DATE: January 10, 2001

FROM: JAMES G. POWERS, DIRECTOR
OFFICE OF MANAGEMENT AND OPERATIONS SUPPORT, MA-4

TO: DIRECTIVES POINTS OF CONTACT

SUBJECT: DRAFT DOE G 435.1-2, FORMAT AND CONTENT GUIDE FOR U.S. DEPARTMENT OF ENERGY LOW-LEVEL WASTE DISPOSAL FACILITY PERFORMANCE ASSESSMENTS AND COMPOSITE ANALYSES; DRAFT DOE G 435.1-3, FORMAT AND CONTENT GUIDE FOR U.S. DEPARTMENT OF ENERGY LOW-LEVEL WASTE DISPOSAL FACILITY CLOSURE PLANS; DRAFT DOE G 435.1-4, MAINTENANCE GUIDE FOR U.S. DEPARTMENT OF ENERGY LOW-LEVEL WASTE DISPOSAL FACILITY PERFORMANCE ASSESSMENTS AND COMPOSITE ANALYSES; AND DRAFT DOE G 435.1-5, LOW-LEVEL WASTE DISPOSAL FACILITY FEDERAL REVIEW GROUP GUIDE

This is to notify you that the subject directives have been posted in the "Draft" section of the Explorer system for your review and comment. DOE G 435.1-2 provides more specific technical guidance to preparers of DOE low-level radioactive waste disposal facility performance assessments and composite analyses. DOE G 435.1-3 provides guidance to preparers of closure plans for DOE low-level radioactive waste disposal facilities. DOE G 435.1-4 provides guidance for maintenance of DOE low-level radioactive waste disposal facility performance assessments and composite analyses. DOE G 435.1-5 provides guidance to Low-Level Waste Disposal Facility Federal Review Group for conducting review of DOE low-level radioactive waste disposal facility performance assessments and composite analyses.

Comments on the Guides are due April 10, 2001. ***Guides now have a separate coordination process in the directives system. Guides will be posted in the "drafts" section of Explorer for simultaneous use and coordination. Comments on Guides should not be designated "major" or "suggested", as in the past. From this point on, comments on Guides should be simply labeled as "comments". Please refer to the memo from James G. Powers, dated March 31, 2000, subject: Management of DOE Guides. The following procedures should be followed for the submission of comments:***

Directives Points of Contact at Headquarters Elements: Submit one set of consolidated comments to the originator of the Guides: Karen Guevara, EM-22, Germantown; facsimile (301) 903-9770; or internet address: KAREN.GUEVARA@em.doe.gov.

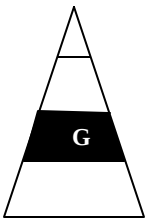
Send an additional copy of comments to LaVerne Fuller, MA-4, Room 4B-245, Forrestal; facsimile (202) 586-1972; or to laverne.fuller@hq.doe.gov.

Directives Points of Contact at Field Elements: Submit consolidated comments to the writer as well as a copy to MA-4. The package submitted by Field Elements must include as an attachment the comments provided by contractors.

Contractors will submit comments directly to their appropriate Field Elements.

Questions concerning the content of the Guide should be directed to Karen Guevara, (301) 903-4981. Questions on the directives system should be directed to LaVerne Fuller at (202) 586-1996.

DOE G 435.1-3



Approved: XX-XX-XX

IMPLEMENTATION GUIDE for use with DOE M 435.1-1

Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Closure Plans

U.S. DEPARTMENT OF ENERGY

Distribution:
All Departmental Elements

Initiated By:
Office of Environmental Management

Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Closure Plans

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LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
CA	composite analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
D&D	decontamination and decommissioning
Department	U.S. Department of Energy
DOE	U.S. Department of Energy
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
LLW	low-level radioactive waste
NEPA	National Environmental Policy Act
PA	performance assessment
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision

PART A: INTRODUCTION

1. PURPOSE

This document provides guidance to preparers of closure plans for U.S. Department of Energy (DOE) low-level radioactive waste (LLW) disposal facilities, as required by DOE O 435.1, RADIOACTIVE WASTE MANAGEMENT, and DOE M 435.1-1, RADIOACTIVE WASTE MANAGEMENT MANUAL (Refs.1, 2). The closure plan is prepared to define the approach to be taken for ensuring the long-term protection of the public and the environment from disposed LLW. The closure plan is reviewed and approved by the field element manager, and the approved closure plan becomes part of the radioactive waste management basis for the LLW disposal facility.

This *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Closure Plans* (hereafter referred to as "Guide") is intended to provide a structured base from which closure plans are prepared, thereby enhancing consistency in the closure plans and ensuring a technically sound review and decision making process. This Guide is not intended to provide guidance on the technical aspects of the closure process (e.g., design of covers and barriers).

The closure plan is a living document that is constantly updated through the operational life of the facility with specific information about contents, partial closure of disposal units, and other information necessary to result in the final closed state. This Guide describes the process of updating the closure plan. The design and operating features specified in the closure plan define key elements of the conceptual model(s) for the facility performance assessment (PA) and composite analysis (CA). Thus, as the closure plan is updated, it will also be necessary to update the performance assessment and composite analysis. The latter activity comprises maintenance of the performance assessment and composite analysis and is discussed in a companion document, *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (Ref. 3).

Guidance related to implementation of the requirements of DOE M 435.1-1, including those related to closure plans, is provided in *Implementation Guide for Use with DOE M 435.1-1, DOE G 435.1-1* (Ref. 4). Technical guidance related to closure of LLW disposal facilities is contained in *Considerations for Closure of Low-Level Radioactive Waste Engineered Disposal Facilities* (Ref. 5) and *Guidance on the Stabilization and Closure of U.S. Department of Energy Mixed and Low-Level Radioactive Waste Disposal Facilities* (Ref. 6).

The guidance in this Guide does not supersede statutory or regulatory requirements, or other DOE Orders or Policies issued under the DOE directives system. Modifications and additions to this guidance will be made periodically. These changes will be formally made under the DOE directives system and will be distributed to recipients of this original guidance.

2. ORGANIZATION OF DOCUMENT

This Guide is divided into four parts. This first part is an introduction that provides an overall context of the closure plan process described in latter sections of the document. It also describes the relationship of the closure plan to the other activities affecting LLW disposal facilities. Finally, this first part identifies and describes the responsibilities for preparing, reviewing, and approving closure plans. The second part of this Guide is an annotated outline that describes the recommended format and content for the closure plan. Because the closure plan is a living document, guidance is provided on the information that should be included in each section during each phase of the LLW disposal facility life. The third part this Guide identifies closure plan requirements under Resource Conservation and Recovery Act (RCRA) regulations that are applicable to mixed LLW disposal facilities. Finally, the fourth part lists documents referenced in this Guide.

3. BACKGROUND

This section provides background information on the closure process for LLW disposal facilities. Part A, section 3.1 describes the overall objective of the process and its relationship to other activities affecting LLW disposal facilities. Part A, section 3.2 describes how the closure plan is updated over the life of the disposal facility and part A, section 3.3 describes the different phases of closure that will be implemented.

3.1 Closure Objectives and Relationship to Other Programs

Low-level waste disposal is a critical activity requiring engineering and institutional controls because the potential hazards from disposed radioactive waste continue into the future. One of the most important of controls for long-term safety of disposed low-level waste is the closure plan for the facility, the elements of which represent the last line of defense against the possible interaction of buried radioactivity and the public, worker, or environment. The development and implementation of a low-level waste disposal facility closure plan is a crucial function in ensuring that disposal is conducted safely and effectively and will remain safe into the future.

The Department's approach to ensuring that its activities will not compromise future radiological protection of the public uses a combination of assessments, depending on regulatory requirements applicable to specific facilities or activities. Assessments applicable to LLW disposal facilities are the performance assessment and composite analysis. The performance assessment is used to provide the Department with a reasonable expectation that LLW disposal will meet the radiological performance objectives established in DOE M 435.1-1. The composite analysis is used by the Department as a planning tool in efforts to ensure that the combined effect of all sources of residual radioactive material that could contribute to the dose calculated from a disposal facility will not compromise requirements for protecting the public. The closure plan plays a key role in the performance assessment and composite analysis. Specifically, the closure plan provides the technical basis for defining critical design features and future conditions needed to conduct the performance assessment and composite analysis.

The closure plan is associated with various DOE Orders and, in some cases, regulatory requirements. The principal DOE Order requirements related to LLW disposal are contained in DOE O 435.1 and DOE M 435.1-1. Specific requirements of DOE O 435.1 and DOE M 435.1-1 related to closure plans are discussed in Part B.

DOE Order 5400.5, RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT (Ref. 7), establishes requirements for protecting the public against radiation. The closure plan provides the basis for ensuring compliance with these requirements, which rely principally on—

- institutional control mechanisms such as land use control,
- actual measurements or assessments conducted on a real time basis, and
- those protective or remedial actions that may be necessary to reduce doses and risks to low levels consistent with the as low as reasonably achievable (ALARA) process.

Because a closed LLW disposal facility constitutes a long-term source of potential radiation exposure, closure is related to requirements associated with long-term use and care of the site surrounding the disposal facility. Depending on site-specific conditions, closure of an LLW disposal facility may be regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or RCRA, or it may be associated with activities regulated under these laws. As such, closure plans may need to address specific CERCLA or RCRA requirements, or they may need to be prepared in conjunction with other documents required by CERCLA or RCRA. Similarly, LLW facility closure may be addressed in long-term site planning documents, such as those prepared under the National Environmental Policy Act (NEPA). Closure may also be included in activities associated with long-term site stewardship. In these cases, closure activities contained in the closure plan must be consistent with long-term site plans.

Disposal facilities that receive mixed LLW will also be regulated under RCRA. The RCRA regulations applicable to mixed waste landfills are contained in Part 264 of Title 40 of the Code of Federal Regulations (40 CFR 264). These regulations include requirements for closure and post-closure plans. Thus, closure plans for mixed LLW landfills must comply not only with requirements under DOE M 435.1-1, but also with requirements under 40 CFR 264 (or equivalent state regulations in states authorized to regulate mixed LLW management activities). In addition, mixed LLW landfills must also receive an operating permit issued under RCRA (or equivalent state regulations). RCRA closure plan requirements contained in 40 CFR 264 are presented in Part C.

3.2 Maintenance of Closure Plans Over Facility Life

The closure plan is a living document that evolves over the life of the disposal facility. A preliminary closure plan is initially prepared during the planning and design phase before the site is constructed. This plan is updated during the operational phase of the facility life. A final closure plan is then

prepared at the time of closure. The role of the closure plan during these phases of the facility life is described below.

3.2.1 Preliminary Closure Plan

The preliminary closure plan is prepared as part of the facility planning and design process and is integral to the initial performance assessment for the facility. The requirement for a preliminary closure plan is contained in DOE M 435.1-1, Chapter IV, paragraph Q(1), which states the following:

> 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.

The objective of the preliminary closure plan is to ensure that critical information on LLW disposal facility closure analyzed in the performance assessments and composite analyses is documented in a preliminary plan that is submitted along with the performance assessment and composite analysis for review. By reviewing the preliminary closure plan along with the performance assessment and composite analysis, Headquarters can better assess whether there is a reasonable expectation of meeting performance objectives.

The performance assessment evaluates the expected performance of the facility given specified conditions planned to be met at closure. The closure plan describes the technical approach that will be employed to meet these conditions. By reviewing the closure plan, the Department can assess whether the closure plan represents a realistic and technically feasible approach for achieving the conditions that performance assessment indicates will result in a reasonable expectation of meeting the performance objectives.

3.2.2 Operational Closure Plan

The operational closure plan is the closure plan that is revised and updated during facility operations. The first update of the closure plan occurs when the preliminary closure plan is updated after the disposal authorization statement is issued. The purpose of this update is to ensure that any changes to the facility closure plan that are part of a condition of the disposal authorization statement are formally incorporated into the closure plan. Changes mandated in the disposal authorization statement that may cause a re-evaluation of the performance assessment need to also be addressed as part of the performance assessment maintenance program. According to the requirements of DOE M 435.1-1, this revision to the preliminary closure plan must be completed within 1 year after the disposal authorization statement is issued.

Updates of the closure plan will then continue during operation. DOE M 435.1-1, Chapter IV, paragraph Q(1)(a), requires that closure plans "[b]e updated as required during the operational life of the facility." The objective of this requirement is to ensure that the closure plan incorporates in a timely

fashion the conditions encountered or developed during the operation of an LLW disposal facility that will impact long-term safety and environmental considerations when the facility is closed.

The closure plan is a living document that is continually updated throughout the operational life of the facility. As noted above, the preliminary closure plan must be updated so that it is consistent with the conditions in the disposal authorization statement. Additional updates can also be anticipated as the disposal facility matures from design to construction to operation. Changes in facility design and operations, additional information developed from monitoring data, or improved understanding of low-level waste disposal facility performance can lead to changes in the analyses and documentation for the facility, which could lead to changes in the closure plan. Updates of the closure plan are necessary to ensure that the radioactive waste management basis is current and protects workers, the public, and the environment. The determination of the need to update the closure plan for a disposal facility is site-specific, but is ultimately made when there is reason to believe that the radioactive waste management basis for the disposal facility is no longer consistent with the actual performance of the disposal facility.

The process of updating the closure plan is closely linked to the performance assessment and composite analysis maintenance process. Any information that is incorporated into the closure plan, or any changes made to closure of the facility that would change assumptions used in the performance assessment or composite analysis, should be incorporated into those evaluations as part of the maintenance process. Such changes should be evaluated in a timely manner so that the extent of their impact on waste acceptance or other aspects of operation can be known and any required changes can be made effective as soon as possible.

Compliance with the requirement for updating the closure plan is demonstrated by the closure plan being a current representation of the planned facility closure, and by the plan being correctly represented in the performance assessment for the disposal facility.

3.2.3 Final Closure Plan

The final closure plan is prepared at the end of the operational life, prior to final closure activities. The requirement for a final closure plan is contained in DOE M 435.1-1, Chapter IV, paragraph Q(2)(b), which states the following:

> 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.

The final closure plan incorporates all of the findings of the final update of the performance assessment and composite analysis and includes the final waste and radionuclide inventory for the disposal facility. The final closure plan clearly presents the steps to be taken to ensure long-term stability of the facility and site. The plan specifies the ongoing maintenance and monitoring activities to be performed during the period of institutional control and the process for conducting any corrective actions that may be required.

3.3 Phases of Closure

As described in part A, section 3.2, the closure plan evolves over the various phases of the facility life. Similarly, the closure plan addresses the three steps of facility closure: 1) operational or interim closure, 2) final facility closure, and 3) institutional control. These phases of closure are described below.

3.3.1 Operational or Interim Closure

Operational or interim closure describes closure activities that are implemented prior to final closure. Interim closure activities would generally include emplacement of barriers (e.g., covers) to stabilize the site and isolate the disposed waste until final closure. Interim closure would also include site monitoring.

In most cases, operational or interim closure will involve closure of individual disposal cells or units within the overall facility. For example, a landfill facility may be comprised of several disposal trenches that are to be operated sequentially. After being filled, each trench would undergo interim closure to stabilize it until final closure of the entire facility, which would occur after the final trench is filled.

In some cases, interim closure may be implemented at the end of the operational life in anticipation of final closure to be implemented under another regulatory program. For example, an active LLW disposal facility may be located within an area that contains a number of inactive disposal facilities that are CERCLA sites. An approach to final closure of the entire area may be developed under the CERCLA remedy selection process. In this case, the LLW disposal facility would undergo interim closure at the end of its operational life to stabilize it until final closure was implemented under CERCLA.

3.3.2 Final Facility Closure

Final facility closure activities, which are clearly described in the closure plan for the facility, are intended to stabilize the site and minimize the need for ongoing active maintenance. Activities performed during this period include placement of intruder barriers, completion of final grading to ensure appropriate management of runoff and to minimize infiltration, placement of erosion controls, and placement of site markers, permanent identification markers to locate disposal units, and monitoring equipment. Final closure also includes the compilation and proper disposition and storage of all records in a retrievable manner in accordance with the DOE M 435.1-1. . At the end of the closure period, the facility should require only institutional control, including site monitoring and minor custodial care.

3.3.3 Institutional Control

The institutional control phase begins following completion of final closure. Post-closure institutional control is required by DOE M 435.1-1, Chapter IV, paragraph Q(2)(c), which states the following:

> 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.

The objective of this requirement is to ensure that institutional control will continue until the low-level waste disposal facility can be released for unrestricted use.

Institutional control, for the purposes of a performance assessment, is typically assumed to last for 100 years. However, the actual period of institutional control, when DOE maintains a custodial presence and controls the use of the land, lasts until the facility can be released. A low-level waste disposal facility cannot be released until the requirements for public and environmental radiation protection of DOE 5400.5, RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT, for releasing a facility for unrestricted use are met. Institutional control is no longer necessary for a facility released for unrestricted use.

For low-level waste disposal facilities, the period of institutional control could extend well beyond 100 years before the requirements of DOE 5400.5 are met. The closure plan includes the necessary activities to be performed during this period of institutional control to ensure protection of the public health and the environment, such as facility monitoring, custodial maintenance, access controls, corrective actions, passive controls and restrictions, reporting requirements, and record keeping. Determination of the necessary activities to be performed during the institutional control period is based on the documentation and analysis included in the facility radioactive waste management basis, including the performance assessment, composite analysis, closure plan, and monitoring plan. Institutional control measures must be incorporated into the site's land use and stewardship plans and programs to ensure that control of the site is not compromised. Throughout the period of institutional control, the responsibility for maintaining the facility to protect the public and the environment rests with the field element manager.

4. RESPONSIBILITIES FOR PREPARATION AND REVIEW OF CLOSURE PLANS

The primary responsibilities associated with closure plans rest with the field element managers. DOE M 435.1-1, Chapter I, paragraph 2f(8,) states that field element managers are responsible for 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.

As part of the planning and design process for a new LLW disposal facility, the field element manager is responsible for reviewing and approving the preliminary closure plan that is submitted to Headquarters with the performance assessment, composite analysis, and preliminary monitoring plan. The preliminary closure plan is reviewed by Headquarters, along with the performance assessment, composite analysis, and preliminary monitoring plan. Either the Deputy Assistant Secretary for Site Closure or the Deputy Assistant Secretary for Project Completion will then issue a disposal authorization statement, depending

on which office has jurisdiction for the disposal facility. This disposal authorization statement will contain specific conditions applicable to the design, construction, operation, and closure of the disposal facility. The field element manager is then responsible for updating the preliminary closure plan, performance assessment, composite analysis, and preliminary monitoring plan, so that they are consistent with the conditions in the disposal authorization statement. These documents then become part of the radioactive waste management basis for the facility. The field element manager is responsible for maintaining the radioactive waste management basis throughout the operational life of the facility.

PART B: CLOSURE PLAN STANDARD FORMAT AND CONTENT

Part B of this Guide contains the recommended format and content for DOE LLW closure plans prepared to fulfill the requirements of DOE M 435.1-1. The structure of the closure plan is designed to provide flexibility in their preparation. Such flexibility is desirable for two primary reasons. First, disposal of LLW at DOE sites may involve a variety of facility types (landfills, vaults, tumuli) and waste types (containerized waste, bulk solidified liquids, vitrified monoliths). Second, the requirements for LLW disposal facilities in DOE M 435.1-1 are based on performance standards, as opposed to technical design standards. As a result, a number of different technical approaches could be used to meet performance standards for a given facility type. Thus, the type and amount of information contained in a closure plan may vary considerably from facility to facility. A flexible approach to closure plan contents is also consistent with application of the graded approach.

The recommended format of the closure plan closely parallels the format of the facility performance assessment contained in the *PA/CA Format and Content Guide*. Because the closure plan and performance assessment are closely related and must be updated on a similar schedule, the use of a similar format should facilitate the updating and maintenance process.

1. EXECUTIVE SUMMARY

This section should summarize the closure plan, highlighting the features of each section that are important to understanding how the facility will be closed and how closure activities will meet the requirements of DOE M 435.1-1.

2. INTRODUCTION

This section should summarize information and activities associated with closure of the facility. This includes descriptions of the facility and site, a general overview of the technical approach to meeting the closure requirements, a summary of the schedule for implementing closure activities over the life of the facility, a description of the relationship of closure to other programs and activities at the site, and a list of key assumptions related to closure.

Information presented in this section of the preliminary closure plan should be based on the best available information, recognizing that some information may not have been developed yet. This information should then be revised in closure plan updates.

2.1 General Facility Description

This section should present a general description of the waste disposal facility and its location. It should provide a basic overall description of the LLW disposal facility and waste operations, without referring to other sections of the closure plan, that is sufficient to understand the remaining sections of the introduction. The information presented should address major design and operational features and closure concepts. For existing disposal facilities, a brief description of the historical development and use of the facility should also be provided.

The general facility description should also present a general description of the types and quantities of wastes disposed at the site, including any treatment or processing prior to disposal and information on waste containerization. Ancillary facilities associated with the disposal facility should also be described.

Finally, the general facility description should describe the general land use patterns in the vicinity of the DOE site. Descriptions should be limited to predominant land uses in the vicinity of the disposal facility and the DOE site. Any land use plans or probable future changes that could affect the institutional control phase of closure should be described and relevant documents cited.

2.2 General Closure Approach

This section of the closure plan should explain the general approach that will be taken to close the facility, including controlling release of radionuclides from the facility following closure, minimizing infiltration of water, and minimizing maintenance and ensuring long-term stability. The information presented should demonstrate how the closure approach is appropriate for site and waste characteristics and the current state of knowledge concerning these characteristics.

2.3 Closure Schedule

This section should briefly describe the chronology of major closure activities and milestones. For facilities that will implement interim closure prior to final closure, interim closure activities should be included on the schedule.

2.4 Related Activities

This section should discuss all applicable relationships between facility closure and other activities and programs at the DOE site. This information should provide the site-specific regulatory context for closure. The other programs and activities discussed could include mixed LLW regulation under RCRA, cleanup activities under CERCLA and RCRA, land-use planning, NEPA documentation, and long-range site stewardship. This section should also describe any institutional relationships, agreements, or commitments that may affect the closure of the disposal facility. As appropriate, the following examples should be discussed:

- the performance assessment, composite analysis, and preliminary monitoring plan to be prepared and submitted with the preliminary closure plan as required by DOE M 435.1-1;

- any RCRA requirements, including permit conditions, applicable to management of mixed LLW at the facility;

- any relevant agreements between DOE, the Environmental Protection Agency (or other Federal agency), or the State, including agreements or Records of Decision (RODs) for environmental restoration of waste disposal sites under CERCLA, agreements for remedial actions under RCRA, or agreements on groundwater protection, and any other relevant agreements;

- any planned or completed evaluations or documents prepared in order to comply with the NEPA, with mention of the specific activities evaluated in each document;

- any safety analysis reports prepared in accordance with DOE Order requirements and any design or operational requirements derived from the safety analysis that affect closure; and

- the Groundwater Protection Management Plan prepared for the DOE site in accordance with DOE Order 5400.1, including any groundwater protection requirements that apply to operation, closure, or long-term performance of the disposal site.

2.5 Summary of Key Assumptions

This section should highlight key assumptions used to prepare the closure plan. Assumptions are typically related to unknown or uncertain information, which should be reduced over the life of the facility. Thus, while the preliminary closure plan may contain a number of key assumptions, the final closure plan should contain few, if any.

Certain key assumptions may be related to uncertainties or data gaps that will be addressed as part of research and development activities associated with performance assessment maintenance. These assumptions are identified in the performance assessment and should be so noted in the closure plan.

3. DISPOSAL FACILITY CHARACTERISTICS

This section should provide descriptions and data for the DOE site and surrounding environment, LLW disposal facility, and LLW characteristics to provide the basis for understanding the approach to closure. The information in this section should emphasize those characteristics important to implementation of closure activities and the long-term performance of the disposal system. The information should be sufficient for the reader to assess whether the closure plan represents a realistic and technically feasible approach for meeting closure performance requirements and achieving conditions that will result in a reasonable expectation of meeting the performance objectives stated in the performance assessment.

Much of the information identified in this section is similar or identical to the information presented in the corresponding section of the performance assessment. As appropriate, the descriptive information gleaned from the performance assessment can be summarized in this section and the performance assessment referenced for additional details.

As indicated previously in the introduction to part B, the type and amount of descriptive information needed will vary from facility to facility. Not all topics identified in the subsections of part B, section 3, apply to every type of LLW disposal facility. Use of a graded approach in preparing this section is appropriate.

Because closure plans will be updated as site characteristics change, it is very important that all sources of information presented in this section be clearly referenced, including the date of the information. This will help ensure that updates incorporate the most recent data.

3.1 Site Characteristics

This section of the performance assessment should present the relevant natural and demographic characteristics and data for the disposal site and surrounding area. The level of detail included in this section should be sufficient to provide a basis for understanding site characteristics affecting closure. The presentation of the site characteristics should provide sufficient information to allow an independent reviewer to conclude that the closure approach is technically feasible, and that it will minimize maintenance, ensure long-term stability, and provide a reasonable expectation of meeting radiological performance objectives.

Much of the descriptive information contained in this section relates to characteristics that are not likely to change over time. Therefore, the information presented in the preliminary closure plan is not expected to require significant revision in closure plan updates.

3.1.1 Geography and Demography

3.1.1.1 Disposal Site Location

The location of the DOE site and the disposal facility should be specified. The general location should be described (e.g., distance and direction to nearby towns, rivers, or other natural or man-made landmarks). A regional map should be provided as a figure in this section, as well as a more detailed disposal site map. The boundaries of the existing or proposed disposal site should be clearly indicated on the disposal site map. The future boundary of DOE-controlled land should be clearly indicated on the map(s).

3.1.1.2 Disposal Site Description

A general description of the disposal site and surrounding area should be provided. This includes the physical area of the disposal site, area of the disposal site identified for actual disposal, general vegetation type, topography, and location relative to nearby bodies of water, roadways, or other landmarks. Any nearby features that are potentially significant relative to the long-term performance of the disposal facility (e.g., nearby dams, seismic faults, etc.) should be mentioned. These should be discussed in greater detail in later sections and subsections, as appropriate.

3.1.1.3 Population Distribution

Existing and projected populations should be presented to the extent necessary to support land use plans related to the site.

3.1.1.4 Uses of Adjacent Lands

The closure plan should include a summary of relevant historical and current uses of the land in the vicinity of the disposal facility. Nearby facilities or land use having the potential to impact the site (e.g., large-scale irrigation that could affect water table levels) should be identified and discussed.

3.1.2 Meteorology and Climatology

A general description of regional and site-specific climatological conditions should be provided, with a more detailed description of local meteorology and microclimate. The emphasis of this section should be on conditions that could affect long-term stability of the disposed waste, such as conditions that could result in wind or water erosion of barriers. This section should also provide applicable information on regional natural phenomena that are reasonably foreseeable (such as tornadoes, convective storms, hail, and waterspouts) with a sufficient probability to be considered in the closure design. The information in this section should be presented in sufficient detail to support the design basis for the features to be constructed or implemented as part of closure.

The information on local meteorological parameters should include any interpretations of data for defining parametric values used to analyze the performance of the disposal facility. A brief discussion of the data on which meteorological and climatological characterization are based should be incorporated, including locations of meteorologic stations and duration of data collection.

3.1.3 Ecology

This section should contain relevant information (derived from existing site surveys, environmental impact statements, etc.) concerning plant and animal species and communities that may be important with respect to long-term performance of the disposal facility. This could include burrowing insect or mammal populations, major plant communities, or vegetation types, as necessary to define maintenance requirements for the site during the institutional control period.

3.1.4 Geology

Relevant information on the geologic characteristics of the disposal site and the region around the disposal site should be provided. The degree of detail included should be sufficient to support the design basis for the features to be constructed or implemented as part of closure. This section should also provide applicable information on regional natural processes and phenomena that are reasonably foreseeable (such as erosion and seismic events) with a sufficient probability to be considered in the closure design.

3.1.4.1 Regional and Site-Specific Geology /Topography

The structural geology of the region should be described, and its relationship to the disposal site geologic structure should be discussed to provide the basis for the conceptual model of the disposal facility. Any relevant features, such as faults, folds, open jointing, fractures, or shear zones in the region should be identified, and their significance to the closure design should be discussed. Maps and geologic profiles should be presented as needed to supplement the descriptive language.

Reasonably foreseeable processes with sufficient probability to be considered in the design, such as mass wasting, erosion, slumping, and landsliding, should also be described as necessary to support the design. Any applicable results from geotechnical engineering studies conducted at or near the disposal site should also be summarized and referenced.

3.1.4.2 Seismology

Relevant information describing all known or inferred faults in the disposal site vicinity that could potentially affect facility design should be described. Graphical presentation of the relationship of seismic features to the disposal facility should be included, as appropriate. The relationship of these faults to the present-day local stress field should be described, as well as any potential effects on the disposal site as a result of fault displacement. This section should also provide applicable information on the seismologic investigations that have been or are to be carried out at the disposal site and the region surrounding the disposal facility.

3.1.5 Hydrology

Data and results of technical analyses that describe the relevant characteristics of the surface and groundwater hydrology of the disposal site and vicinity should be presented. The degree of detail included should be sufficient to support the design basis for the features to be constructed or implemented as part of closure.

3.1.5.1 Surface Water

The data and information included in this section should provide a characterization of disposal site drainage and the surrounding watershed. As necessary, topographic maps should be included that show elevations of the disposal site and relevant features of the disposal system, natural drainages, and man-made features. The location, size, shape, and other hydrologic characteristics of relevant surface water bodies near the disposal site should be described. The potential for the disposal site to be flooded should be discussed, including the occurrence of any previous flooding at the disposal site.

3.1.5.2 Groundwater

Information characterizing the geohydrology of the disposal site should be provided as relevant to closure of the facility. Information presented should include characteristics that may affect the ability to monitor performance of the facility during the institutional care period.

3.1.6 Geochemistry

Information characterizing the geochemistry of the disposal site should be provided as relevant to closure of the facility. Information should include characteristics that may affect the ability to monitor performance of the facility during the institutional care period.

3.1.7 Natural Resources

The information in this section should include descriptions of current or reasonably foreseeable exploitation of natural resources in the vicinity of the disposal site that could potentially affect the site during the institutional care period.

3.2 Facility Characteristics

This section should provide sufficient descriptive information to allow the reader to understand the engineered features of the site and their effectiveness in meeting performance standards. General descriptive information about the facility should include the type of disposal facility (e.g., landfill, vault, tumulus), size of the facility, number of disposal units or cells, and general design and construction features (e.g., liners, covers). In most cases, summarizing the facility description information contained in the performance assessment and providing a reference to the performance assessment for more detailed information should be sufficient.

Some facility characteristics may not be finalized at the time the preliminary closure plan is prepared. That is, in many cases, an objective of the initial performance assessment is to determine key design features that will provide a reasonable expectation of meeting performance objectives. The performance assessment is thus used to determine performance specifications (e.g., maximum infiltration rates) that will be the design bases for preparation of detailed designs. In such cases, information in this section of the preliminary closure plan will be conceptual in nature. As the design is refined, the information should be updated and finalized by the time the final closure plan is prepared.

The specific information presented in this section will vary depending on the type of disposal facility under consideration. Principal design features that may be relevant and should be addressed include features that—

- minimize the infiltration of water through disposal units,
- ensure integrity of disposal unit covers and minimize maintenance,

- provide for the structural stability of backfill, waste, and covers, and
- provide a barrier against intrusion.

Each of these principal design features is discussed in the following sections. The discussions in this section should be general. Detailed discussions of design features will be presented in part B, section 4.2.

3.2.1 Water Infiltration

Design features that will be used to minimize water infiltration should be identified, including those that are designed to direct onsite precipitation away from the disposal units, as well as those that direct the flow of offsite surface and groundwater away from the disposal facility or disposal units.

3.2.2 Disposal Unit Cover Integrity

Design features that will be used to ensure the integrity of the disposal unit should be identified, including erosion protection of disposal unit covers. In addition, any features used to prevent long-term degradation of disposal unit covers should be presented.

3.2.3 Structural Stability

Design features and operating conditions that will be used to ensure the structural stability of the fill, wastes, and waste covering should be identified. Information presented should include the volume of anticipated voids within waste containers and within the backfill around the containers, and anticipated degradation of fill, waste forms, engineered features, and waste cover materials.

3.2.4 Inadvertent Intruder Barrier

Information on design features related to inadvertent intruder barriers should address information such as degradation rates, engineered barriers, and the materials separating stable and unstable wastes.

3.3 Waste Characteristics

This section should present information on the inventory of wastes disposed at the site and the radionuclide content of those wastes. DOE M 435.1-1, Chapter IV, paragraph Q(1)(c), states that closure plans must "[i]nclude the total expected inventory of wastes to be disposed of at the facility over the operational life of the facility." The objective of this requirement is to ensure that the closure plan is updated throughout the operation of the facility to accurately reflect and consider all of the long-term hazards associated with the actual inventory of low-level waste disposed at the facility over its operational lifetime. The information presented in this section should be identical to that presented in the corresponding section of the performance assessment.

This accounting includes the estimated inventory of each isotope expected to be present in the waste, as well as the total waste inventory. The estimated inventory presented in the preliminary or initial closure plan should be consistent with the inventory used in the performance assessment and any limits on inventory incorporated into the waste acceptance criteria. This initial inventory estimate for a new disposal facility is likely to be subject to uncertainties because it is based on expected or projected waste volumes and attributes. As the facility operates and waste is received, periodic updates should be made, as required by DOE M 435.1-1, Chapter IV, paragraph Q(1)(a), to reflect the actual volumes and characteristics of the disposed waste and to reduce the uncertainty in the total and isotopic inventory.

DOE M 435.1-1, Chapter IV, paragraph Q(2)(a), states the following:

> 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.

In accordance with this requirement, the expected inventory included in the closure plan must be updated to provide the final inventory of waste actually disposed of in the facility. The final inventory should include a complete listing of the wastes received, the inventory of each radionuclide disposed, and the total volume of waste disposed. The final inventory should provide a crosswalk with the waste manifests for each waste package disposed in the facility to facilitate the resolution of any specific issues related to the location, waste characteristics, waste packaging, and concentrations of radionuclides present in the disposal facility.

4. TECHNICAL APPROACH TO CLOSURE

This section of the closure plan should describe the specific activities that will be conducted to close the facility in accordance with DOE O 435.1 and DOE M 435.1-1 and any other applicable requirements. Section 4.1 should describe the approach for meeting each of the performance objectives contained in DOE M 435.1-1 and similar requirements under other programs. Section 4.2 should then describe in detail specific activities to be conducted during each phase of closure. Finally, Section 4.3 should describe the monitoring activities that will be conducted during each phase of closure.

4.1 Compliance With Performance Objectives and Other Requirements

This section should describe the conceptual closure approach for meeting the performance objectives contained in DOE M 435.1-1. The facility performance assessment will provide the technical basis for demonstrating that there is a reasonable expectation of meeting the performance objectives. The purpose of this section is to describe the closure activities and facility design features that comprise the basis of the performance assessment models. For example, the performance assessment model may be based on limiting infiltration into the closed disposal cells to a specified rate. This section would describe the design features (e.g., vegetative cover, capillary barrier) that would be used to control moisture infiltration.

At the time the preliminary closure plan is prepared, detailed design specifications may not have been developed for all components of the disposal facility. In such cases, the preliminary closure plan should present the design criteria or performance specifications that were developed using the performance assessment. As the design is refined during the performance assessment maintenance process, the closure plan should be updated with more specific design information. At the time of final closure, the design of all components to be installed as part of closure must be finalized.

4.1.1 All-Pathways Dose

This section should describe the relationship between site closure activities and design features and the post-closure, all-pathways dose evaluated in the performance assessment. The performance assessment conceptual model(s) and results, including the sensitivity/uncertainty analysis, should be reviewed to identify the mechanisms for controlling future dose for each pathway. This review should identify the specific controls and features needed to provide a reasonable expectation of meeting the all-pathways dose performance objective. Those controls and features to be implemented as part of facility closure should then be identified and described. The specific types of controls and features employed will depend on the type of disposal facility, but in most cases are expected to be barriers to limit moisture infiltration and prevent intrusion by plants and animals. For each such feature, this section should also identify the general approach to be used to minimize future maintenance and provide long-term stability.

4.1.2 Air Pathway Dose

This section should describe the relationship between site closure activities and design features and the post-closure, air pathway dose evaluated in the performance assessment. The type of information presented, and the approach to developing this information, is essentially the same as described in part B, section 4.1.1 for the all-pathways dose. If the inventory of volatile radionuclides in the disposed waste is insignificant, the performance assessment may indicate insignificant dose by the air pathway. If so, the section should indicate that no closure activities or design features are needed with respect to this performance objective.

4.1.3 Radon Flux

This section should describe the relationship between site closure activities and design features and the radon flux from the facility evaluated in the performance assessment. The type of information presented, and the approach to developing this information, is essentially the same as described in part B, section 4.1.1 for the all-pathways dose. If the inventory of radon precursors in the disposed waste is insignificant, the performance assessment may indicate insignificant release of radon from the facility. If so, this section should indicate that no closure activities or design features are needed with respect to this performance objective.

4.1.4 Other Requirements

This section should describe other requirements related to facility performance or design that could affect closure and the approach to be taken during closure to meet those requirements. Requirements will be facility-specific, but could include those related to—

- other performance measures evaluated in the performance assessment (e.g., inadvertent intrusion, water resources impacts);
- design standards and other requirements associated with RCRA hazardous waste regulations;
- DOE 5400.5 requirements for decontamination and release of equipment and structures;
- CERCLA remedial action and RCRA corrective action; and
- long-term site stewardship.

4.2 Detailed Closure Activities

This section should provide a detailed description of the activities to be conducted during each phase of facility closure. This information is needed to satisfy the requirements of DOE M 435.0-1, Chapter IV, paragraph Q (1)(b), which states that the closure plan shall—

> [i]nclude 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.

This section provides the details for implementing the activities identified in part B, section 4.1. The information presented in this section should be sufficient to demonstrate that closure conditions will achieve stability of the disposal facility, reduce the need for active maintenance, and meet the requirements of DOE 5400.5. The specific information presented will vary depending on the type of facility and wastes received. In addition, the level of technical detail will depend on the maturity of the facility design. Information presented in the preliminary closure plan may be conceptual in nature. Information in the final closure plan must be of sufficient technical detail to serve as the basis for implementing closure activities. Similarly, if interim closure is to be conducted, the technical details for interim closure must be thoroughly developed and presented in this section before the first phase of interim closure is implemented.

4.2.1 Operational/Interim Closure

This section should provide a detailed description of the activities to be conducted for interim closure of disposal units or cells. The preliminary closure plan should present a conceptual design for interim

closure, including design criteria. Before interim closure of the first closure unit or cell occurs, the closure plan should be updated to present detailed engineering plans and specifications for interim closure activities. Before implementing interim closure, this design information should be used to update the performance assessment to ensure that interim closure activities are consistent with long-term performance requirements for the disposal facility.

The specific information presented in this section will depend on the type of disposal facility. In most cases, interim closure is expected to involve installation of temporary barriers to provide isolation of the disposed wastes until final closure. Types of information that would typically be presented include—

- engineering drawings, including grading plans, cross sections, drainage plans;
- specifications for materials and placement of materials (e.g., permeability, lift height, compaction, moisture content);
- specifications for final survey of disposal cell location;
- construction quality control plan;
- records management plan for documents and records generated during interim closure; and
- detailed construction schedule for interim closure activities.

If multiple disposal units or cells are to undergo interim closure over the life of the facility, the drawings should show site conditions (e.g., grading and drainage) following interim closure of each unit/cell. Drawings, detailed specifications, and procedures may be presented in appendices. Monitoring to be performed as part of interim closure should be described in part B, section 4.3.

4.2.2 Final Closure

This section should describe in detail the activities to be conducted for final closure of the disposal facility. The preliminary closure plan should present a conceptual design for final closure, including design criteria. Before final closure occurs, the closure plan should be updated to present detailed engineering plans and specifications for final closure activities. Before implementing final closure, this design information should be used to update the performance assessment to confirm that the final closure configuration will provide a reasonable expectation of meeting performance objectives.

The specific information presented in this section will depend on the type of disposal facility. In most cases, final closure is expected to involve installing final barriers, including final site grading and vegetation; surveying disposal unit locations; decontaminating and decommissioning (D&D) ancillary facilities (e.g., those for waste receipt, packaging, analysis); decontaminating and releasing equipment; installing permanent markers; filing facility location records with local land use and zoning officials; and managing records associated with final closure. Types of information that would typically be presented include—

- engineering drawings, including grading plans, cross sections, drainage plans;
- specifications for materials and placement of materials;
- specifications and plans for D&D of ancillary facilities;
- procedures for radiological decontamination of equipment for release;
- specifications for final survey of disposal facility location;
- specifications for emplacement of permanent facility location markers;
- construction quality control plan;
- records management plan for documents and records generated during final closure; and
- detailed construction schedule for final closure activities.

Drawings, detailed specifications, and procedures may be presented in appendices. The monitoring to be performed as part of final closure should be described in part B, section 4.3.

4.2.3 Institutional Control

This section should describe in detail the activities to be implemented during the institutional control period following final closure of the disposal facility. The preliminary closure plan should generally describe these activities, based on the conceptual design for final closure. Before final closure occurs, the closure plan should be updated to present detailed procedures for institutional control. Before implementing final closure, this information should be used to update the performance assessment to confirm that the planned institutional control measures will provide a reasonable expectation of meeting performance objectives. During institutional control, the closure plan should be updated to reflect any changes to institutional control activities made as a result of actual post-closure conditions. These changes should be made in conjunction with performance assessment maintenance.

The specific information presented in this section will depend on the type of disposal facility. In most cases, institutional control is expected to consist of inspection and maintenance activities. Types of information that would typically be presented include the following:

- detailed procedures for inspection and maintenance of the closed disposal facility (e.g., final cover, run-on and run-off control system);
- detailed procedures for inspection and maintenance of the monitoring system;
- a detailed schedule for institutional control activities;
- a corrective action plan, including specific conditions requiring corrective action (e.g., subsidence, erosion), criteria for determining whether corrective action is required, and specific corrective action procedures; and

- a records management plan for documents and records generated during institutional control.

This section should also describe how institutional control activities will be incorporated into the site's land use and stewardship plans and programs to ensure that control of the site in not compromised by activities under other programs.

Detailed plans and procedures may be presented in appendices. The monitoring to be performed during institutional control should be described in part B, section 4.3.

4.2.4 Unrestricted Release of Site

This section should describe in detail the activities to be implemented to result in unrestricted release of the site under DOE 5400.5, RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT. The preliminary closure plan should present a conceptual approach for meeting the requirements for unrestricted release under DOE 5400.5. For the final closure plan, this conceptual approach should be finalized, including detailed procedures and analyses to be used to verify that the facility meets the requirements for unrestricted release. This information would be updated during the institutional control period based on actual post-closure conditions. A final update would be prepared at the end of the institutional control period.

The specific information presented in this section will depend on the type of disposal facility. Types of information that would typically be presented include the following:

- establishment of authorized limits for residual radioactive material, as specified in DOE 5400.5;
- identification of other requirements applicable to release of the property [e.g., CERCLA Section 120(h)]; and
- a description of existing site conditions compared to requirements for unrestricted release.

Detailed analyses, such as those used to establish authorized limits, may be presented in appendices. Unrestricted release of the site would be accompanied by cessation of monitoring activities.

If unrestricted release of the site will not be pursued, this section should so indicate.

4.3 Monitoring

This section should describe the monitoring to be performed during the various phases of the facility life. A detailed description of facility monitoring will be contained in the monitoring plan required by DOE M 435.1-1, Chapter IV, paragraph R(3). This section should focus on those aspects of the monitoring program that relate to facility closure. This would include monitoring performed to verify closure performance and to identify conditions requiring corrective actions. The monitoring plan will be updated over the life of the disposal facility in a manner similar to that for the closure plan. For example, DOE M 435.1-1, Chapter IV paragraph R(3), requires a preliminary monitoring plan to be submitted with the performance assessment and composite analysis, and updated

based on the disposal authorization statement. This requirement is identical to the corresponding requirement for submitting and updating the preliminary closure plan. As required by DOE M 435.1-1, Chapter IV paragraph R(3)(a), the monitoring plan for the disposal facility must be developed using the results of the performance assessment and composite analysis. Thus, as the performance assessment and composite analysis are updated through the maintenance process, the monitoring plan must also be updated. Similarly, as the monitoring plan is updated, the description of the monitoring program contained in the closure plan should also be updated.

4.3.1 Operational/Interim Closure

This section should describe monitoring activities that would be implemented during operation to monitor the performance of interim closure measures. The exact information presented will depend on the type of monitoring activities being employed. In general, the information that should be presented includes the following:

- application of the data quality objectives (DQO) process to identify the specific data that should be collected during monitoring;
- summary of the sampling and analysis plan developed using the DQO process (e.g., types of samples, sample locations, sampling frequency, sampling methods, analytical methods);
- summary of data management procedures;
- description of data evaluation procedures (i.e., how disposal facility performance will be evaluated using the monitoring data); and
- summary of quality assurance/quality control procedures.

It is expected that most facilities will employ groundwater monitoring. If groundwater monitoring is being conducted, the descriptive information presented should include details on the construction of the monitoring wells.

4.3.2 Final Closure/Institutional Care

This section should describe monitoring activities to be implemented during the institutional care period to monitor the performance of final closure measures. The exact information presented will depend on the type of monitoring activities being employed. The information that should be presented in this section is essentially identical to that for part B, section 4.3.1 and includes the following:

- application of the DQO process to identify the specific data that should be collected during monitoring;
- summary of the sampling and analysis plan developed using the DQO process;
- summary of data management procedures;

- description of data evaluation procedures; and
- summary of quality assurance/quality control procedures.

It is expected that most facilities will employ groundwater monitoring. If groundwater monitoring is being conducted, the descriptive information presented should include details on the construction of the monitoring wells.

5. CLOSURE SCHEDULE

This section of the closure plan should present a comprehensive schedule for closure of the facility. The schedule should show each phase of closure including operational/interim closure, final closure, and institutional control. The schedule should present key decisions and milestones and include the preparation and approval of related documents and permits such as the final performance assessment, composite analysis, safety analysis report, other permits, or state approvals.

For the preliminary closure plan, this section should present a generic schedule with milestones, as actual dates for specific activities will probably not exist. The preliminary schedule should, however, reflect the logic of the schedule (e.g., predecessor and successor activities). If operational/interim closure will be implemented, the preliminary schedule should clearly identify how these closure activities will be implemented.

Once the facility is operational, the closure schedule should be updated with actual and planned dates for specific activities. The schedule should also be updated to reflect changes in the closure approach resulting from the performance assessment maintenance process.

The final closure plan schedule should contain specific dates for all remaining closure activities in order to demonstrate compliance with closure requirements. Specifically, DOE M 435.1-1, Chapter IV, paragraph Q(2), states that "[c]losure of a disposal facility shall occur within a five-year period after it is filled to capacity, or after the facility is otherwise determined to be no longer needed." The objective of this requirement is to ensure that the disposal facility does not remain in an unmaintained state, leading to compromise of the ability of the disposal units to contribute to long-term stability and protection of the public, workers, and the environment.

6. REFERENCES

This section should contain the complete citations for references cited in the closure plan.

7. APPENDICES

This section should contain all of the appendices to the closure plan. The appendices should include detailed technical information such as engineering drawings and specifications and analyses to support unrestricted release. The appendices should also present "stand-alone" plans and procedures that are too lengthy to present in the text (e.g., data management plans, quality assurance procedures).

PART C:
RCRA CLOSURE PLAN REQUIREMENTS FOR MIXED LLW DISPOSAL FACILITIES

Department of Energy disposal facilities that receive mixed LLW are subject to the requirements of RCRA, as well as DOE O 435.1 and DOE M 435.1-1. Closure plans for such facilities, therefore, must also satisfy both sets of requirements. The purpose of this part of the Guide is to generally describe RCRA closure plan requirements and identify whether they are consistent with requirements under DOE M 435.1-1 and, therefore, addressed in the closure plan format and content presented in Part B. If not, additional information needed for the mixed LLW closure plan to meet RCRA requirements is briefly discussed.

It should be noted that most states are authorized to regulate mixed LLW management and have developed their own regulatory programs to do so. These state programs must be at least as stringent as the RCRA regulations developed by the U.S. Environmental Protection Agency (EPA), and often contain additional requirements. Preparers of closure plans for mixed LLW disposal facilities should, therefore, refer to applicable state regulations to determine specific closure plan requirements.

General RCRA closure and post-closure requirements are contained in 40 CFR 264, subpart G (sections 40 CFR 264.110 through 40 CFR 264.120). These requirements are described below in part C, sections 1 through 11. Additional closure requirements applicable to landfills are contained in section 40 CFR 264.310 and are described in part C, section 12.

1. 40 CFR 264.110 – APPLICABILITY

This section indicates the applicability of 40 CFR 264 Subpart G to various types of hazardous waste management facilities. All sections of 40 CFR 264 Subpart G are applicable to disposal facilities, including landfills.

2. 40 CFR 264.111 – CLOSURE PERFORMANCE STANDARD

This section establishes general closure performance standards, which are to close the facility in a manner that—

(1) minimizes the need for further maintenance;

(2) controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous wastes, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and

(3) complies with the requirements of Subpart G and other sections applicable to specific facility types.

Item (1) is also a requirement of DOE M 435.1-1 and is addressed in part B, section 4.2 of the closure plan guidance.

Item (2) is not specifically addressed in DOE M 435.1-1. The information presented in part B, section 2.2 addresses the general approach to closure, including minimizing future releases of radionuclides, but does not address release of nonradioactive constituents. Part B, section 4.2 addresses how closure will meet the performance standards in DOE M 435.1-1, which are based on radiological protection of the public, but does not specifically address releases of nonradioactive constituents. The closure plan for mixed LLW disposal facilities must, therefore, present additional information related to nonradioactive releases to address this requirement. Specifically, part B, section 2.2 should address control of releases of nonradioactive constituents, as well as radionuclides. Part B, section 2.4 should describe the general requirements of RCRA related to preventing post-closure release of hazardous wastes and constituents. These requirements, and the closure activities and design features needed to meet them, should be described in part B, section 4.1.4. Finally, the description of closure activities in part B, section 4.2 should include those specifically related to RCRA requirements.

It should be noted that the RCRA hazardous waste landfill regulations are based on technical design standards, rather than performance standards, such as those used in DOE M 435.1-1. The approach to demonstrating compliance with RCRA requirements will, therefore, be different than that used to demonstrate compliance with the DOE M 435.1-1 performance objectives.

Item (3) is addressed in the subsequent sections of this part of the Guide.

3. 40 CFR 264.112 – CLOSURE PLAN; AMENDMENT OF PLAN

This section contains several paragraphs with requirements related to preparing and amending closure plans.

3.1 40 CFR 264.112(a) – Written Plan

This paragraph requires owners and operators of hazardous waste facilities to have a written closure plan. This requirement is identical to that for closure plans in DOE M 435.1-1.

3.2 40 CFR 264.112(b) – Content of Plan

This paragraph identifies the following specific items that must be contained in the closure plan:

(1) a description of how each unit will be closed to meet the closure performance standard;

(2) a description of how final closure of the facility will be conducted to meet the closure performance standard;

(3) an estimate of the maximum inventory of hazardous wastes ever on site;

(4) a detailed description of the steps needed to remove or decontaminate all hazardous waste residues and contaminated system components, equipment, structures, and soils;

(5) a detailed description of other activities necessary during closure to satisfy the closure performance standard, including groundwater monitoring, leachate collection, and run-on and run-off control;

(6) a schedule for closure of each unit and for final closure; and

(7) the expected year of closure for facilities using trust funds to establish financial assurance.

Items (1) and (2) were previously addressed in the discussion of the closure performance standard in part C, section 2.

Item (3) is similar to the DOE M 435.1-1 requirement to identify the inventory of LLW and radionuclides, which is addressed in part B, section 3.3. For mixed LLW closure plans, the information in part B, section 3.3 must be expanded to address the above requirement.

Item (4) is primarily directed toward "clean closure" of facilities other than disposal facilities. These requirements would, however, apply to ancillary facilities (e.g., waste receiving, handling, or packaging facilities) associated with the disposal facility. Radiological D&D of ancillary facilities is addressed in part B, section 4.2. For mixed LLW facilities, this information would need to be expanded to include any chemical decontamination activities.

Item (5) is similar to DOE M 435.1-1 requirements. Groundwater monitoring would be included in the monitoring program required by DOE M 435.1-1 and described in part B, sections 4.2 and 4.3. The requirement for leachate collection is specifically derived from RCRA technical design standards for landfills, which require leachate collection systems. A leachate collection system would, thus, be required for a mixed LLW landfill, and leachate collection would need to be addressed in part B, section 4.2. The guidance for part B, sections 3.2 and 4.1 addresses minimizing moisture infiltration and erosion, which would address run-on and run-off control.

Item (6) is addressed by part B, sections 2.3 and 5.

Item (7) does not apply to Federal facilities, which do not have to demonstrate financial assurance.

3.3 40 CFR 264.112(c) – Amendment of Plan

This paragraph establishes requirements for amending the closure plan if a change in operating plans or facility design affects closure. This requirement is essentially identical to the requirement to update the closure plan [DOE M 435.1-1, Chapter IV, paragraph Q(1)(a)]. The process of updating the closure plan according to DOE M 435.1-1 requirements should, therefore, comply with the RCRA requirement for plan amendments. The primary effect of 40 CFR 264.112(c) on mixed LLW facilities is that closure plan amendments are considered modifications to the facility's RCRA operating permit.

Amendments must, therefore, be approved through the formal RCRA permit modification process. In addition, 40 CFR 264.112(c) establishes time limits for amending closure plans.

3.4 40 CFR 264.112(d) – Notification of Partial Closure and Final Closure

This paragraph establishes requirements for notifying EPA in writing before beginning partial or final closure. DOE M 435.1-1 contains no equivalent requirements. The closure plan schedules in part B, sections 2.3 and 5 should, therefore, be modified to include milestones for this notification.

3.5 40 CFR 264.112(e) – Removal of Wastes and Decontamination or Dismantling of Equipment

This paragraph allows the owner or operator to remove hazardous wastes or decontaminate or dismantle equipment at any time before or after notification of partial or final closure. This requirement is primarily directed toward "clean closure" and would not apply to disposal facilities, other than ancillary facilities, as discussed for 40 CFR 112(b).

4. 40 CFR 264.113 – CLOSURE; TIME ALLOWED FOR CLOSURE

This section establishes time limits for beginning and completing partial and final closure.

4.1 40 CFR 264.113(a)

Under this paragraph, closure activities must begin within 90 days of receiving the final volume of waste. DOE M 435.1-1 does not contain a similar requirement. The closure plan schedules in part B, sections 2.3 and 5 should, therefore, be modified to include milestones for starting closure. If a time extension is necessary, this paragraph also describes the conditions under which an extension may be granted.

4.2 40 CFR 264.113(b)

Under this paragraph, closure activities must be completed within 180 days of receiving the final volume of waste. A similar requirement in DOE M 435.1-1 I, Chapter IV, paragraph Q(2), requires closure to be completed within 5 years after the facility reaches capacity or is no longer used. The closure schedules in part B, sections 2.3 and 5, therefore, must meet the 180-day RCRA time limit. If a time extension is necessary, this paragraph also describes the conditions under which an extension may be granted.

4.3 40 CFR 264.113(c)

This paragraph describes the process by which an extension to the time limits for beginning or completing closure may be requested.

4.4 40 CFR 264.112(d)

This paragraph describes the process by which a disposal facility may continue to operate to receive nonhazardous waste after it has received the final volume of hazardous waste. This requirement would apply to a mixed LLW disposal facility that ceases receiving mixed LLW, but continues to operate and receive LLW. The paragraph describes the process for obtaining a permit modification to allow such operation.

4.5 40 CFR 264.112(e)

This paragraph contains requirements applicable only to surface impoundments that comply with requirements for liners and leachate collection systems.

5. 40 CFR 264.114 – DISPOSAL OR DECONTAMINATION OF EQUIPMENT, STRUCTURES, SOILS

This section contains requirements for disposal or decontamination of equipment, structures, or soils during partial or final closure. As discussed previously, these requirements apply mainly to "clean closure." If such activities related to decontamination of equipment or ancillary structures are to be included in part B, section 4.2, they must be evaluated to determine whether they result in generation of hazardous wastes.

6. 40 CFR 264.115 – CERTIFICATION OF CLOSURE

This section contains requirements for providing EPA with a closure certification following closure of each unit and final closure of the facility. This requirement is not contained in DOE M 435.1-1 and should be added to the closure activities described in part B, section 4.2 and to the schedules described in part B, sections 2.3 and 5.

7. 40 CFR 264.116 – SURVEY PLAT

This section contains requirements for submitting a survey plat showing the location and dimensions of disposal units to the local zoning or land-use authority when each disposal unit is closed. This requirement is very similar to the requirement of DOE M 435.1-1, Chapter IV, paragraph (2)(d), although 40 CFR 264.116 contains a deadline for submitting the plat by the time of closure certification, and specifically requires the survey plat to be prepared by a professional land surveyor. These requirements should be added to the closure activities described in part B, section 4.2 and to the schedules in part B, sections 2.3 and 5.

8. 40 CFR 264.117 – POST-CLOSURE CARE AND USE OF PROPERTY

This section establishes requirements for care and use of the facility property following closure.

8.1 40 CFR 264.117(a)

This paragraph requires that post-closure care begin following closure and continue for 30 years. At a minimum, post-closure care must consist of environmental monitoring and reporting and monitoring and maintenance of waste containment systems. The required period for post-closure care may be shortened or extended by EPA, depending on site-specific conditions.

These requirements are similar to those in DOE M 435.1-1, though the required RCRA post-closure care period is much less than the required institutional care period. The activities required to be performed during the post-closure care period are essentially the same as those described in part B, section 4.2.3 that would be performed during the institutional control period. The monitoring program described in part B, section 4.3 should be expanded to include additional monitoring requirements under RCRA (e.g., analysis of nonradioactive constituents).

8.2 40 CFR 264.117(b)

This paragraph requires maintaining RCRA facility security requirements (e.g., fences, signs) during the post-closure care period if hazardous wastes may remain exposed or if access by the public or livestock may pose a hazard to human health. These requirements are less stringent than those needed to meet radiological protection performance objectives under DOE M 435.1-1. The institutional care activities described in part B, section 4.2.3 should, therefore, meet these requirements.

8.3 40 CFR 264.117(c)

This paragraph requires that post-closure care or use of the property never be allowed to disturb the integrity of the final cover, liner(s), or any other components of the containment system, or to disturb the function of the monitoring systems. These requirements are less stringent than those needed to meet radiological protection performance objectives under DOE M 435.1-1. The institutional care activities described in part B, section 4.2.3, should, therefore, meet these requirements.

8.4 40 CFR 264.117(d)

This paragraph requires that all post-closure care activities be in accordance with the approved post-closure plan. This requirement is somewhat different than that in DOE M 435.1-1 because RCRA specifies separate closure and post-closure plans, while DOE M 435.1-1 uses a single closure plan that includes activities during the institutional care period. For mixed LLW disposal facilities, therefore, the closure plan prepared under DOE M 435.1-1 would need to function as both the RCRA closure plan and post-closure plan.

9. 40 CFR 264.118 – POST-CLOSURE PLAN; AMENDMENT OF PLAN

This section contains several requirements related to preparation and amendment of post-closure plans.

9.1 40 CFR 264.118(a) – Written Plan

This paragraph requires owners and operators of hazardous waste facilities to have a written closure plan. As discussed in part C, section 8.4, the requirements for a closure plan under DOE M 435.1-1 meet the RCRA requirements for a post-closure plan.

9.2 40 CFR 264.118(b)

This paragraph identifies the following specific items that must be contained in the post-closure plan:

(1) a description of planned monitoring activities and frequencies;

(2) a description of planned maintenance activities; and

(3) the name, address, and phone number of a contact person.

Item (1) is addressed by the monitoring activities described in part B, sections 4.2.3 and 4.3. As noted previously, the monitoring programs developed under DOE M 435.1-1 would need to be expanded to address additional RCRA requirements.

Item (2) is addressed by the inspection and maintenance activities described in part B, section 4.2.3.

Item (3) is not specifically included in the requirements of DOE M 435.1-1 and would need to be added to the information presented in part B, section 4.2.3.

9.3 40 CFR 264.118(c)

This paragraph requires that a copy of the approved post-closure plan be maintained by the person identified in part C, section 9.2 and submitted to the EPA upon request. This requirement would be met by the DOE M 435.1-1 requirement for maintaining the radioactive waste management basis for the facility.

9.4 40 CFR 264.118(d) – Amendment of Plan

This paragraph establishes requirements for amendment of the post-closure plan to reflect any change in operating plans or facility design that would affect post-closure care. This requirement is essentially identical to the requirement in DOE M 435.1-1, Chapter IV, paragraph Q(1)(a), which stipulates that the closure plan be updated during the facility life, including the institutional care period. The process of updating the closure plan according to DOE M 435.1-1 requirements should, therefore, comply with the RCRA requirement for post-closure plan amendments. The primary effect of 40 CFR 264.118(d) on mixed LLW facilities is that post-closure plan amendments are considered modifications to the facility's RCRA post-closure permit. Amendments must, therefore, be approved through the formal RCRA permit modification process. In addition, 40 CFR 264.118(d) establishes time limits for amending closure plans.

10. POST-CLOSURE NOTICES

This section contains the following requirements for submitting notices at the time of closure related to past use of the property for hazardous waste disposal:

(1) submission of a record of the type, location, and quantity of hazardous waste disposed of within each unit to the local zoning or land-use authority and EPA;

(2) recording a notice on the deed to the property that the property has been used for disposal of hazardous waste and that its use is restricted; and

(3) submitting a certification to EPA that the deed notification described in item (2) has been made.

These requirements are similar, though not identical to, the requirement in DOE M 435.1-1, Chapter IV, paragraph Q(2)(d), to file the location and use of the facility with the local land use and zoning authorities. The notification activities described in part B, section 4.2.2 should be amended to include the specific RCRA notification requirements noted above.

Paragraph 40 CFR 264.119 allows the above deed restrictions to be removed if the hazardous wastes or hazardous waste residuals are removed from the property following closure. If such activities were to be performed as part of the process for releasing the property for unrestricted use, they should be included in part B, section 4.2.4.

11. 40 CFR 264.120 – CERTIFICATION OF COMPLETION OF POST-CLOSURE CARE

This section contains requirements for providing a certification of closure to EPA following completion of the required post-closure care period for each disposal unit. This requirement is not contained in DOE M 435.1-1 and should be added to the institutional care activities described in part B, section 4.2 and to the schedules in part B, sections 2.3 and 5.

12. 40 CFR 264.310 – CLOSURE AND POST-CLOSURE CARE

This section contains requirements for closure and post-closure care that apply to hazardous waste landfills.

12.1 40 CFR 264.310(a)

This paragraph requires that the landfill be covered with a final cover that—

(1) provides long-term minimization of migration of liquids through the closed landfill;

(2) functions with a minimum of maintenance;

(3) promotes drainage and minimizes erosion or abrasion of the cover;

(5) accommodates settling and subsidence to maintain the integrity of the cover; and

(6) has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils.

Items (1) through (4) are equivalent to DOE M 435.1-1 requirements and are addressed in part B, sections 3.2 and 4. Item (5) is related to the technical design standards for RCRA hazardous waste landfills and is not specifically addressed in DOE M 435.1-1. This requirement should be included in part B, sections 3.2 and 4 for mixed LLW disposal facilities. It should be noted that the purpose of item (5) is to prevent the long-term accumulation of moisture within the disposal unit. LLW disposal facility design characteristics that would lead to such conditions would presumably be identified during the performance assessment.

12.2 40 CFR 264.310(b)

This paragraph requires the facility owner or operator to comply with post-closure care requirements after closure. These requirements include—

(1) maintaining the integrity of the final cover, including making repairs needed as a result of settling, subsidence, or erosion;

(2) continuing to operate the leachate collection and removal system until leachate is no longer detected;

(3) maintaining and monitoring the leak detection system;

(4) maintaining and monitoring the groundwater monitoring system;

(5) preventing run-on and run-off from eroding or damaging the final cover; and

(6) protecting and maintaining surveyed benchmarks.

Items (1), (4), (5), and (6) are equivalent to DOE M 435.1-1 requirements and are addressed in part B, section 4.2.3. Items (2) and (3) are related to the technical design standards for RCRA hazardous waste landfills, which require leachate collection and leak detection systems, and are not specifically addressed in DOE M 435.1-1. These requirements should be included in part B, section 3.2 and 4 for mixed LLW disposal facilities.

PART D: REFERENCES

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3. U.S. Department of Energy, DOE G 435.1-4, *Maintenance Guide For U.S. Department of Energy Low-level Waste Disposal Facility Performance Assessments and Composite Analyses*, Washington, DC, XX-XX-00.

4. U.S. Department of Energy, DOE G 435.1-1, *Implementation Guide for Use with DOE M 435.1-1*, U.S. Department of Energy, Washington, DC, 7-9-99.

5. U.S. Department of Energy, DOE/LLW-133, *Considerations for Closure of Low-Level Radioactive Waste Engineered Disposal Facilities*, DOE/LLW-133, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1992.

6. U.S. Department of Energy, DOE/LLW-82, *Guidance on Stabilization and Closure of U.S. Department of Energy Mixed and Low-Level Radioactive Waste Disposal Facilities*, U.S. Department of Energy, National Low-Level Waste Management Program, Idaho Falls, ID, 1990.

7. U.S. Department of Energy, DOE 5400.5, RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT, Change 2, U.S. Department of Energy, Washington, DC,1-7-93.