclude practical disposal options if a fraction of the public dose limit (100 mrem/yr) were applied. To address the situation where a waste may have a reasonably high radon concentration, the Department is applying the radon flux standard as a separate limit for waste disposal. This requirement was adopted from the uranium mill tailings requirements at 40 CFR Part 192 and 10 CFR Part 40. 10 CFR Part 40 discusses both Rn-222 from the decay of Uranium and Rn-220 from the decay of Thorium, therefore, the performance objective refers only to Radon, and the correct species must be analyzed depending on the characteristics of the waste streams.

Other Considerations. This requirement is consistent with the critical performance assessment assumptions and performance assessment guidance that the Department has developed under its implementation plan for Defense Nuclear Facilities Safety Board Recommendation 94-2. Final wording of the performance objective reflects consideration of comments from DOE-EH on draft versions of the Manual.

DOE wastes should be recognized to be unlike uranium mill tailings where the radon levels are real problems that exist at the current time, the release of radon from much of DOE's waste will not occur for many years to come because of the time needed for uranium and thorium daughter products to build up in the waste.

IV. P.(2) **<u>Performance Assessment.</u>**

A site-specific radiological performance assessment shall be prepared and maintained for DOE low-level waste disposed of after September 26, 1988. The performance assessment shall include calculations for a 1,000 year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in this Chapter are not exceeded as a result of operation and closure of the facility.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement, along with the DOE M 435.1-1 requirement IV.P.(3) for a composite analysis, addresses the need to evaluate the disposal system and expected waste receipts to provide some assurance that today's waste disposal will not present an unacceptable future dose. The requirement addresses the potential weaknesses and conditions of not having evaluated the long-term safety and performance of the disposal facility when it needs to provide safety protection for the long-term, poor integration of documents important to safety (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or no accountability at the highest management positions for ensuring the most important requirements for safety will be met.

Requirements Analysis. This requirement is a modification of the DOE 5820.2A requirement III.3.b.(1). The modifications include specifying a date for applicability (the date was previously stated in paragraph III.3.a of 5820.2A), stating that the PA is to provide a reasonable expectation rather than demonstrating compliance with the performance objectives, and establishing a time of compliance of 1000 years. The requirement for low-level waste disposed of after September 26, 1988 to meet a set of performance objectives was included in 5820.2A, III.3.a. The requirement has been reworded for clarity by stating the relationship to the cutoff date in the positive rather than the negative.

The date of September 26, 1988 was established with the issuance of DOE 5820.2A as a date for application of the performance objectives. This cutoff date was set because only new waste (i.e., waste disposed of after the cutoff) would be able to be disposed of in accordance with the new criteria in DOE 5820.2A. Applying the standard to new waste was done with recognition that the *Comprehensive Environmental Response, Compensation, and Liability Act* provides a process for addressing remediation of past waste disposal, if needed. Maintaining this date recognizes that DOE O 435.1 and DOE M 435.1-1 is an improvement on the performance assessment methodologies of 5820.2A, not a change in concepts or methods.

The addition of the term reasonable expectation was made to put the results of the performance assessment in the proper context. A performance assessment constitutes a projection of future events, not a prediction. Therefore, compliance with performance objectives in the future cannot be demonstrated in the present. Rather, the intent of the performance assessment is to provide a reasonable expectation, considering uncertainties in engineered and natural systems over long time periods, that the actual performance of the disposal facility will not result in exceeding the selected performance objectives.

The time which the performance assessment is to project compliance is set at 1000 years. This time frame was selected after consideration of the times used in other requirements (e.g., 40 CFR Part 191, 40 CFR Part 192), and recognition of the uncertainties and hypothetical nature of long-term projections. Paragraph IV.P.(2)(e) addresses performance assessment calculations for periods longer than 1000 years. Based on the study, "Comparison of Low-Level Waste Disposal Programs of DOE and Selected International Countries," (DOE/LLW-236) two countries (Canada and Sweden) have established a time of compliance of 10,000 years. The other two countries (France and the United Kingdom) have not specified a time of compliance. Similarly, to date, DOE, NRC, and the EPA have not specified a time of compliance for low-level waste disposal facility performance assessments. A team composed primarily of DOE contractor performance assessment staff evaluated the options for a time of compliance. In its progress report, "Performance Assessment Task Team Progress Report" (DOE /LLW-157, Rev. 1), the team recommended a time of compliance of 10,000 years. This time was consistent with the time specified in 40 CFR Part 191 for high-level and transuranic waste disposal, and was considered to be conservative in that no longer times had been seriously proposed. This time or longer times had been used in DOE disposal facility performance assessments conducted up to that time. Subsequently, EPA asked agency reviewers for their opinion on the use of 10,000, 1000 or some other time frame as the time for compliance for low-level waste disposal facility performance assessments. DOE responded that its position was that 1000 years was an appropriate time.

This is consistent with USNRC practice, as a performance assessment is a critical piece of the safety documentation required under 10 CFR Part 61, *Licensing Requirements for Land Disposal of Radioactive Waste*.

Other Considerations. The performance assessment is a performance-based system used to evaluate the low-level waste system and to aid in the design, operation, and closure of a low-level waste disposal facility. Unlike a prescriptive approach to facility design and operation that does not incorporate unique environmental features of a site or the wastes to be disposed of, developing innovative design approaches to address site-specific issues or unique wastes being managed with the use of a performance assessment allows for the implementation of an approach to low-level waste disposal directed toward achieving a desired level of performance. The final wording of this requirement is in response to comments made by the Senior Review Panel on draft versions of the Manual.

IV. P.(2)(a) Analyses performed to demonstrate compliance with the performance objectives in this Chapter, and to establish limits on concentrations of radionuclides for disposal based on the performance measures for inadvertent intruders in this Chapter shall be based on reasonable activities in the critical group of exposed individuals. Unless otherwise specified, the assumption of average living habits and exposure conditions in representative critical groups of individuals projected to

receive the highest doses is appropriate. The likelihood of inadvertent intruder scenarios may be considered in interpreting the results of the analyses and establishing radionuclide concentrations, if adequate justification is provided.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that performance assessments do not become extreme in their analyses by trying to project what the activities and lifestyles of future generations will be. To that end, the requirement is to assume that customs and practices of today are assumed to continue into the future. This provides a common basis across the complex for conducting analyses and avoids speculation about the rate and nature of technological development. The requirement also establishes the basis for the dose calculations to be made in the performance assessment by identifying the critical group of exposed individuals as the potential dose recipients.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement was adopted from a recommendation from the *Performance Assessment Task Team Progress Report* (DOE /LW-157, Rev. 1). This requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2.

Other Considerations. The final wording of this requirement was modified from the draft version of the Order in response to comments received from the Field, DOE-EH, and the Senior Review Panel. The final wording is reflective of international practice with respect to radiation protection of the public.

IV. P.(2)(b) The point of compliance shall correspond to the point of highest projected dose or concentration beyond a 100 meter buffer zone surrounding the disposed waste. A larger or smaller buffer zone may be used if adequate justification is provided.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement is based on the need to establish a point of compliance for the purposes of performing prospective assessments of low-level waste disposal facilities.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. The selected point of compliance represents a DOE policy decision and is not derived directly from any other requirements. However, the point of compliance is consistent with regulatory positions included in 40 CFR 192.32 and 40 CFR 264.95.

The NRC requirements at 10 CFR 61.52(a)(8) states that a "buffer zone of land must be maintained between any buried waste and the disposal site boundary . . ." In NUREG-1200, section 4.3.6 it is recommended that this buffer zone be at least 30 m wide [emphasis added]. The Performance Assessment Task Team recommended a point of compliance of 100 m in the *Performance Assessments Task Team Progress Report* (DOE /LW-157, Rev. 1). In the *Draft Recommendations on Prospective Assessments for Long-Term Management of Low-Level Radioactive Wastes* (memorandum, R. Berube, dated September 5, 1996), the DOE Office of Environment recommended that the point of compliance should be point of public access. Therefore, the point of compliance would be the site boundary. The Office of Environment recommendations further acknowledge that it may be prudent to use a closer point of assessment if there is uncertainty about the future location of the site boundary. 40 CFR 192.32 permits the establishment of alternative concentration limits that are as low as reasonably achievable and meet the standards of 40 CFR 264.94(a) at all points at a greater distance than 500 meters from the edge of the disposal area and/or outside the site boundary.

For most sites where this requirement applies the site boundary is less than 500 meters. 40 CFR 264.95 defines the point of compliance as the vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units.

The DOE M 435.1-1 requirement makes the default location for assessing performance at the location of greatest impact beyond a 100 m buffer zone around the disposal facility. However, it also provides flexibility to accommodate site-specific conditions where there may be cause to evaluate at a closer or further location. Evaluation at a closer location may be dictated by site hydrologic features such as outcropping of water near the disposal site or the possibility of a closer site boundary. More distant points of compliance may be justified based on DOE's intent to not to release land and the cost-benefit consideration of having to find alternative disposal options for a particular waste stream. A more distant point of compliance may also be justified based on DOE plans for retaining ownership of land.

Other Considerations. The use of a 100 m point of compliance introduces a measure of defense in depth to protection from low-level waste in a disposal facility, because it is generally expected

that there will be a greater distance to the point of public access due to DOE's continued ownership of land.

IV. P.(2)(c) Performance assessments shall address reasonably foreseeable natural processes that might disrupt barriers against release and transport of radioactive materials.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. The requirement addresses the need to account for recognized natural processes that will have an effect on the long-term performance of the disposal system. Therefore, in a performance assessment a barrier cannot necessarily be modeled as if it continues to function over long periods as it does at the time of construction. Instead, the modelers have to account for the possibility of agradation or degradation of the cover system, degradation of concrete, consolidation of waste materials, etc.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement was adopted from the *Performance Assessment Task Team Progress Report* (DOE/LW-157) and the *Draft Recommendations on Prospective Assessments for Long-Term Management of Low-Level Radioactive Wastes* (memorandum, R. Berube, dated September 5, 1996).

Other Considerations. This requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2. The use of reasonably foreseeable events is consistent with the concept of demonstrating a reasonable expectation that the performance objectives will be met, as using any hypothetical extreme events that may or may not occur would result in overly conservative results.

IV. P.(2)(d) Performance assessments shall use DOE-approved dose coefficients (dose conversion factors) for internal and external exposure of reference adults.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analysis. The requirement addresses a need to provide consistency in the application of health physics practices in the development of prospective assessments. By establishing a standard for calculating doses, the Department avoids the potential of making management decisions on disposal of waste based on consideration of different receptors at the different sites.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement was adopted from the *Performance Assessment Task Team Progress Report* (DOE/LW-157) and the *Draft Recommendations on Prospective Assessments for Long-Term Management of Low-Level Radioactive Wastes* (memorandum, R. Berube, dated September 5, 1996). Additionally, this practice is consistent with the EPA-proposed *Federal Radiation Protection Guidance for Exposure of the General Public* (59 FR 66423). The rationale for using standard adult dose conversion factors comes from the fact that in a performance assessment one is calculating a postulated dose to a hypothetical future person assumed to be engaged in a set of normal activities over a period of years. Consequently, performing calculations as if real people of known age were being impacted by releases from the facility is not reasonable.

Other Considerations. This requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2. The use of DOE approved dose coefficients is included in the requirement to ensure the dose coefficients used in performance assessment have been properly reviewed and representative of the current scientific understanding of the effects of radiation on human health.

IV. P.(2)(e) The performance assessment shall include a sensitivity/uncertainty analysis.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. In addition to calculations over the time of compliance (1000 years), performance assessments also are to present calculations of the maxima relative to each of the performance objectives. The results of these calculations are to be part of the sensitivity and uncertainty analysis which would support a conclusion that the model is providing a reasonable projection. These longer calculations address the need to ensure that there are no unexpected significant increases shortly after the time of compliance and provide a mechanism for understanding the model performance and the significance of modeling parameters. The calculation of maxima does present the possibility that there may be results that exceed the performance objectives. The significance of these results must be handled with caution and

judgment. The further out in time that the maxima occurs, the less significant is the relationship to the performance objective.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. This requirement represents a DOE policy decision; it derives in part from IAEA publication, *Fundamental Principles of Radioactive Waste Management*.

Other Considerations. The calculation of maxima represents best management practice in the conduct of performance assessments. It provides additional information about the behavior of the model of site and the system being modeled that would not be available if the calculations were truncated at the time of compliance. This additional information may be useful in evaluating alternative designs and similar ALARA considerations. The final wording of the requirement reflects consideration of comments from the Field on draft versions of the Manual.

IV. P.(2)(f) Performance assessments shall include a demonstration that projected releases of radionuclides to the environment shall be maintained as low as reasonably achievable (ALARA).

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. Requiring projected releases from a disposal facility to be as low as reasonably achievable is consistent with the concept that a performance assessment is to be used as a tool to aid in the development of facility design, waste acceptance criteria, and closure design. Consistent with the reasonableness portion of ALARA, projected doses or releases well below the performance objectives would not require additional analyses to show that further reduction would not be reasonable.

Requirements Analysis. This is a slight modification of a portion of the DOE 5820.2A requirement III.3.a.(2). The wording has been changed to improve clarity and the requirement has been separated from the performance objectives IV.P.(1). The clarification is to remove the term effluents, which connotes stack and pipeline releases, and instead refer to releases from a disposal facility.

Other Considerations. The use of the ALARA concept in long-term assessments is a best management practice that contributes defense-in-depth to the possible exposures from a disposal facility. Application of the ALARA principle for managing current operational exposures has practical and measurable merit in that real doses are being avoided or reduced. This concept is extended here by addressing projected releases of materials well into the future which may result in doses.

IV. P.(2)(g) For purposes of establishing limits on radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts to water resources.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment, and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that water resource protection is considered in the disposal of low-level waste and to establish inventory controls for waste that can be disposed of in the near surface. This requirement addresses the weakness and condition of eventual degradation of the disposal facility to the point where water resources around the disposal facility could be impacted, leading to health effects long in the future to the public, or damage to the environment. This requirement specifically addresses possible damage to the environment that might occur due to impacts to the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a modification of the DOE 5820.2A performance objective III.3.a.(4) that required protection to groundwater resources. The performance objective was no longer needed as it was worded because it is redundant with one of the fundamental requirements of DOE O 435.1, which is to follow all existing Federal, State, and local laws and regulations. The wording for this requirement has been changed from its 5820.2A wording to broaden the requirement to include surface water, not just groundwater, in the analysis to determine inventory limits, and to improve clarity.

Other Considerations. Guidance developed for this requirement describes a tiered structure for determining appropriate performance measures to include in this part of the evaluation in the performance assessment to be consistent with the site's groundwater protection program. The tiered structure recognizes that, at this time, there are no applicable Federal requirements for protection of water resources at radioactive waste disposal facilities. At some disposal facilities, the performance measure selected to protect groundwater will be 4 mrem/yr through the drinking water pathway or application of the *Safe Drinking Water Act* maximum contaminant limits. Selection of these restrictive performance measures provides defense-in-depth relative to the all-pathways analysis because the limitations imposed by the water protection analysis may result in a six-fold reduction in the allowable limit for a specific radionuclide.

IV. P.(2)(h) For purposes of establishing limits on the concentration of radionuclides that may be disposed of near-surface, the performance assessment shall include an assessment of impacts calculated for a hypothetical person assumed to inadvertently intrude for a temporary period into the low-level waste

disposal facility. For intruder analyses, institutional controls shall be assumed to be effective in deterring intrusion for at least 100 years following closure. The intruder analyses shall use performance measures for chronic and acute exposure scenarios, respectively, of 100 mrem (1 mSv) in a year and 500 mrem (5 mSv) total effective dose equivalent excluding radon in air.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. Requirements for intruder calculations address the need to establish concentration limits for waste that can be disposed of in the near surface. This requirement addresses the weakness and conditions of an inadvertent intruder onto a disposal facility at some time in the distant future. While such a form of intrusion is unlikely, the consequences of direct intrusion could be have a significant affect on human health.

Requirements Analysis. This requirement is a significant modification of the DOE 5820.2A requirement III.3.a(3). Wording changes were made to clarify that the purpose of the intruder calculations is to establish concentration limits on waste that can be disposed of near surface. This is a change relative to the language of 5820.2A that implied that the analyses could assure that dose limits for an inadvertent intruder would not be exceeded. The requirement has been removed from the Performance Objectives in recognition that intruder analyses are more a function of the intrusion scenarios that are assumed than of the performance of the disposal system. In addition, the DOE 5820.2A requirement III.3.i.(4), which requires use of a specific performance assessment and a *National Environmental Policy Act* (NEPA) process to justify the disposal of DOE waste exceeding the 10 CFR 61.55 Class C limits, has been deleted.

The concept of protection of inadvertent intrusion is consistent with national and international practice (NCRP, ICRP, IAEA). The NRC included the protection of inadvertent intruders as one of the performance objectives in 10 CFR Part 61. Other international and national organizations have and continue to include the protection of inadvertent intruders as one of the elements of radiation protection.

The NRC implemented inadvertent intruder limits on a generic basis through the establishment of a waste classification system. In spite of the merits of having a single classification system, such a system does not account for geographic differences that influence the resultant consequence of intrusion. Whereas installation of a groundwater well to water a home garden may be reasonable in most parts of the country, at the DOE Nevada Test Site, the depth to groundwater at certain parts of the site is so great as to make an extended, farming intrusion scenario implausible.

Similarly, geographic differences in building practices or well drilling practices (e.g., diameter) provide real differences in the potential impacts of an intruder. The use of intruder performance measures allows for these geographic differences to be considered.

The requirement for special consideration of waste exceeding the NRC Class C limit was deleted because it was considered unnecessary. The requirement for NEPA is not unique to the disposal of waste and is adequately addressed by the Department's rule 10 CFR Part 1021, "National Environmental Policy Act Implementing Procedures." Consideration of this type of waste is adequately addressed in the current system since a performance assessment, which includes consideration of intrusion as well as offsite impacts, is required for each disposal facility. If a waste stream with radionuclide concentrations in excess of the 10 CFR 61.55 limits is proposed for a disposal facility, it would have to be addressed in the performance assessment.

Other Considerations. The clarification of this requirement is consistent with *Critical Assumptions for Department of Energy Low-Level Waste Disposal Facility Performance Assessments* prepared by the Department in response to Defense Nuclear Facilities Safety Board Recommendation 94-2.

Since the intent of the Department is to control the use of land where low-level waste is disposed until the land can be released, inadvertent intruder calculations provide defense-in-depth by limiting the concentration of waste that can be disposed of in the near surface. With each performance assessment evaluating and developing limits for near-surface disposal, DOE is more cost-effective in managing waste and is consistent with the philosophy of using performance-based requirements.

IV.P.(3) **Composite Analysis.**

For disposal facilities which received waste after September 26, 1988, a site-specific radiological composite analysis shall be prepared and maintained that accounts for all sources of radioactive material that may be left at the DOE site and may interact with the low-level waste disposal facility, contributing to the dose projected to a hypothetical member of the public from the existing or future disposal facilities. Performance measures shall be consistent with DOE requirements for protection of the public and environment and evaluated for a 1,000 year period following disposal facility closure. The composite analysis results shall be used for planning, radiation protection activities, and future use commitments to minimize the likelihood that current low-level waste disposal activities will result in the need for future corrective or remedial actions to adequately protect the public and the environment.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement meets the need to evaluate the impact of all sources that impact a potential future member of the public rather than considering only the low-level waste disposed of after September 26, 1988.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A.

The requirement was adopted from the DNFSB 94-2 deliverable, *Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal*, (letter from A. Alm, July 31, 1996). In most cases, the composite analysis will address existing sources of contamination such as previously disposed waste, spills, etc. Therefore, unlike the performance assessment which applies a near-in point of compliance to ensure that new waste disposal has an extra degree of protection, the composite analysis evaluates the potential impacts at the site boundary. The composite analysis takes into account that the current site boundary may not be the future site boundary should DOE release some of the land it now controls. The guidance supporting this requirement calls for the preparation of a corrective action plan if the projected doses exceed the DOE limit for protection of the public. The corrective action plan describes what DOE will do to ensure projected doses are never realized. Actions to be considered include limitations on the use of the active or proposed burial ground, additional cleanup of another source, and enhanced analysis and monitoring to determine whether the projected impacts may be the result of excess conservatism. Also, this requirement is consistent with the concept presented in the draft version of 10 CFR Part 834 of an environmental radiation protection program and plan. The composite analysis provides part of the comprehensive analysis and planning which is needed for developing such a program and plan.

Other Considerations. This requirement for a composite analysis for analyzing the projected dose from a low-level waste disposal facility and other contributing sources addresses the Defense Nuclear Facilities Safety Board 94-2 recommendation concerning evaluating all past, present, and future LW streams at a disposal facility. The final wording of this requirement was developed in response to comments submitted on the draft versions of DOE M 435.1-1 from DOE-EH and the Field.

IV. P.(4) **<u>Performance Assessment and Composite Analysis Maintenance.</u>**

The performance assessment and composite analysis shall be maintained to evaluate changes that could affect the performance, design, and operating bases for the facility. Performance assessment and composite analysis maintenance shall include the conduct of

research, field studies, and monitoring needed to address uncertainties or gaps in existing data. The performance assessment shall be updated to support the final facility closure. Additional iterations of the performance assessment and composite analysis shall be conducted as necessary during the post-closure period.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. The requirement to maintain a performance assessment and composite analysis addresses the need to keep the analyses supporting the authorization basis for the facility up to date. The requirement responds to a weakness associated with receiving waste streams with characteristics not considered in the original performance assessment and a weakness associated with not updating an analysis based on a better understanding of the performance of a disposal system component gained through testing and research. The requirement also addresses a weakness associated with changes in decisions about remediating other sources of radioactivity that may contribute to the dose projected for the disposal facility. The hazards examined that resulted in this requirement are specifically associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a modification of a portion of the DOE 5820.2A requirement III.3.b.(1). The current requirement is an elaboration of the 5820.2A requirement to maintain the performance assessment. The changes convey the fact that a necessary part of facility operation and closure is to evaluate changes that may affect facility performance. Additionally, necessary revisions of the performance assessment may be appropriate even after closure. These same requirements apply to composite analyses.

Other Considerations. The final wording of the requirement specifies that performance assessment and composite analysis maintenance must include the conduct of research, field studies, and monitoring to address the uncertainties or gaps in existing data used in the performance assessment. This change was in response to a comment from DOE-EH.

IV. P.(4)(a) Performance assessments and composite analyses shall be reviewed and revised when changes in waste forms or containers, radionuclide inventories, facility design and operations, closure concepts, or the improved understanding of the performance of the waste disposal facility in combination with the features of the site on which it is located alter the conclusions or the

conceptual model(s) of the existing performance assessment or composite analysis.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. The requirement to revise the performance assessment or composite analysis addresses the need to keep the analyses supporting the authorization basis for the facility up to date. It responds to a weakness associated with receiving waste streams with characteristics that were not considered in the original performance assessment and a weakness associated with not updating an analysis based on a better understanding of the performance of a disposal system component gained through testing and research. The hazards examined that resulted in this requirement are specifically associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a modification of a portion of the DOE 5820.2A requirement III.3.b.(1). The 5820.2A requirement stated that a performance assessment is to be maintained. This requirement elaborates on what is involved in maintenance by requiring a revision of the performance assessment or composite analysis if a review indicates the possibility of changes to the conclusions of the analysis or to the conceptual model.

Other Considerations. Guidance for performance assessment maintenance developed in response to Defense Nuclear Facilities Safety Board recommendation 94-2, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*, indicates that sites should conduct tests and research during the operational life of the disposal facility. The testing and research should be designed to improve confidence in modeling results or to remove conservatism necessitated by conservative assumptions. Additionally, since disposal facilities may be requested to accept certain waste streams that were not specifically considered in the original performance assessment, supplemental analyses may be necessary to evaluate whether the waste can be safely disposed.

This requirement promotes performance-based management of the performance assessment or composite analysis maintenance activity by not demanding a revision on a set timetable, but allowing a decision to be made based on need.

IV. P.(4)(b) A determination of the continued adequacy of the performance assessment and composite analysis shall be made on an annual basis, and shall consider the results of data collection and analysis from research, field studies, and monitoring.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazards Analyses. This requirement addresses the need for maintaining the performance assessment and composite analysis through determining whether waste receipts and operations would cause any changes to assumptions used in the evaluations. The systems engineering of LW identified this as an activity needing requirements, and it was so evaluated. This requirement addresses the need for the field organization to make routine determinations of the acceptability of the performance assessment or composite analysis. This addresses a weakness associated with failure to keep these analyses which support the authorization basis low-level waste disposal facility up to date.

The requirement addresses the potential conditions and weaknesses of the reliance on performance assessments and the use of assumptions in the calculations. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor integration of documents important to safety (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area). The hazards examined that resulted in this requirement are specifically associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. The requirement for evaluations of performance assessments and composite analyses to be conducted by the Department field elements is an improvement to the performance assessment maintenance requirements of DOE 5820.2A, III.3.b.(1). The improvements include requiring an annual evaluation of the continued adequacy of the evaluations and providing summary reports to headquarters concerning the continued adequacy of the assessments and the need to revise the performance assessment and composite analysis. The requirement for annual determinations is based on a requirement in the DNFSB 94-2 deliverable *Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal*, (letter from A. Alm, July 31, 1996).

Other Considerations. The Defense Nuclear Facilities Safety Board Recommendation 94-2 pointed out the inherent weaknesses in using assumptions in the performance assessments. The final wording of the requirement ties the continued adequacy of the performance assessment and composite analysis to the conduct of research, field studies, and monitoring required in the performance assessment and composite analysis maintenance. This change was in response to a comment from DOE-EH.

IV. P.(4)(c) Annual summaries of waste disposal operations shall be prepared with respect to the conclusions and recommendations of the performance assessment and

composite analysis and a determination of the need to revise the performance assessment or composite analysis.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for Headquarters to be apprised of the performance of the disposal facilities with respect the conclusions in the performance assessment and the composite analysis on a routine basis. This also provides a vehicle for routinely notifying Headquarters of the need to revise either the performance assessment or composite analysis.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A. The requirement for annual reports is based on a requirement in the DNFSB 94-2 deliverable "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal," (letter from A. Alm, July 31, 1996).

Other Considerations. None.

IV. P.(5) **<u>Disposal Authorization.</u>**

A disposal authorization statement shall be obtained prior to construction of a new low-level waste disposal facility. Field Elements with existing low-level waste disposal facilities shall obtain a disposal authorization statement in accordance with the schedule in the Complex-Wide Low-Level Waste Management Program Plan. The disposal authorization statement shall be issued based on a review of the facility's performance assessment, composite analysis, performance assessment and composite analysis maintenance, preliminary closure plan, and preliminary monitoring plan. The disposal authorization statement shall specify the limits and conditions on construction, design, operations, and closure of the low-level waste facility based on these reviews. A disposal authorization statement is a part of the radioactive waste management basis for a disposal facility. Failure to obtain a disposal authorization statement by the implementation date of this Order shall result in shutdown of the disposal facility.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. This requirement addresses a programmatic management need to ensure that prior to committing significant resources to the development and construction of a disposal facility, there is a reasonable expectation the facility will accept the projected waste streams, and provide protection of the future public and the environment. Additionally, it addresses a DNFSB concern and Complex-Wide Review Vulnerability on the operation of low-level waste disposal facilities which have not completed the Performance Assessment Approval process. The requirement addresses the need for a formal process to ensure that a disposal facility has been appropriately evaluated relative to authorizing it to accept waste.

Requiring completion of the PA and composite analysis and issuance of a disposal authorization statement based on a review external to line management addresses a weakness associated with receiving waste which is not appropriate for the disposal facility.

Requirements Analysis. This is a new requirement that was not included in DOE 5820.2A, which expands on the 5820.2A, III.3.b.1 requirement for a performance assessment for disposal facilities and the 5820.2A, III.3.e.2 requirement for facilities to establish waste acceptance criteria. The requirement for a disposal authorization statement comes from the DNFSB 94-2 deliverable "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal," (letter from A. Alm, July 31, 1996). As discussed in the interim policy, the idea of the disposal authorization statement is similar to a portion of the licensing activity administered by NRC or a NRC Agreement State. However, in this case, the review is focused on the long-term impacts of a disposal facility.

This requirement was newly developed, but is based on the concept of establishing an authorization basis for a facility per DOE 5480.23, *Safety Analysis Reports*, and DOE O 420.1, *Startup and Restart of Nuclear Facilities*. The concept of the authorization basis has been expanded to include consideration of waste management-specific concerns such as performance assessments, composite analyses, closure plans, and waste acceptance criteria.

Other Considerations. This requirement provides for a best management practice by requiring an overall approval step (i.e., issuance of an disposal authorization basis statement) for operating a disposal facility. The Department is not requiring additional documentation beyond what is required under DOE O 435.1 and other orders. The disposal authorization concept is being employed is performance based, the rigor of documentation is commensurate with the hazards and safety implications of activities carried out at a given facility.

IV. P.(6) Disposal Facility Operations.

The disposal facility design and operation must be consistent with the disposal facility closure plan and lead to disposal facility closure that provides a reasonable expectation that performance objectives will be met. Low-level waste shall be disposed in such a manner that achieves the performance objectives stated in this Chapter, consistent with the disposal facility radiological performance assessment. Additional requirements include:

Basis:

Functions Evaluated. The requirement addresses the function of designing, operating and closing a low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure the entire process of low-level waste disposal is conducted with consideration of the intended closure, such that the disposed waste will not adversely impact the environment or the public. The weakness remedied by this requirements is the use of waste acceptance criteria for operating practices which are contrary to the analyses included in the performance assessment. This could lead to the closed facility not providing adequate protection of the public and the environment, and other hazards associated with impacts on the long-term performance of the disposal facility.

Requirements Analysis. This requirement is a significant rewording of the DOE 5820.2A requirement III.3.i.(2). The modifications were made to embrace the concept that all aspects of the life of a disposal facility (design through closure) are to be consistent with the analyses in the performance assessment, and to separate elements that are addressed in guidance from the basic requirements. The portions of the 5820.2A requirement that suggest the use of a site-specific waste classification system, stabilization, greater burial depth, etc. are addressed in guidance rather than appearing as requirements in the manual. The wording in this requirement is similar to the standards for issuance of a license by the NRC under the requirements at 10 CFR 61.23(b) and (c) that require siting, design, operations, and closure to be submitted together to provide reasonable assurance that the performance objectives will be met.

Other Considerations. Final wording of the requirement uses the term reasonable expectation for consistency with other changes made in response to comments on draft versions of the Manual.

IV.P.(6)(a) Operating procedures shall be developed and implemented for low-level waste disposal facilities that protect the public, workers, and the environment; ensure the security of the facility; minimize subsidence during and after waste

emplacement, achieve long-term stability and minimize the need for long-term active maintenance; and meet the requirements of the closure/post-closure plan.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. This requirement addresses weaknesses associated with personnel operating a low-level waste disposal facility or maintaining a disposal facility in a manner that violates facility integrity and impacts long-term performance. Hazards specifically addressed include exposures to workers during disposal facility operations, and hazards associated with the public and environment from long-term impacts on the performance of the disposal facility.

Requirements Analysis. This requirement is a slight modification of DOE 5820.2A requirement III.3.i.(9)(a). 10 CFR Part 61 was evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be " . . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the closure element of the 10 CFR Part 61 performance objective. Also, the standards for issuance of a license in 10 CFR 61.23 contains language which ties the adequacy of operating procedures of the disposal facility to the determination of reasonable assurance that the performance objectives will be met, the facility will meet NRC security requirements, and the facility will remain stable.

Other Considerations. The final wording of this requirement was developed in response to comments on the draft version of DOE M 435.1-1.

IV. P.(6)(b) Permanent identification markers for disposal excavations and monitoring wells shall be emplaced.

Basis:

Functions Evaluated. This requirement addresses the function of designing, operating, and closing a low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. This requirement addresses the need to know the locations of disposal units after backfilling so the units can be monitored, and ongoing operations will not compromise disposal units. This requirement addresses weaknesses associated with personnel operating the low-level waste disposal facility or maintaining the disposal facility in a manner that violates facility integrity and impacts long-term performance. The hazards addressed include possible exposure to workers during disposal operations and long-term impacts to the public associated with disposal of low-level waste.

Requirements Analysis. This requirement is a slight modifications of DOE 5820.2A requirement III.3.i.(9)(b) to improve clarity and consistency.

Other Considerations. This requirement provides defense-in-depth for avoiding the accidental disturbance of disposal units. This defense-in-depth extends through the post-closure period and contributes to the reduction of the potential for inadvertent intrusion. This requirement is similar to the requirement at 10 CFR 61.52(a)(7), except it adds permanent identification of monitoring wells.

IV. P.(6)(c) Low-level waste placement into disposal units shall minimize voids between waste containers. Voids within disposal units shall be filled to the extent practical. Uncontainerized bulk waste shall also be placed in a manner that minimizes voids and subsidence.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. This requirement addresses the weaknesses associated with personnel operating a low-level waste

disposal facility or maintaining a disposal facility in a manner that violates facility integrity and impacts long-term performance. The requirement for minimizing voids was specifically enhanced to address the weakness associated with facilities being closed with significant void spaces. Over time the voids will fill, either by natural settling or through the catastrophic collapse of containers after degradation.

Requirements Analysis. The requirement is similar to the requirement in DOE 5820.2A, Chapter III.3.i.(9)(d), but it has been strengthened and expanded. The 5820.2A version said that voids between packages "should" be avoided; this is now a "shall" statement. The requirement was then augmented by requiring the filling of void spaces that cannot be avoided by methods of waste placement. Minimizing voids in containers is addressed in the waste acceptance criteria. The procedures for facility operations must invoke practices to minimize voids during the placement of waste and backfilling. This requirement is consistent with 10 CFR 61.52(4) and (5).

Other Considerations. This requirement provides defense-in-depth for protecting site stability by the use of a performance based requirement that seeks to "minimize voids . . . to the extent practicable." The use of a performance-based requirement is preferred to requiring the reduction of void space to some arbitrary percentage of the total volume or some other numerical criteria which could not be justified. The final requirement includes a performance based requirement that uncontainerized bulk waste must also be placed in a manner that minimizes voids and subsidence in response to comments by DOE-EH on draft versions of the Manual.

IV. P.(6)(d) Operations are to be conducted so that active waste disposal operations will not have an adverse effect on any other disposal units.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation and closure of a low-level waste disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to have documented processes to direct waste management activities at a low-level waste disposal facility. The procedures are necessary to ensure that operations are consistent with the requirements and constraints derived from the performance assessment and safety analysis documents. Additionally, it addresses the need to know the locations of disposal units after backfilling to avoid compromising disposal units by ongoing operations. This requirement addresses weaknesses associated with personnel operating a low-level waste disposal facility or maintaining a disposal facility in a manner that violates facility integrity and impacts long-term performance.

Requirements Analysis. The requirement is equivalent to the requirement in DOE 5820.2A, Chapter III.3.i.(9)(e). This requirement is essentially equivalent to 10 CFR 61.52(a)(10).

Other Considerations. This requirement provides defense-in-depth for the protection of site stability. By providing additional support for site stability, the need for long-term maintenance is reduced and additional assurance is provided that the performance objectives will be achieved.

IV. P.(6)(e) Operations shall include a process for tracking and documenting low-level waste placement in the facility by generator source.

Basis:

Functions Evaluated. The requirement addresses the function Emplace Waste under the Disposal of Low-Level Waste.

Safety and Hazard Analyses. The specific need for this or a similar requirement was not evaluated in the original safety and hazard analyses. However, during review of draft versions of the Manual (see Other Considerations), it was identified that future corrective actions at low-level waste disposal facilities would benefit greatly if a system existed that could track waste characterization information prepared by the waste's generator to the specific location of the waste in the disposal facility.

Requirements Analysis. This requirement has no predecessor requirement in DOE 5820.2A. The requirements analysis did not evaluate the need for this specific condition, and did not consider inclusion of this requirement.

Other Considerations. The requirement was added as a result of review of the draft versions of the Manual at the suggestion of DOE-EH.

IV. P.(7) Alternate Requirements for Low-Level Waste Disposal Facility Design and Operation. Requirements other than those set forth in this Section for the design and operation of a low-level waste disposal facility may be approved on a specific basis if a reasonable expectation is demonstrated that the disposal performance objectives will be met.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. The specific need for this or a similar requirement was not evaluated in the original safety and hazard analyses. However, during review of draft versions of the Manual (see Other Considerations), it was identified that there may be some instances concerning the disposal of low-level waste that would benefit if the design of the facility could be

based on an alternative analysis other than the performance assessment methodology, as long as there was still a reasonable expectation that the performance objectives identified for low-level waste disposal would still be met. A facility may need to be designed using an alternative approach if waste streams other than those normally evaluated in disposal of low-level waste using the performance assessment methodology were to be disposed of, for example, a facility planned for disposal of waste exclusively composed of mill tailings for which disposal at an UMTRAP or currently operating mill facility cannot be arranged.

Requirements Analysis. This requirement has no predecessor requirement in DOE 5820.2A. The requirements analysis did not evaluate the need for this specific condition, and did not consider inclusion of this requirement.

Other Considerations. The requirement was added as a result of review of the draft versions of the Manual at the suggestion of DOE-EH.

IV. Q. Closure.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Disposal Facility Closure Plans. A preliminary closure plan shall be developed and submitted to Headquarters for review with the performance assessment and composite analysis. The closure plan shall be updated following issuance of the disposal authorization statement to incorporate conditions specified in the disposal authorization statement.

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need to ensure that the plan for closure of the facility is consistent with the performance assessment. It further addresses the need to ensure that consideration of closure is not postponed to the end of facility operations when options to mitigate projected impacts are more limited. The addresses the current weakness and conditions where existing disposal facilities are developing closure plans long after the initiation of disposal operations.

Requirements Analysis. This requirement slightly modifies DOE 5820.2A requirement III.3.i.(j)(1). The modifications were made to eliminate requirements that were unnecessary, because they were adequately addressed by other requirements (i.e., 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures* and the *Comprehensive Environmental Response, Compensation, and Liability Act*). The additions to the requirement are deadlines on

when closure plans are to be prepared, a requirement for updating. The DOE M 435.1-1 requirement IV.Q.(2) addresses the portion of the 5820.2A requirement III.3.i.(j)(1) dealing with closure of the disposal facility within 5 years after it is filled. This requirement is consistent with 10 CFR Part 61 which requires a closure plan to be submitted prior to the operation of the facility (Part 61.12(g))

Other Considerations. This requirement recognizes that closure is an integral part of planning and operating a low-level waste disposal facility. The final wording of this requirement was prepared in response to comments received on the draft version of the Order, and to improve the clarity of the requirement.

IV. Q. Closure.

The following requirements are in addition to those in Chapter I of this Manual.

(1) Disposal Facility Closure Plans shall:

(a) Be updated as required during the operational life of the facility.

(b) Include a description of how the disposal facility will be closed to achieve long-term stability and minimize the need for active maintenance following closure and to ensure compliance with the requirements of DOE 5400.5*, Radiation Protection of the Public and the Environment.*

(c) Include the total expected inventory of wastes to be disposed of at the facility over the operational life of the facility.

Basis:

Functions Evaluated. This requirement addresses the functions associated with the design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. These requirements address the need to ensure that the plan for closure of the facility is consistent with the performance assessment. They further address the need to ensure that consideration of closure is not postponed to the end of facility operations when options to mitigate projected impacts are more limited. These requirements address the weakness and conditions where existing disposal facilities are developing closure plans long after disposal operations were initiated. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility.

Requirements Analysis. These requirements slightly modify DOE 5820.2A requirements III.3.i.(j)(1). The modifications were made to eliminate requirements that were unnecessary, because they were adequately addressed by other requirements (i.e., 10 CFR Part 1021, *National Environmental Policy Act Implementing Procedures* and the *Comprehensive Environmental Response, Compensation, and Liability Act*). The additions are a requirement for updating during the operational life of the facility, and the inclusion of the total expected waste receipts (in the updates). The DOE M 435.1-1 requirement IV.Q.(2) addresses the portion of the 5820.2A requirement III.3.i.(j)(1) dealing with closure of the disposal facility within 5 years after it is filled.

10 CFR Part 61 was evaluated for essential requirements for DOE low-level disposal facilities. Part 61 contains a performance objective (61.44) that requires the disposal facility to be ". . . sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practical the need for ongoing active maintenance of the disposal site. . . " Because the performance objectives in DOE M 435.1-1 are measures to be used in conjunction with the performance assessment only, the fundamental concepts for long-term stability and reduction of the need for active maintenance following closure were incorporated as necessary in the Manual in the specific sections on siting, design, operations, and closure. This requirement captures the closure element of the Part 61 performance objective.

Other Considerations. These requirements recognize that closure is an integral part of planning and operating a low-level waste disposal facility and adds defense-in depth by providing minimal requirements for the closure plan that recognize stability and minimizing maintenance.

The requirement for including the total expected inventory in the closure plan was identified as a necessary component of a closure plan and integrated low-level waste operations during the revision of the waste management order.

IV. Q.(2) **<u>Disposal Facility Closure.</u> Closure of a disposal facility shall occur within a five-year period after it is filled to capacity, or the facility is otherwise determined to be no longer needed.**

Basis:

Functions Evaluated. This requirement addresses the functions associated with design, operation, and closure of the disposal facility.

Safety and Hazard Analyses. This requirement addresses the need for final closure to be accomplished in a timely manner following the end of disposal operations, and in a manner protective of the public and environment, as projected in the performance assessment.

Requirements Analysis. This requirement is a modification of DOE 5820.2A requirement III.3.j.(1). The requirement for closure within 5 years following the end of disposal comes from a portion of 5820.2A, III.3.j.(1). The requirement in 5820.2A has been divided to avoid confusion as to whether the closure plan is due within 5 years or whether the site is to be closed within 5 years. The requirement for the closure plan is addressed in DOE M 435.1-1, IV.Q.(1). In addition, the requirement recognizes the DOE policy regarding institutional control of the land where low-level waste is disposed of until the land can be released pursuant to DOE 5400.5, *Radiation Protection of the Public and the Environment*.

Other Considerations. None.

IV. Q.(2) Disposal Facility Closure.

(a) Prior to facility closure, the final inventory of the low-level waste disposed in the facility shall be prepared and incorporated in the performance assessment and composite analysis which shall be updated to support the closure of the facility.

(b) A final closure plan shall be prepared based on the final inventory of waste disposed in the facility, the plan implemented, and the updated performance assessment and composite analysis prepared in support of the facility closure.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment and the closure of a disposal facility.

Safety and Hazard Analyses. These requirements address the need for final closure to be accomplished in a timely manner following the end of disposal operations, and in a manner which is protective of the public and environment, as projected and documented in the performance assessment and composite analysis. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. Specific weaknesses addressed include implementation of final closure plans and conditions without the use of actual final inventories and other information that should be used.

Requirements Analysis. These requirements are modifications and expansions of the DOE 5820.2A requirements III.3.j.(1). The requirement in 5820.2A has been divided to avoid confusion associated with closure requirements. The requirement for the closure plan is addressed in DOE M 435.1-1, IV.Q.(2).

Other Considerations. The requirement to include the total inventory in the closure plan was identified as a necessary component of a closure plan and integrated low-level waste operations during the revision of the waste management order.

IV. Q.(2) Disposal Facility Closure.

(c) Institutional control measures shall be integrated into land use and stewardship plans and programs, and shall continue until the facility can be released pursuant to DOE 5400.5, *Radiation Protection of the Public and the Environment.*

(d) The location and use of the facility shall be filed with the local authorities responsible for land use and zoning.

Basis:

Functions Evaluated. This requirement relates to the development of a disposal facility, preparation and maintenance of a performance assessment, and the closure of a disposal facility.

Safety and Hazard Analyses. These requirements address the need for final closure to be accomplished in a timely manner following the end of disposal operations, and in a manner protective of the public and environment, as projected in the performance assessment.

Requirements Analysis. These requirements are modifications and expansions of the DOE 5820.2A requirements III.3.j.(1) and III.3.j.(6). Significant changes have been made to the requirement concerning monitoring and maintenance to change the notion that the site will be released at the end of an institutional control period. Instead, the requirement is to maintain the land until it can be released based on DOE's requirement for release of land documented in DOE 5400.5. This is consistent with the policy that DOE will control the land until it can be released. The 5820.2A requirements were augmented with requirements to provide an agency other than DOE (i.e., local land use planning authorities) with records indicating the location of the low-level waste disposal facility. The requirement to file information with local land use authorities was derived from NRC requirements at 10 CFR 61.80(g).

Other Considerations. As a means of providing some defense-in- depth to mitigate consequences of temporary lapses in active institutional controls, filing information with local authorities with responsibility for land use and zoning is required.

IV. R. Monitoring.

The following requirements are in addition to those in Chapter I of this Manual:

(1) All Waste Facilities. Parameters that shall be sampled or monitored, at a minimum, include: temperature, pressure (for closed systems), radioactivity in ventilation exhaust and liquid effluent streams, and flammable or explosive mixtures of gases. Facility monitoring programs shall include verification that passive and active control systems have not failed.

(2) Liquid Waste Storage Facilities. For facilities storing liquid low-level waste, the following shall also be monitored: liquid level and/or waste volume, and significant waste chemistry parameters.

Basis:

Functions Evaluated. The requirement derives from the analysis of the Treatment function for providing interim storage at a treatment facility. This requirement also derives from the analysis of the following high-level waste management functions: maintaining safe high-level waste pretreatment and storage envelopes, and operating, monitoring, and maintaining high-level wastes storage systems.

Safety and Hazard Analyses. A potentially high hazard scenario was identified for the storage of liquid low-level waste in a tank prior to processing at a treatment facility. Weaknesses and conditions addressed by the requirement include an overfill of an interim storage tank, incompatible materials mixing in a storage tank, over pressurization of stored waste, storage longer than planned for, the opening of containers to verify waste acceptance criteria are met, and specifically respirable fines in waste containers that are opened. The weaknesses and conditions identified in the high-level waste safety and hazard analyses were failing to detect flammable gas buildup in waste storage tanks, failing to sample and test waste storage tank contents to establish ignition limits, and inadequate waste tank level monitoring.

Requirements Analysis. The requirements are similar to requirements at DOE 5820.2A, I.3.b.(3)(a) for high-level waste storage tanks, extended to management of low-level waste and to all low-level waste management activities (in the case of requirement R.(1)), not just storage.

Other Considerations. This requirement is included in the low-level waste chapter as a result of achieving consistency across the waste type chapters. The requirement was not originally identified as an essential requirement in the analysis of low-level waste management, but was recognized as good management practice in storage of high-level waste that should be adopted for management of low-level waste. The requirement supports the ALARA and defense-in-depth

concepts by specifying minimum parameters that must be monitored in all low-level waste management facilities for identifying known hazards, and by implementing monitoring as a contingency rather than relying on waste characterization and certification to guarantee no unacceptable materials will be present in waste. The final wording of the requirement includes the provision that facility monitoring programs are to include verification that passive and active control systems have not failed in response to comments made by DOE-EH on draft versions of the Manual.

IV. R.(3) **<u>Disposal Facilities.</u> A preliminary monitoring plan for a low-level waste disposal facility shall be prepared and submitted to Headquarters for review with the performance assessment and composite analysis. The monitoring plan shall be updated within one year following issuance of the disposal authorization statement to incorporate and implement conditions specified in the disposal authorization statement.**

Basis:

Functions Evaluated. This requirement derives from the analysis of activities associated with disposal facility monitoring, both during operations and after closure.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that possible disposal facility releases are monitored during the short-term, and long-term disposal facility stability is monitored following closure. This requirement also addresses the need for evaluating the most important safety related activities necessary to manage low-level waste at the highest level of responsibility. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility.

The requirement addresses the potential weaknesses and conditions for releases from disposal facilities due to poor operational performance, design, or due to poorly performing disposal units or wastes forms. Also, the requirement addresses the potential weaknesses and conditions of lack of or poor integration of documents important to safety (potential weaknesses and conditions that may occur in any one area important to authorization basis may result in potential weaknesses in an other area), or lack of accountability at the highest management positions for ensuring the most important requirements for safety will be met.

Requirements Analysis. This requirement for monitoring is a modification of the requirement in DOE 5820.2A, III.3.k.(1). The requirement for disposal facility monitoring plans is added as an essential component of the documentation necessary for the disposal authorization statement. This requirement is consistent with 10 CFR Part 61 which requires the description of a monitoring program to be submitted to the NRC prior to the disposal facility operating (Part 61.12(l)).

Other Considerations. Authorization basis is the implementation of the Department's system engineering of the low-level waste management system which showed the need for accountability to demonstrate requirements are being met.

IV. R.(3)(a) The site-specific performance assessment and composite analysis shall be used to determine the media, locations, radionuclides, and other substances to be monitored.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions for maintaining the low-level waste disposal facility during operational and post-operational periods and for maintaining the performance assessment.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that long-term disposal facility performance and stability is monitored and maintained. The requirement addresses the potential conditions and weaknesses that would result from poor performance assessment assumptions and a lack of understanding of site performance due to poor site characterization or poor operations. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. Also, the requirement partially addresses the Complex-Wide Review Concern on Groundwater Monitoring.

Requirements Analysis. The requirement for facility monitoring to be based on the performance assessment and composite analysis at a low-level waste disposal facility is a significant modification to requirements in DOE 5820.2A, Chapter III.3.b.(3) and III.3.k.(2) and (3). Specific language in requirements from 5820.2A regarding the media to be monitored has been moved to guidance.

Requirements for disposal facility performance monitoring are a performance based set consistent with and partially derived from 10 CFR Part 61 requirements as well as the Defense Nuclear Facilities Safety Board Recommendation 94-2 performance assessment deliverable entitled, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*.

Other Considerations. This requirement adds defense-in-depth for confirmation of modeling/performance assessment calculations and the need to understand changes in disposal facility performance.

IV. R.(3)(b) The environmental monitoring program shall be designed to include measuring and evaluating effluent releases, migration of radionuclides, disposal unit subsidence, and changes in disposal

facility and disposal site parameters which may affect long-term performance.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions for maintaining the low-level waste disposal facility during the operational and post-operational periods.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that possible disposal facility releases are monitored during the short-term and possible releases as well as long-term performance of disposal facility stability is also monitored following closure. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. The requirement addresses the potential conditions and weaknesses of inadequate understanding of the pre-operational conditions of the disposal facility, of a poorly designed monitoring plan or system, and poor site characterization information or performance assessment assumptions.

Requirements Analysis. This requirement for an environmental monitoring program is a significant modification to the requirements in DOE 5820.2A, Chapter III.3.b.(3) and III.3.k.(2). The requirement to design monitoring enhances both III.3.b.(3) and III.3.k.(2) to not only monitor and measure for releases, migration, subsidence, and performance changes but also to evaluate the monitoring results. Requirements for baseline monitoring are a performance based set consistent with and partially derived from 10 CFR Part 61 requirements as well as the Defense Nuclear Facilities Safety Board Recommendation 94-2 performance assessment deliverable entitled, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*.

Other Considerations. This requirement partially addresses the Complex-Wide Review Concern on Groundwater Monitoring. These requirements add defense-in-depth for confirmation of modeling/performance assessment calculations, and the need to understand changes in disposal facility performance. The final wording of this requirement was prepared I response to comments received on the draft version of DOE M 435.1-1.

IV. R.(3)(c) The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives in this Chapter.

Basis:

Functions Evaluated. This requirement derives from the analysis of functions for maintaining the low-level waste disposal facility during operational and post-operational periods and for maintaining the performance assessment.

Safety and Hazard Analyses. This requirement addresses the need for ensuring that long-term disposal facility performance and stability is monitored and maintained. The hazards addressed by this requirement are associated with impacts to the long-term performance of the disposal facility. The requirement addresses the potential conditions and weaknesses that would result from poor performance assessment assumptions and a lack of understanding of site performance due to poor site characterization or poor operations.

Requirements Analysis. This requirement for monitoring of low-level waste disposal facility performance is essentially equivalent to the requirement in DOE 5820.2A, Chapter III.3.k.(4). The corrective measures requirement is similar to a specific 10 CFR Part 61 requirement (Part 61.12(l)). This requirement partially addresses the Complex-Wide Review Concern on Groundwater Monitoring.

Requirements for disposal facility performance monitoring are a performance based set consistent with and partially derived from 10 CFR Part 61 requirements as well as the Defense Nuclear Facilities Safety Board Recommendation 94-2 performance assessment deliverable entitled, *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments.*

Other Considerations. These requirements add defense-in-depth for confirmation of modeling/performance assessment calculations and the need to understand changes in disposal facility performance.