NUREG–1200
Revision 3

Standard Review Plan
for the review of a license application for a Low-Level Radioactive Waste Disposal Facility

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

NUREG–1200
Rev. 3

Standard Review Plan
for the review of a license application for a Low-Level Radioactive Waste Disposal Facility

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Division of Low-Level Waste Management and Decommissioning
Office of Nuclear Material Safety and Safeguards
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ABSTRACT

The Standard Review Plan (SRP) (NUREG-1200) provides guidance to staff reviewers in the Office of Nuclear Material Safety and Safeguards who perform safety reviews of applications to construct and operate low-level radioactive waste disposal facilities. The SRP ensures the quality and uniformity of the staff reviews and presents a well-defined base from which to evaluate proposed changes in the scope and requirements of the staff reviews. The SRP makes information about the regulatory licensing process widely available and serves to improve the understanding of the staff's review process by interested members of the public and the industry. Each individual SRP addresses the responsibilities of persons performing the review, the matters that are reviewed, the Commission's regulations and acceptance criteria necessary for the review, how the review is accomplished, the conclusions that are appropriate, and the implementation requirements.

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PREFACE

The Standard Review Plan (SRP) provides guidance to staff reviewers in the Office Of Nuclear Material Safety and Safeguards (NMSS) on performing safety reviews of applications to construct and operate low-level waste disposal facilities and provides implicit guidance to licensees and applicants. Although this document is intended to be used by the NMSS staff in conducting its reviews, it can also be helpful to Agreement States and interested parties responsible for conducting their own licensing reviews or developing license applications. The principal purpose of the SRP is to ensure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. It is also a purpose of the SRP to make information about regulatory matters widely available and to improve the understanding of the staff review process by interested members of the public and the nuclear industry.

The safety review is primarily based on the information provided by an applicant in a Safety Analysis Report (SAR). Section 61.10 Title 10 of the Code of Federal Regulations (10 CFR 61.10) requires that each application for a low-level waste disposal facility include an SAR. The SAR must be sufficiently detailed to permit the staff to independently verify that the facility can be built and operated without undue risk to the health and safety of the public. Before an SAR is submitted, an applicant should have designed and analyzed the facility in sufficient detail to conclude that it can be built and operated safely. The SAR is the principal document in which the applicant provides the information needed to understand the basis on which this conclusion has been reached.

10 CFR 61.11 specifies, in general terms, the information to be supplied in an SAR. The specific information that the staff needs in order to evaluate an SAR is identified in NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility." The individual SRPs are keyed to NUREG-1199 and are numbered according to the section numbers in that document.

The SRP is written to cover a variety of site conditions and facility designs. Each individual SRP provides the complete procedures and all acceptance criteria for all the areas of review pertinent to that SRP. However, for any given application, the staff reviewers may select and emphasize particular aspects of each SRP as is sufficiently similar to a feature previously reviewed so that a complete new review is not needed. For these and other similar reasons, the staff may not carry out in detail all of the review steps listed in each SRP.

Each individual SRP identifies who will perform the review, the matters to be reviewed, the basis for the review, how the review will be performed, and the conclusions that are sought. The safety review is performed by three branches in the Division of Waste Management: the Low-Level Waste and Decommissioning Projects Branch, which manages the license review for the Division, reviews the financial assurance portions of the SAR, and ensures consistency and continuity of the review; the Engineering and Geosciences Branch, which

reviews the engineering aspects of the SAR such as the disposal facility and package design and materials issue, as well as the geologic, and geochemical aspects of the SAR; and the Performance Assessment and Hydrology Branch, which reviews the hydrologic aspects of the design and how it impacts surface and groundwater characteristics of the site. Each SRP identifies the primary disciplines needed for the review under that SRP. In some review areas, the supporting disciplines needed are also identified in the SRP. The SRP is one of the principal mechanisms that will allow the NRC staff to review a license application within 15 months.

Each SRP is organized into the following seven sections:

- 1. RESPONSIBILITY FOR REVIEW

  This section identifies the discipline(s) responsible for evaluating the subject or functional area covered by the SRP.

- 2. AREAS OF REVIEW

  This section describes the information that will be reviewed by the individual with primary review responsibility. It contains a description of the systems, components, analyses, data, or other information that will be reviewed as part of that particular section of the SAR. It may also discuss briefly the information needed or the expertise required from other NRC technical areas to permit the primary reviewer to complete his review.

- 3. REVIEW PROCEDURES

  This section discusses how the review will be performed. It generally includes step-by-step procedures that the reviewer will follow to reasonably verify that the applicable criteria have been met.

- 4. ACCEPTANCE CRITERIA

  This section contains a statement of the purpose of the review, applicable NRC regulatory requirements as well as related guidance, and the technical bases for determining the acceptability of the design or the programs within the scope of review of the SRP. The technical bases consist of specific criteria such as NRC regulatory guides, industry codes and standards, and branch technical positions.

  The technical bases for some sections are provided in branch technical positions or appendices, which are or will be included in the SRP. These documents typically set forth the solutions and approaches determined to be acceptable by the staff in dealing with a specific problem or design area. These solutions and approaches are codified in this form so that staff reviewers can take consistent positions on similar problems as they arise.

  Branch technical positions and appendices present solutions and approaches that are acceptable to the staff, but that are not considered

as the only possible solutions and approaches. However, applicant should recognize that substantial time and effort on the part of the staff have gone into developing the branch technical positions and appendices and that a corresponding amount of time and effort will probably be needed to review and accept new or different solutions and approaches. Thus, applicants proposing solutions and approaches to problems or design areas other than those described in the branch technical positions must expect longer review times and more extensive questioning in these areas. The staff is willing to consider proposed solutions and approaches on a generic basis, apart from a specific license application, so as to avoid the additional time that would be spent reviewing individual cases.

- 5. EVALUATION FINDINGS

  This section presents the type of conclusion that is sought for the particular review areas. For each SRP, a conclusion of this type will be included in the Safety Evaluation Report (SER), in which the staff publishes the results of its review. The SER also will contain a description of the review, including aspects of the review that were selected or emphasized; matters that were modified by the applicant, require additional information, will be resolved in the future, or remain unresolved; where the facility's design or the applicant's programs deviate from the criteria in SRP; and the bases for any deviations from the SRP or exemptions from the regulations.

- 6. IMPLEMENTATION

  This section explains how the SRP and acceptance criteria will be implemented by the staff.

- 7. REFERENCES

  This section lists the references that will be used in the review process and designates references as "Essential" or "General."

REVISIONS OF THE STANDARD REVIEW PLAN

The current versions of the SRP and NUREG-1199 are directed toward near-surface trench disposal. The SRP has been revised to provide guidance on additional near-surface disposal concepts, specifically those alternative concepts that incorporate structures constructed of cementitious materials with earthen cover. The SRP will be revised and updated periodically to clarify the content or correct errors and to incorporate modifications approved by the Director of the Division of Waste Management, Office of Nuclear Material Safety and Safeguards.

A revision number and publication date are printed on the lower right-hand corner of each page of each SRP, since individual SRPs will be revised as needed. The contents and status sheet indicates the revision numbers of the current SRPs. As the need arises, NUREG-1199 will be changed to correspond with the revised SRP.

Comments and suggestions for improving this document, as well as notices of errors or omissions, should be sent to LeRoy S. Person, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

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ACKNOWLEDGMENTS

The Standard Review Plan (NUREG-1200, Rev. 3) for low-level radioactive waste disposal was prepared under the supervision of LeRoy S. Person, who acted as project manager, and is based on contributions from the staff members of the Low-Level Waste Management Branch, Uranium Recovery Branch, and Decommissioning and Regulatory Issues Branch of the Division of Low-Level Waste Management and Decommissioning. The Authors would like to thank John Thoma, Section Leader of the Technical and Special Issues Section, for his technical advice during preparation of Revision 3. Also, a special thanks is given to Karen McQuighan for long hours in preparing the manuscript for printing.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1
GENERAL INFORMATION

This SRP consists of the following:

SRP 1.0 Licensing Process
SRP 1.1 Introduction
SRP 1.2 General Facility Description
SRP 1.3 Schedules
SRP 1.4 Institutional Information
SRP 1.5 Material Incorporated by Reference
SRP 1.6 Conformance to Regulatory Guides
SRP 1.7 Summary of Principal Review Matters

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U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1
LICENSING PROCESS

1. INTRODUCTION

Land disposal of low-level radioactive waste (LLW) is regulated by the Nuclear Regulatory Commission under 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste." Part 61 contains procedural requirements and performance objectives that apply to all methods of LLW land disposal and specific technical requirements for LLW disposal in or within the upper 30 meters of the earth's surface or on top of the earth's surface but earthen covered, designated as near surface disposal. SRP-1 applies to all land disposal. However, the majority of the SRP chapters in NUREG-1200 are written to apply the technical requirements for near surface disposal. Technical requirements for other types of land disposal will be developed on a case by case basis. To receive the license required under Part 61, the license applicant must submit an application that demonstrates that the proposed facility will conform to the licensing standards cited in 10 CFR 61.23 and meet the four performance objectives specifically stated in 10 CFR 61.41 to 61.44. This "Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility," NUREG-1200 (the SRP) provides guidance to the NRC staff for their review of those applications for which Part 61 sets out specific technical requirements (i.e., for near-surface disposal methods). As additional technical requirements are added to Part 61, the SRP will be expanded to accommodate those additional requirements.

The staff's responsibility in the review of an application for a license for a LLW disposal facility is to determine, with reasonable assurance, that the proposed facility will conform to the requirements of Federal legislation, that is, that it will not be inimical to the common defense and security; that it can be sited, designed, operated, and closed without undue risk to public health and safety; and that environmental values will be protected. To do this, the staff evaluates the contents of the application and makes selected independent assessments to verify that compliance with specific legislative and regulatory requirements will be achieved. To assist an applicant in understanding how the review will be conducted, the staff must clearly state and identify those standards, criteria, and bases to be applied in reaching a licensing decision. The SRP serves the dual role of guiding the staff review

and informing the applicant of the considerations to be applied in that review.

The burden of proof for compliance with the requirements for licensing always rests on the applicant. NRC staff analyses are intended to provide regulatory confirmation of reasonable assurance regarding compliance or non-compliance. A staff determination of reasonable assurance of compliance leads to a decision to issue the license. Where reasonable assurance of compliance is lacking, the staff must inform the applicant of the specific requirements with which compliance is unclear and the basis for the staff position, and then review subsequent approaches prepared by the applicant for resolution of issues requiring clarification.

In this SRP 1, the staff is providing information to assist individual licensing staff and the applicant in understanding how the following elements are mutually inter-related:

a. NRC's requirements in Part 61;

b. the operation of the licensing process;

c. the major guidance documents NRC staff has prepared for licensing a LLW disposal facility; and

d. the details of the staff review process set out in the subsequent sections of this SRP.

2. SATISFACTION OF PERFORMANCE OBJECTIVES AND FACILITY LICENSING STANDARDS

In Part 61, the performance objectives (10 CFR 61.41-10 CFR 61.44) and standards for the issuance of a license (10 CFR 61.23) are expressed as general criteria, each depending for its satisfaction on satisfaction of sub-criteria appropriate to the license application under review. Consequently, conformance to the performance objectives and licensing standards must in practice be evaluated by examining the details of individual issues related to facility siting, design, construction, operation, and closure. The SRP offers a set of detailed evaluations to assist in the review of these individual features and activities. To ensure that all relevant issues are addressed systematically, and in the context of the performance objectives and licensing standards of Part 61, this SRP (NUREG-1200) and its companion document, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," (NUREG-1199) (the SFC) describe in detail nearly 70 such issue-oriented evaluations related to nuclear safety at proposed LLW disposal facilities. Each of these evaluations, singly or in combination, serves to address and satisfy one or more of the performance objectives and standards for the issuance of a license of Part 61. Together

they allow an overall evaluation of the proposed facility as a unified system, so that upon favorable completion of all reviews, reasonable assurance is achieved that all licensing requirements will have been met.

3. PURPOSE AND CONTENT

This SRP 1 is intended to show how the individual SRP evaluations are derived from Part 61, and how the SRP is employed as part of the process leading to the regulatory decision to issue or deny a license. Also addressed is the assembly of the separate SRP evaluations into a unified Safety Evaluation Report (SER) that documents the required finding of reasonable assurance that the performance objectives and standards for the issuance of a license will be met. To fulfill these aims, this SRP 1 reviews below, as separate items, the place of Part 61 in the hierarchical approach used by NRC for the regulation of LLW disposal, the internal relationships within Part 61, the operation of the licensing process under Part 61, and the manner in which the separate SRP reviews address and satisfy one or more of the requirements of Part 61.

4. RELATIONSHIP OF SRP TO PERFORMANCE OBJECTIVES AND LICENSING STANDARDS

One aspect of site licensing that illustrates the relationships among performance objectives, licensing standards, and the SRP is that of ensuring stability of the site after closure.

Addressing this concern, the broadly stated performance objective set forth in 10 CFR Part 61 requires:

> "§ 61.44 Stability of the disposal site after closure.
>
> The disposal facility must be sited, designed, used, operated and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

In the Standards for Issuance of a License, that broad requirement is reinforced, equally broadly, by allowing the issuance of a license after a finding, under 10 CFR 61.23(e), that:

> The applicant's proposed disposal site, disposal site design, land disposal facility operations, disposal site closure, and post-closure institutional control are adequate to protect the public health and safety in that they will provide reasonable assurance that long-term stability of the disposed waste and the disposal site will be achieved and will eliminate to the extent practicable the

need for ongoing active maintenance of the disposal site following closure.

These generalized criteria are most specifically addressed in the SRP by Review Plan 4 - "Facility Operations" and Review Plan 6 - "Safety Assessment" which together contain five individual SRPs directly related to post-closure site safety and stability. In addition to the five reviews within Sections 4 and 6, another six SRPs lead to evaluations from which positive findings contribute to and support the five primary SRPs in Sections 4 and 6. The five primary findings address the roles played by the receipt of authorized wastes only, their proper disposal, and reasonable assurance that post-closure geotechnical stability will not be disturbed. The supporting SRPs in Table 1-1 provide further details about geotechnical stability, and seek confidence that the Quality Assurance/Quality Control (QA/QC) program will operate to secure perforamance of site operations in conformance with license conditions through all phases of site life. These 11 SRPs are listed in Table 1-1.

5. HIERARCHICAL APPROACH TO LICENSING OF LLW DISPOSAL

NRC licenses disposal of LLW through an approach that is hierarchical in form, serving to project requirements for radiological safety and environmental protection, established by the Atomic Energy Act of 1954 (AEA) and other subsequent Federal statutes, onto all levels and all phases of licensing for LLW disposal. The Federal statutes stand at the top of the hierarchy and cover the entire process of licensing the planning, operation and closure of a LLW disposal facility; conversely, the information supplied in a license application describing proposed conformance to Federal statutes provides the base of the hierarchy that supports achievement of the requirements of the Federal statutes.

The intervening levels of the hierarchical approach include the performance objectives and licensing requirements of 10 CFR Part 61, and the formal and informal guidance offered by NRC for the preparation of an application.

Figure 1-1 depicts the hierarchical approach to the licensing of LLW disposal. At the apex of the triangle (Figure 1-1) stand the Federal statutes that require that the disposal of LLW not be inimical in Figure 1-1 to the common defense and security and not constitute an unreasonable risk to the health and safety of the public or the environment. These goals are set out in the Atomic Energy Act of 1954, as amended, the National Environmental Policy Act, the Low-Level Radioactive Waste Policy Act of 1980, and the LLRWPAA.

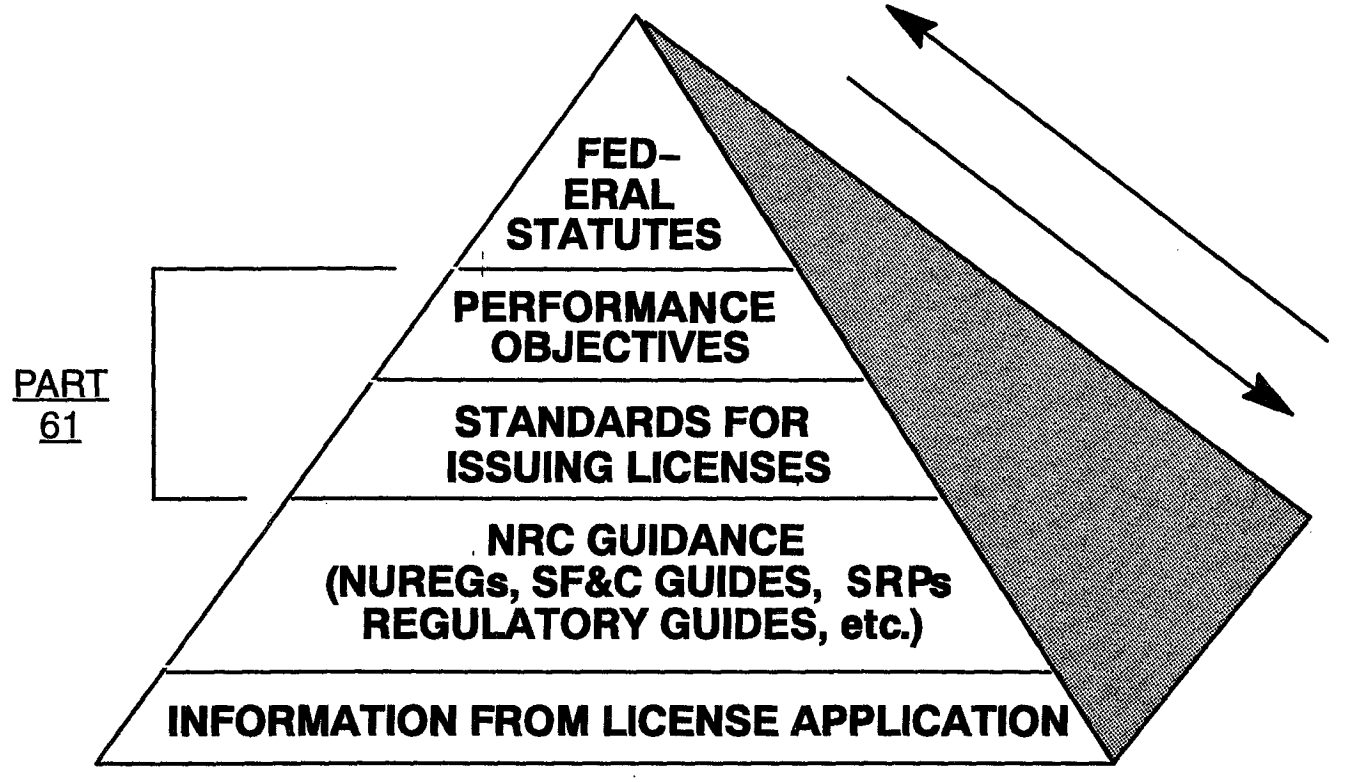
Table 1-1

SRP Sections Responding to Requirements of
Performance Objective (10 CFR 61.44) and Licensing Standard (10 CFR 61.23(e))
for Long-Term Stability

Number	Title
Part I	SRPs Responding Directly to 10 CFR 61.44 and 10 CFR 61.23(e)
4	FACILITY OPERATIONS
4.1	Receipt and Inspection of Waste
4.3	Waste Disposal Operations
6	SAFETY ASSESSMENT
6.3.1	Surface Drainage and Erosion Protection
6.3.2	Stability of Slopes
6.3.3	Settlement and Subsidence
Part II	SRPs That Contribute to Satisfaction of SRPs in Part I
5	SITE CLOSURE PLAN AND INSTITUTIONAL CONTROLS
5.1A	Closure and Stabilization for Below-Ground Vaults and Earth-Mounded Concrete Bunkers
5.1.1	Surface Drainage and Erosion Protection
5.1.2	Geotechnical Stability
5.2	Decontamination and Decommissioning
5.3	Post-Operational Environmental Monitoring and Surveillance
9	QUALITY ASSURANCE
9.1	Quality Assurance in Design, Construction, Operation, and Closure

Figure 1-1

HIERARCHICAL APPROACH TO LICENSING LLW DISPOSAL



Requirements and Objectives Project Downward
Applicant's Actions Must Support Requirements and Objectives

10 CFR Part 61 provides the mechanism for transforming the requirements of the Federal statutes into conformance by licensees. At the outset, in conformance with Federal Statutes, overall performance objectives were established, in Part 61 to define the level of nuclear safety and environmental protection to be achieved in the land disposal of LLW. In support of the performance objectives, Part 61 next establishes specific licensing requirements for each of the major components of a disposal system, including the site characteristics, facility design and operation, the classification and form of acceptable wastes, and institutional controls.

At the second level of the hierarchy, the performance objectives are specifically stated in 10 CFR 61.41 through 61.44 and address limitation of human exposure to radiation from LLW facilities resulting from 1) releases of radioactivity, 2) inadvertent intrusion, 3) onsite operations, and 4) by requiring the site to be closed in a manner that will achieve long-term stability and minimize the need for on-going active maintenance other than surveillance, monitoring, or minor custodial care. The need to satisfy the performance objectives provides the basis for the content of the three successive foundation levels of the hierarchy -- standards for issuing licenses, NRC guidance, and information from the license application -- and the performance objectives and the requirements of the Federal statutes are in turn supported by the foundation levels of the hierarchy.

At the third level, licensing standards are established by 10 CFR 61.23. These standards require that 1) the applicant be qualified to safely manage LLW; 2) the performance objectives be met; 3) the technical and institutional requirements of Subpart D, the financial requirements of Subpart E, and the administrative requirements of Subpart G be satisfied; and that 4) concerns related to physical security, criticality safety, and environmental impact be satisfactorily addressed. Specific technical requirements for facility siting, design and operations, and for the form and classification of waste acceptable for disposal are established by 10 CFR 61.23 through reference to more detailed requirements for these subjects in Subpart D.

The fourth level, designated as NRC guidance, serves as a bridge between the licensing standards level above and the license application level below. NRC guidance provides elaboration and clarification of Part 61 requirements, offers acceptable approaches for meeting those requirements, describes details of the information to be included in an application, and establishes acceptance criteria for the license application review. This guidance includes NUREGs, regulatory guides, information notices, other publications of NRC, and formal and informal contact, as appropriate. Through these means, NRC guidance offers technical support to the applicant while allowing information from the applicant, at the foundation level of the hierarchy, to be submitted to NRC for evaluation against the requirements of 10 CFR Part 61. For radiological safety, three documents are especially important: these SRPs

(NUREG-1200), the SFC (NUREG-1199) previously discussed, and "Review Process for Low-Level Radioactive Waste Disposal License Application Under Low-Level Radioactive Waste Policy Amendments Act," August 1987 (NUREG-1274). In relation to the environmental concerns incorporated by reference in Subpart B of 10 CFR Part 61, two other documents are also especially significant: Regulatory Guide 4.18, "Standard Format and Content of Environmental Reports for Near-Surface Disposal of Radioactive Waste," June 1983, and "Environmental Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility," April, 1987 (NUREG-1300).

At the foundation level of the hierarchy, information from the license application describes in detail how the proposed facility will comply with NRC requirements and Federal statutes.

The up-and-down arrows at the side of the diagram in Figure 1-1 emphasize that the influence of each of the upper layers must project downward to the base of the hierarchy, and that each of the lower levels must support the levels above it.

In the following three sections, the use within the NRC staff review process, of licensing standards, NRC guidance, and the content of the license application is discussed. Section 6 provides a simplified description of the licensing process in relation to preparation and review of the license application. Administrative procedures addressing eligibility for participation in the review of an application, the presentation of comments on draft reports, and the presentation of appeals, among other actions, which are beyond the scope of the SRP, are acknowledged, but are not included in the discussion. Section 7 shows how the requirements of Part 61 are interrelated within the licensing process, and how the requirements for the contents of an application relate directly to the standards for the issuance of a license. Section 8 shows how individual SRPs are used to associate the information required in a license application to satisfaction of specific licensing standards and performance objectives.

6. OPERATION OF THE LICENSING PROCESS

As previously noted, a detailed description of the licensing review process is provided in NUREG-1274, "Review Process for Low-Level Radioactive Waste Disposal License Application Under Low-Level Radioactive Waste Policy Amendments Act," In its total operation, considering both the technical review and administrative mechanisms, the review process is quite complex. After a brief summary of the administrative mechanisms to be considered, the operation of the technical review process is described in more detail.

6.1 Summary of Administrative Mechanisms

The licensing process begins when the applicant submits a license application to the NRC for review. On receipt, a copy of the application is placed in the Public Document Room; a notice that the application has been filed is published in the Federal Register; NRC notifies appropriate Federal, State, tribal officials, and governing bodies, and posts a public notice in general circulation newspapers in the affected States and regions. NRC has 30 days after receipt to judge the application for completeness against published standards; if complete, the application is docketed; if not, it is returned to the applicant for further information. After formal docketing, affected States and Indian tribes may petition NRC to participate in the license review that is required by the LLRWPAA, to be completed within 15 months. Dialogue among all interested parties typically begins before preparation and submission of the application, and continues for as long as necessary throughout the review process.

A complete application includes both a Safety Analysis Report (SAR) and an Environmental Report (ER). NRC reviews these together. Within 8 months after docketing, the staff is to issue a draft Safety Evaluation Report (DSER) and a draft Environmental Impact Statement (DEIS). Approximately 180 days are then required for receipt, review and response to public comments on the DSER and DEIS. Then, on the basis of comments received, the staff will revise the draft documents and issue a final SER and Environmental Impact Staement (EIS) before the expiration of the 15-month time limit.

After publication of the final SER and EIS, interested parties may request a hearing. If no request for a hearing is received, the license application may be evaluated by the Commission solely on the basis of administrative review or on the basis of a hearing it may hold on its own initiative. Hearings, if held, are conducted by a three member Atomic Safety and Licensing Board (ASLB) appointed for the purpose, which makes recommendations to the Commission. After resolution of any appeals, the Commission authorizes the Director of the Office of Nuclear Material Safety and Safeguards (NMSS) to issue a license for the receipt, possession, and disposal of LLW.

6.2 Technical Review

This discussion of the licensing process concentrates on activities that are directly related to use of the radiological safety SRP (NUREG-1200) and the environmental SRP (NUREG-1300); time schedules, dialogue and feedback, the distinctions between the draft and final versions of the SER and the EIS, and post-review administrative actions, as discussed above, are not considered, to focus attention on the central role of the SRP in license application review.

ER is evaluated at the same time as the SAR but under the provisions of NUREG-1300. In reviewing the ER, the staff assesses the effect of the proposed facility on its surroundings and examines potential alternative actions. Upon completion of its review, the staff prepares and issues an EIS. The EIS is issued concurrently with the SER and provides the staff's conclusions on the environmental effects of the proposed facility. Although processing of the ER is administratively separate from the nuclear safety evaluation review using the SRPs, Part 61 takes cognizance of the requirement for the preparation of the ER, and 10 CFR 61.23(l) specifically requires satisfaction of 10 CFR Part 51 (which implements the National Environmental Policy Act) before the NRC staff may conclude that regulatory standards have been met.

Based on the review and supporting documentation contained in the SER and EIS, the staff will conclude whether the standards for the issuance of a license set out in 10 CFR 61.23 have been satisfied and that reasonable assurance exists that the performance objectives will also be satisfied, and on the basis of those conclusions recommend issuance or denial of a license. As required by 10 CFR 2.765, the staff may not issue any license until expressly authorized to do so by the Commission.

7. INTER-RELATIONSHIPS WITHIN PART 61

For the purposes of preparing and reviewing a license application, Part 61 contains four sections of major significance:

1. 10 CFR 61.40 to 61.44 specify the performance objectives;

2. 10 CFR 61.10 to 61.16 require the submittal of a license application and specify its contents;

3. 10 CFR 61.23 establishes standards for the issuance of a license; and

4. Subparts D and E elaborate and expand upon the standards of 10 CFR 61.23. These latter subparts include, for example, details related to waste classification, waste form, institutional information and financial assurances, inspections, and environmental monitoring. Subparts D and E influence both the preparation of the SAR and the evaluations made under the SRPs, since they contain specific requirements that the staff must conclude have been met in order to make the findings required by 10 CFR 61.23.

Figure 1-3 visually shows the inter-relationships among the major provisions of Part 61, and is, in effect, a local magnification of the *Regulatory Review Process* block shown in Figure 1-2.

1C CFR 61.23 is the key section. It provides the link between the performance objectives, technical, financial and administrative requirements, the information required in the application, and the findings that are required for the issuance of a license.

Figure 1-3 contains three major blocks that may be considered to represent, respectively, the application (SAR and ER) submitted by the applicant under 10 CFR 61.10 and 10 CFR 51.45, using the SFC and Regulatory Guide 4.18; regulatory review employing NUREG-1200 and NUREG-1300; and the SER and EIS, prepared by the regulatory staff, presenting conclusions that the standards of 10 CFR 61.23 will be satisfied. In the preparation of the SAR, 10 CFR 61.11 to 61.16 specify the organizational information, technical data and analyses, and information about institutional and financial arrangements, physical security and criticality safety of the proposed facility that must be submitted in the application. For the evaluation of the application, 10 CFR 61.23 contains sub-sections related to these same topics, and also contains a requirement that environmental concerns be satisfied. For the SAR, 10 CFR 61.13 requires that the technical data be analyzed to demonstrate compliance with the performance objectives of 10 CFR 61.40 through 61.44. For the SER, 10 CFR 61.23(b) to (e) require that the staff also conclude that the performance objectives will be met.

Figure 1-3 shows that each of the requirements for submittal of information in 10 CFR 61.11 to 16 corresponds to an individual standard for the issuance of a license under 10 CFR 61.23. In addition, Subparts D and E provide complementary technical, institutional, and financial requirements that the applicant must satisfy for the issuance of a license. Table 1-2 relates these specific additional technical, institutional and financial requirements to the relevant sub-paragraph of 10 CFR 61.23 and further shows the inter-relationship of the various sections of Part 61 and other parts of NRC regulations that must be satisfied for issuance of a license.

8. CORRELATION OF INDIVIDUAL SRPs TO PART 61 REQUIREMENTS

Because individual SRPs address details of facility planning, construction, operation, and closure they are by nature, issue-oriented in contrast to the licensing standards of 10 CFR 61.23, which have earlier been noted to be general and broad-scale in their coverage. As a consequence, the relation of individual SRPs, singly or in combination, to the licensing requirement of

Part 61, which they address, may not always be readily apparent. Identificationof the relationships between individual sections of the SFC and the SRP and those performance objectives and standards, for the issuance of a license to which they respond, is reviewed below.

The SFCG provides a uniform structure for preparation of a license application and lists the information needed to satisfy 10 CFR 61.10 through 61.16, and to allow the staff to make findings required by 10 CFR 61.23. For each element of information required, the staff must be able to identify the following five characteristics:

1. the purpose for requiring and evaluating each element of information;

2. the specific requirements that are applicable;

3. the criteria and bases for determining the acceptability of the information submitted;

4. the procedures that the staff evaluator must follow to provide reasonable assurance that the applicable requirements have been satisfied; and

5. the conclusion or type of conclusion that is sought from the evaluation of the information element under review.

The SFC and the SRP follow identical outlines listing the topics to be covered in a license application. The SFC explains what information is needed, and the SRP complements the SFC by providing, for each topic specified, the five characteristics listed above.

For the evaluation of a license application, Section 7 has shown that 10 CFR 61.23 itemizes the specific standards to be satisfied, and incorporates by reference other sections of Part 61 and other parts of Chapter 10 of the Code of Federal Regulations. For the NRC staff to concur that the standards for issuance of a license have been met, the requirements of 10 CFR 61.23 must be met in totality. Because the individual SRPs are sharply focused, any one may address some or all of the requirements of 10 CFR 61.23, or alternatively, it may address only portions of one or more requirements. In such cases, combined successful reviews under several individual SRPs may ultimately be necessary for any single requirement to be fully satisfied. Figure 1-4 has been prepared to visually demonstrate the relationships among the individual requirements of Part 61 and the individual SRPs needed to satisfy them. (The information presented previously in Table 1-1 was compiled from Figure 1-4.)

In Figure 1-4, entries in the left margin identify each individual SRP review. For ease in reading the chart, the entries in the left margin are

repeated in the right margin. The headings across the top of Figure 1-4 identify those individual provisions of Part 61 that affect licensing review; Table 1-3 describes the topics covered by those Part 61 provisions. Individual sub-sections are listed where each has an identifiable effect on licensing and is addressed by an individual SRP; where several sub-sections of 10 CFR Part 61 operate together to produce a unified requirement and can be addressed by a single SRP, only the entire section is identified. Where an individual Part 61 section does not contain a condition requiring review under the SRPs, as for example, protection of the civil rights of employees and rules for participation of States and Indian Tribes in licensing review, it has been omitted from listing in the headings of Figure 1-4. An "X" at the intersection of a row (related to an SRP) with a column (related to a provision of Part 61) indicates the existence of a relationship where the SRP responds directly to the stated requirement. An "O" indicates an implicit or indirect, but nonetheless important relationship.

Where more than one SRP is identified under any section of Part 61, those SRPs must be taken together to satisfy that regulatory provision; where one SRP is identified with more than one provision of Part 61, that SRP contributes to the satisfaction of each of the Part 61 requirements identified. The presence of multiple markings in a column or row, respectively, demonstrates an interrelationship among several SRPs that may be needed to satisfy an individual provision of Part 61; or alternatively, the capability of one SRP to address more than one provision of Part 61.

9. SUMMARY

SRP 1 discusses NRC's hierarchical approach to licensing LLW disposal facilities, the operation of the licensing process, the internal relationships within Part 61, and the relationships between the requirements of Part 61 and the individual issue-oriented evaluations of the SRP, NUREG-1200.

The hierarchical approach for licensing LLW disposal permits the requirements of the Federal statutes and performance objectives at the top of the hierarchy to influence activities at all supporting levels, and requires activities at the supporting levels to contribute to the achievement of the requirements of the Federal statutes and performance objectives. Figure 1-1, as previously mentioned, illustrates this hierarchical approach.

RELATIONSHIPS BETWEEN DISPOSAL FACILITY LICENSING REQUIREMENTS OF 10 CFR PART 61 AND STANDARD REVIEW PROCEDURES (NUREG-1200)

STANDARD REVIEW PLAN 1

A FIG. 1-4A	B FIG. 1-4B
C FIG. 1-4C	D FIG. 1-4D

RELEVANT SECTIONS OF 10 CFR 61 — Subpart B — Licenses

INDIVIDUAL STANDARD REVIEW PLANS	.10	.11 a	.11 b1	.11 b2	.11 b3	.11 b4	.11 c1	.11 c2	.11 c3	.11 c4	.11 c5	.11 d	.12 a	.12 b	.12 c	.12 d	.12 e	.12 f	.12 g	.12 h	.12 i	.12 j	.12 k	.12 l	.12 m
1 GENERAL INFORMATION																									
1.1 Introduction	X	X	X	X	X	X																			
1.2 General Facility Description							X	X	X	X	X		O	O	O	O	O	O	O	O	O	O	O	O	O
1.3 Schedules												X													
1.4 Institutional Information	X																								
1.5 Material Incorporated by Reference																									
1.6 Conformance to Regulatory Guides																	X								
1.7 Summary of Principal Review Matters																									
2 SITE CHARACTERISTICS																									
2.1 Geography, Demography & Future Developments																									
2.1.1 Site Location and Description							X						X									O		O	
2.1.2 Population Distribution													X									O		O	
2.2 Meteorology and Climatology													X			X	O		O			O	O	O	
2.3 Geology and Seismology																									
2.3.1 Geologic Site Characterization				O									X			O	O					O			
2.3.2 Seismic Investigation				O									X			X	O					O			
2.4 Hydrology																									
2.4.1 Surface Water Hydrology													X			X			O			O		O	
2.4.2 Groundwater Characterization							O						X									O		O	
2.5 Geotechnical Characteristics				O									X				O					O			
2.6 Geochemical Characteristics													X									O		O	
2.7 Natural Resources																									
2.7.1 Geologic Resources							O						X							X		O	O		
2.7.2 Water Resources							O						X							X		O	O	O	
2.8 Biotic Features							O						X						O	X		O	O	O	
2.9 Preoperational Environmental Monitoring			O	O			O						X			O				O		O		X	
3 DESIGN AND CONSTRUCTION																									
3.1 Principal Design Features				O										X	X	X	X	O	O			O		O	
3.2 Design for Normal/Abnormal Conditions				O										X	X	X	X	O	O			O		O	
3.2A Struct. Design for BGV and EMCB				O										X	X	X	X	O	O			O		O	
3.3 Construction Considerations																									
3.3A Constr. & Opn for BGV and EMCB				O													X	X				O			
3.3.1 Construction Methods and Features				O													X	X				O			
3.3.2 Construction Equipment.				O													X	X				O			
3.4 Design of Auxiliary Systems and Facilities																									
3.4.1 Utility Systems				O										X	O	O	X	O				O			
3.4.2 Auxiliary Facilities				O										X	O	O	X	O				O			
3.4.3 Fire Protection System				O	O	O								X			X	O				O	X		
3.4.4 Erosion and Flood Control System							O							X	O	O	X	O	O			O		O	
4 FACILITY OPERATIONS																									
4.1 Receipt and Inspection of Waste								O													O	O	O		
4.2 Waste Handling and Interim Storage								O										X			O	O	O	O	
4.3 Waste Disposal Operations			O	O	O	O		X	X	O		O		X			O	X			O	O	O	O	O
4.4 Operational Env. Mon. & Surveillance			O	O	O	O		O			O		O	O				O			O	O	X	X	O

INDIVIDUAL STANDARD REVIEW PLANS	.13 a	.13 b	.13 c	.13 d	.14 a	.14 b	.15	.16 a	.16 b	.21	.23 a	.23 b	.23 c	.23 d	.23 e	.23 f	.23 g	.23 h	.23 i	.23 j	.23 k	.23 l	.24 h
1 GENERAL INFORMATION																							
1.1 Introduction											O											X	
1.2 General Facility Description	O	O	O	O				X	X			O	O	O	O	O			O	O	O	O	O
1.3 Schedules																							
1.4 Institutional Information					X	X	X								X		O	O					
1.5 Material Incorporated by Reference										X													
1.6 Conformance to Regulatory Guides																							
1.7 Summary of Principal Review Matters												X	X	X	X								
2 SITE CHARACTERISTICS																							
2.1 Geography, Demography & Future Developments																							
2.1.1 Site Location and Description	X	O	O	O								O	O	O	O	X							
2.1.2 Population Distribution	X	O		O								O	O		O	X							
2.2 Meteorology and Climatology	X	O	O	O								O	O	O	O	X							
2.3 Geology and Seismology																							
2.3.1 Geologic Site Characterization	X			O							O	X	O	O	X	X							
2.3.2 Seismic Investigation	X			X							O	X	O	O	X	X							
2.4 Hydrology																							
2.4.1 Surface Water Hydrology	O	O	O	O								O	O	O	X	X							
2.4.2 Groundwater Characterization	O	O		O								O	O		X	X							
2.5 Geotechnical Characteristics	X			O							O	X	O	O	X	X							
2.6 Geochemical Characteristics	O											O			X								
2.7 Natural Resources																							
2.7.1 Geologic Resources	O	O	O	O								O	O	O	O	X							
2.7.2 Water Resources	O	O	O	O								O	O	O	O	X							
2.8 Biotic Features	O	O		O								O			O	X							
2.9 Preoperational Environmental Monitoring	O		O	O								O		O	O	X							
3 DESIGN AND CONSTRUCTION																							
3.1 Principal Design Features	X	X	O	X							O	X	X	X	X	X							
3.2 Design for Normal/Abnormal Conditions	X	X	X	X							O	X	X	X	X	X							
3.2A Struct. Design for BGV and EMCB	X	X	X	X							O	X	X	X	X	X							
3.3 Construction Considerations																							
3.3A Constr. & Opn for BGV and EMCB											O	X	X	X	X	X							
3.3.1 Construction Methods and Features											O	X	X	X	X	X							
3.3.2 Construction Equipment.														X									
3.4 Design of Auxiliary Systems and Facilities																							
3.4.1 Utility Systems			X								O	X	X	X		X							
3.4.2 Auxiliary Facilities			X								O	X	X	X		X							
3.4.3 Fire Protection System			X								O	X	X	X		X							
3.4.4 Erosion and Flood Control System	O		O									O	O	O	X	O						O	
4 FACILITY OPERATIONS																							
4.1 Receipt and Inspection of Waste			X									X	X	X	X	X							
4.2 Waste Handling and Interim Storage			X											X		X							
4.3 Waste Disposal Operations	O		X	O				O	O		O	X		X		X			O	X	X	O	
4.4 Operational Env. Mon. & Surveillance	O		O								O	O		X		O				X	X		

LEGEND: X – SRP RESPONDS DIRECTLY TO PART 61 REQUIREMENT
O – SRP RESPONDS INDIRECTLY TO PART 61 REQUIREMENT

ABBREVIATIONS: BGV – Below Ground Vault
EMCB – Earth Mounded Concrete Bunker

Rev. 3 - March 1994

RELATIONSHIPS BETWEEN DISPOSAL FACILITY LICENSING REQUIREMENTS OF 10 CFR PART 61 AND STANDARD REVIEW PROCEDURES (NUREG-1200) (Continued)

A FIG. 1-4A | B FIG. 1-4B | C FIG. 1-4C | D FIG. 1-4D

RELEVANT SECTIONS OF 10 CFR 61

Subpart C Performance Objectives .41.42.43.44	Subpart D Technical Requirements for Land Disposal Facilities .50 1 2 3 4 5 6 7 8 9 10 11	.51 a 1 2 3 4 5 6	.52 a 1 2 3 4 5 6 7 8 9 10 11	.53 a b c d	.55.56 a b	.57.59 a b	Subpart E Financial Assurance .61.62.63	INDIVIDUAL STANDARD REVIEW PLANS
O O O O	O O O O O O O O O O O	O O O O O O	O O O O O O O O O O O	O O O O	O O O			...1 GENERAL INFORMATION
								...1.1 Introduction
								...1.2 General Facility Description
								...1.3 Schedules
X						X X	O O O	...1.4 Institutional Information
								...1.5 Material Incorporated by Reference
								...1.6 Conformance to Regulatory Guides
X X X X								...1.7 Summary of Principal Review Matters
								2 SITE CHARACTERISTICS
O O O O	O O O			O O O				...2.1 Geography, Demography & Future Developments
O O O	O X O			O				...2.1.1 Site Location and Description
O O O O	O O O O O O	O O		O O O				...2.1.2 Population Distribution
								...2.2 Meteorology and Climatology
X O O X	X X X X			X O O				...2.3 Geology and Seismology
X O O X	X X X X			X O O				...2.3.1 Geologic Site Characterization
								...2.3.2 Seismic Investigation
O O O X	O O X X O X			O				...2.4 Hydrology
O O X	O O X X			X				...2.4.1 Surface Water Hydrology
X O O X	X X X X X							...2.4.2 Groundwater Characterization
O X	O X			X O O				...2.5 Geotechnical Characteristics
								...2.6 Geochemical Characteristics
O O O O	O O X							...2.7 Natural Resources
O O O O	O O O O			O				...2.7.1 Geologic Resources
O O	O O O O			O O				...2.7.2 Water Resources
O O	O O			X O O				...2.8 Biotic Features
								...2.9 Preoperational Environmental Monitoring
								3 DESIGN AND CONSTRUCTION
X X X X	X X O	X X X X X X	X X X X X X X X X	O O O	O O			...3.1 Principal Design Features
X X X X	X O	X X X X X X	X X X X X X X X X	O O O	O O			...3.2 Design for Normal/Abnormal Conditions
X X X X	X O	X X X X X X		O O O				...3.2A Struct. Design for BGV and EMCB
O	X O							...3.3 Construction Considerations
		O O O	O O O O O O O	O O	O			...3.3A Constr. & Opn for BGV and EMCB
X X X X		O O O	O O O O O O O	O O	O			...3.3.1 Construction Methods and Features
X X X X								...3.3.2 Construction Equipment
X								...3.4 Design of Auxiliary Systems and Facilities
								...3.4.1 Utility Systems
X X X								...3.4.2 Auxiliary Facilities
X X X					X			...3.4.3 Fire Protection System
X X X								...3.4.4 Erosion and Flood Control System
O O O X		O O O O X X		O O				
								4 FACILITY OPERATIONS
X X X X					X X	X		...4.1 Receipt and Inspection of Waste
X		X	X					...4.2 Waste Handling and Interim Storage
X X			X O X X X X X X X X X	O O	O O O			...4.3 Waste Disposal Operations
O X	X			X X				...4.4 Operational Env. Mon. & Surveillance

LEGEND: X – SRP RESPONDS DIRECTLY TO PART 61 REQUIREMENT
O – SRP RESPONDS INDIRECTLY TO PART 61 REQUIREMENT

ABBREVIATIONS: BGV – Below Ground Vault
EMCB – Earth Mounded Concrete Bunker

RELATIONSHIPS BETWEEN DISPOSAL FACILITY LICENSING REQUIREMENTS OF 10 CFR PART 61 AND STANDARD REVIEW PROCEDURES (NUREG-1200) (Continued)

A FIG. 1-4A | B FIG. 1-4B | C FIG. 1-4C | D FIG. 1-4D

STANDARD REVIEW PLAN 1

RELEVANT SECTIONS OF 10 CFR 61 — Subpart B — Licenses

INDIVIDUAL STANDARD REVIEW PLANS		.10	.11 a	.11 b 1	.11 b 2	.11 b 3	.11 b 4	.11 c 1	.11 c 2	.11 c 3	.11 c 4	.11 c 5	.11 d	.12 a	.12 b	.12 c	.12 d	.12 e	.12 f	.12 g	.12 h	.12 i	.12 j	.12 k	.12 l	.12 m	.13 a	.13 b	.13 c	.13 d	.14 a	.14 b	.15	.16 a	.16 b	.21	.23 a	.23 b	.23 c	.23 d	.23 e	.23 f	.23 g	.23 h	.23 i	.23 j	.23 k	.23 l	.24 h
5	SITE CLOSURE PLAN AND INSTITUTIONAL CONTROLS																																																
5.1	Site Stabilization													O	O	X	O			X			O																										
5.1A	Clos. & Stab. for BGV & EMCB				O									O	X	X	O			X			O				X	O		X							O	X	X	O	X	X							
5.1.1	Surface Drainage and Erosion Protection													O	X	X	O			X			O				O	O	O	O								O	X		X	O							
5.1.2	Geotechnical Stability				O									O	O	X	O			X			O				X			X							O	X	X	X	X	X							
5.2	Decontamination and Decommissioning																			X		X	O															O	O	O	X	X							
5.3	Post-Operational Env. Mon. & Surveillance											O			O					X		X	O		X	O	O		O	O							O	O	O		X	X							
6	SAFETY ASSESSMENT																																																
6.1	Release of Radioactivity - Introduction																																																
6.1.1	Detr'n of Types, Kinds, & Q'ties of Waste									X												X	X	X	X													X	X	X	O								
6.1.2	Infiltration													O	X	X	O		O				O		O		O			X								X			X	O							
6.1.3	Radionuclide Release - Normal Conditions														O	O	O		O	O		O	O	X	X													X	O	O	X	O							
6.1.4	Radionuclide Release - Unusual Conditions														O	O	O		O	O		O	O	X	X													X	O	O	X								
6.1.5	Radionuclide Xfer to Human Access Location																																																
6.1.5.1	Transfer Mechanism - Groundwater									O				O	O	O	O		O	O		O	O	O	O		X											X				X							
6.1.5.2	Transfer Mechanism - Air									O				O	O	O	O		O	O		O	O	O	O		O			O								X		X		O							
6.1.5.3	Transfer Mechanism - Surface Water									O				O	O	O	O		O	O		O	O	O	O		X											X				X							
6.1.5.4	Other Transfer Mechanisms									O	O			O	O	O	O		O	O		O	O	O	O		X		O									X		X		X							
6.1.6	Assess. of Impacts & Reg'y Compliance									X				O	O	O	O		O	O		O	O	O	O		X		X									X		X		X							
6.2	Intruder Protection														X	X			X	X	X	O	O	O			O	X		O									X			O							
6.3	Long-Term Stability																																																
6.3.1	Surface Drainage & Erosion Protection							O						O	X	O	X		O	X			O				O			X								O	O	X	X	X						O	
6.3.2	Stability of Slopes				O									O	X	O	X	O	O	O			O		O		X			X							O	O	O	O	X	O							
6.3.3	Settlement and Subsidence				O									O	X	O	X	O	O	O			O		O		X			X							O	O	O	O	X	X							
7	OCCUPATIONAL RADIATION PROTECTION																																																
7.1	Occupational Radiation Exposures			X	X				O						X	X			X				O	X		O			X											X		X							
7.2	Radionuclide inventories									X					X	X	O		X	X		X	O	X	X	X			X						O			X	X	X	X	X				X			
7.3	Rad. Prot. Design Features & Operat. Proc.							O				O			X	X	O	O	X			X	O	X	X				X											X		X							
7.4	Radiation Protection Program			X	X	X	X								X							O	O	X	O	O			X								X			X		X							X
8	CONDUCT OF OPERATIONS																																																
8.1	Organizational Structure			X			O																														X			X									
8.2	Qualifications of Applicant			O	X	O	O																	X													X			X									
8.3	Training Program					X	O																O	X														X		X									
8.4	Emergency Planning			O	O	X	O												O				O	O	O	O	O	O	O	O					O		O			X		X				O			
8.5	Review and Audit																						O	O	O	O	O	O	O	O				O	O		O			X									
8.6	Facility Admin. & Operating Procedures										X	X	X						O				O	O	O	X	O	O	O	O				O	O		O			X									
8.7	Physical Security							O											O				O											O						X		O			X		X		
9	QUALITY ASSURANCE																																																
9.1	Design,Constr.,Operation & Closure	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	X	O	O	O	O	O	O	O				O	O		O	O	O	O	O	O	O		O	O	O		
10	FINANCIAL ASSURANCE																																																
10.1	Finan. Qual. of Applicant																																X					O		O				X					
10.2	Funding Assurances																																X					O	O		X			X					
11	LICENSE CONDITIONS																																																X

LEGEND: X – SRP RESPONDS DIRECTLY TO PART 61 REQUIREMENT
O – SRP RESPONDS INDIRECTLY TO PART 61 REQUIREMENT

ABBREVIATIONS: BGV – Below Ground Vault
EMCB – Earth Mounded Concrete Bunker

STANDARD REVIEW PLAN 1

A FIG. 1-4A | B FIG. 1-4B | C FIG. 1-4C | D FIG. 1-4D

RELEVANT SECTIONS OF 10 CFR 61

Subpart C — Performance Objectives (.41 .42 .43 .44); Subpart D — Technical Requirements for Land Disposal Facilities (.50, .51, .52, .53, .55.56, .57.59); Subpart E — Financial Assurance (.61 .62 .63)

.41	.42	.43	.44	.50 a 1	.50 a 2	.50 a 3	.50 a 4	.50 a 5	.50 a 6	.50 a 7	.50 a 8	.50 a 9	.50 a 10	.50 a 11	.51 a 1	.51 a 2	.51 a 3	.51 a 4	.51 a 5	.51 a 6	.52 a 1	.52 a 2	.52 a 3	.52 a 4	.52 a 5	.52 a 6	.52 a 7	.52 a 8	.52 a 9	.52 a 10	.52 a 11	.53 a	.53 b	.53 c	.53 d	.55	.56 a	.56 b	.57	.59 a	.59 b	.61	.62	.63	INDIVIDUAL STANDARD REVIEW PLANS
																																													5 SITE CLOSURE PLAN AND INSTITUTIONAL CONTROLS
																																													...5.1 Site Stabilization
X	X	O	X												X	X	O	X	O	X						X			O	O											O		O		...5.1A Clos. & Stab. for BGV & EMCB
O	X		X																X										O						O										...5.1.1 Surface Drainage and Erosion Protection
X	X	X	X							X					X	X	O	X		X									O	O															...5.1.2 Geotechnical Stability
O	O	O	X													O																								O	O		O	O	...5.2 Decontamination and Decommissioning
O	O		X		O										O	O		O	O	O							O						O		X						X			X	...5.3 Post-Operational Env. Mon. & Surveillance
																																													6 SAFETY ASSESSMENT
																																													...6.1 Release of Radioactivity - Introduction
X	X	X	O																		X	X				O										X	O	O							...6.1.1 Detr'n of Types, Kinds, & Q'ties of Waste
X			X		O						O				O	O		X		O	O	O										O													...6.1.2 Infiltration
X	O	O	X										O	O												O							X												...6.1.3 Radionuclide Release - Normal Conditions
X	O	O	X									O								O													X												...6.1.4 Radionuclide Release - Unusual Conditions
																																													...6.1.5 Radionuclide Xfer to Human Access Location
X				X	X					O	O	O	O	O		O		O		O																									...6.1.5.Transfer Mechanism - Groundwater
X		X			X											O		O								O																			...6.1.5.Transfer Mechanism - Air
X					X			O				O	O	O		O		O	O																										...6.1.5.Transfer Mechanism - Surface Water
X		X			X							O	O	O		O										X																			...6.1.5.Other Transfer Mechanisms
X		X												O												X																			...6.1.6 Assess. of Impacts & Reg'y Compliance
	X																					X				O																			...6.2 Intruder Protection
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O	O	X	X																O	O																									...6.3.1 Surface Drainage & Erosion Protection
O	O	O	X									X	X		X	X		O	X														O	O	O										...6.3.2 Stability of Slopes
O	O	O	X									X	X		X	X		O	O						O								O	O	O										...6.3.3 Settlement and Subsidence
																																													7 OCCUPATIONAL RADIATION PROTECTION
		X																			X	X				X					X														...7.1 Occupational Radiation Exposures
X	X	X	X																							X										X		X							...7.2 Radionuclide inventories
		X														X	X									X	X	X																	...7.3 Rad. Prot. Design Features & Operat. Proc.
		X																								X	X							O	O	X	X	X	X						...7.4 Radiation Protection Program
																																													8 CONDUCT OF OPERATIONS
		X																																											...8.1 Organizational Structure
		X																																											...8.2 Qualifications of Applicant
X		X																																											...8.3 Training Program
		X																															X												...8.4 Emergency Planning
		X																																											...8.5 Review and Audit
		X																																											...8.6 Facility Admin. & Operating Procedures
		X																															O												...8.7 Physical Security
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	9 QUALITY ASSURANCE
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O				...9.1 Design,Constr.,Operation & Closure
																																													10 FINANCIAL ASSURANCE
O		O																																								X			...10.1 Finan. Qual. of Applicant
O	O		X																																						X		X	O	...10.2 Funding Assurances
																																													11 LICENSE CONDITIONS

LEGEND: X – SRP RESPONDS DIRECTLY TO PART 61 REQUIREMENT
O – SRP RESPONDS INDIRECTLY TO PART 61 REQUIREMENT

ABBREVIATIONS: BGV – Below Ground Vault
EMCB – Earth Mounded Concrete Bunker

Table 1 - 3

TOPIC SUMMARY OF 10 CFR PART 61 PROVISIONS WHICH AFFECT LICENSING

Subpart B - Licenses

§ 61.10 Content of application

§ 61.11 General information

- a. Identity of the applicant.
  - 1. Applicant data.
  - 2. Partnership data.
  - 3. Corporate data.
  - 4. Agent data.
- b. Qualifications of the applicant.
  - 1. Organizational structure.
  - 2. Technical qualifications.
  - 3. Personnel training program.
  - 4. Staffing plan.
- c. Description of site and planned operations.
  - 1. Location.
  - 2. Character of activities.
  - 3. Types and quantities of wastes to be managed.
  - 4. Plans for land use other than waste disposal.
  - 5. Facilities and equipment.
- d. Proposed schedules for construction, receipt, and first disposal of waste.

§ 61.12 Specific technical information - to demonstrate that performance objectives of Part C and technical requirements of Subpart D will be met.

- a. Description of natural and demographic site characteristics.
- b. Description of design features.
- c. Description of design criteria and relation to performance objectives.
- d. Description of design basis natural events and relation to performance objectives.
- e. Description of applicable codes and standards.
- f. Description of construction and operation of proposed facility.
- g. Description of site closure plan.
- h. Identification of known natural resources at site.
- i. Description of radioactive material to be disposed at site.
- j. Description of QA/QC program to be employed.
- k. Description of radioactive safety and monitoring program for on-site activities.
- l. Description of program for monitoring and remediation of off-site (environmental) radioactivity.

Table 1 - 3 (continued)

m. Description of administrative procedures for control of facility.

§ 61.13 Technical analysis - to demonstrate that the performance objectives of Subpart C will be met.
- a. Demonstrate reasonable assurance that exposure limits of § 61.41 will not be exceeded.
- b. Demonstrate reasonable assurance of protection of individuals against inadvertent intrusion.
- c. Demonstrate reasonable assurance of protection of individuals during operations.
- d. Demonstrate reasonable assurance that there will not be a need for ongoing active maintenance after site closure.

§ 61.14 Institutional information
- a. Certification by Federal or State government owner that it is prepared to accept post-closure license transfer and assume responsibility for custodial care.
- b. When site is not owned by Federal or State government, evidence that arrangements have been made for such ownership in fee.

§ 61.15 Financial information - to demonstrate financial ability to operate site and to meet requirements of Subpart E.

§ 61.16 Other information
- a. Physical security for special nuclear material.
- b. Criticality safety

§ 61.21 Elimination of repetition - previously supplied information may be incorporated by reference.

§ 61.23 Standards for issuance of a license - the Commission must find that issuance of a license will not be inimical to the common defense and security and will not constitute an unreasonable risk to the health and safety of the public and
- a. The applicant is qualified by training and experience;
- b. The performance objectives of § 61.41 will be met;
- c. The performance objectives of § 61.42 will be met;
- d. The performance objectives of § 61.43 will be met;
- e. The performance objectives of § 61.44 will be met;
- f. There is reasonable assurance that the technical requirements of Subpart D will be met;
- g. There is reasonable assurance that institutional control will persist for the time required to ensure the findings of (b) through (e), above, and that the institutional requirements of § 61.59 will be met;
- h. Financial information meets the requirements of Subpart E;
- i. Physical security for special nuclear material will meet the requirements of 10 CFR Part 73;
- j. Criticality safety for special nuclear material will meet the requirements of 10 CFR 70.24;

Table 1 - 3 (continued)

k. Additional information required by the Commission under § 61.16 is adequate; and
l. The requirements of Subpart A of 10 CFR 51 have been met.

§ 61.24 Conditions of licenses
h. The Commission may incorporate in any license additional requirements as deemed appropriate.

Subpart C - Performance Objectives

§ 61.41 Establishes annual dose limits for radioactive releases to the public.
§ 61.42 Requires protection of inadvertent intruders after removal of institutional controls.
§ 61.43 Site operations must conform to standards for radiation protection set out by 10 CFR Part 20.
§ 61.44 Long-term stability must be achieved after closure.

Subpart D - Technical Requirements for Land Disposal Facilities

§ 61.50 Disposal site suitability requirements for land disposal
a. Disposal site suitability for near surface disposal
1. Primary emphasis given to isolation of wastes and achievement of long-term performance objectives.
2. The disposal site shall be capable of being characterized and modelled.
3. Site to be located so the future population growth and development will not affect achievement of performance objectives.
4. Sites must avoid locations with exploitable natural resources.
5. Site must be well-drained and free of flooding or ponding.
6. Upstream drainage areas must be minimized.
7. Site shall not permit groundwater intrusion.
8. No surface discharge from hydrogeological disposal unit within disposal site.
9. Areas with sub-surface geological activity which could affect achievement of performance objectives must be avoided.
10. Areas with surface geological activity which could affect achievement of performance objectives must be avoided.
11. Site must not be located where nearby activities could mask monitoring program.

Table 1 - 3 (continued)

§ 61.51 Disposal site design for land disposal
- a. Disposal site design for near surface disposal
  1. Design must be directed toward long-term isolation and avoidance of maintenance after closure.
  2. Site design and operation must be compatible with closure and long-term stability.
  3. Site design must complement site natural characteristics to secure achievement of performance objectives.
  4. Covers must be designed to minimize infiltration and resist degradation.
  5. Surface features must be designed to prevent erosion.
  6. Site must be designed to minimize contact of waste with water.

§ 61.52 Land disposal facility operation and disposal site closure
- a. Near surface disposal facility operation and disposal site closure
  1. Unstabilized Class A wastes must be segregated.
  2. Class C wastes must have a minimum cover of 5 meters or be placed behind a 500-year intruder barrier.
  3. All wastes must be disposed of in accordance with paragraphs 4 through 11, below.
  4. Package integrity must be maintained and void spaces filled.
  5. Void spaces must be filled to reduce future subsidence.
  6. Wastes must be placed to limit surface radiation to levels specified by 10 CFR 20.
  7. Boundaries and locations of disposal units must be mapped.
  8. A buffer zone adequate for monitoring and remediation must be maintained.
  9. Approved closure plans must be applied to each disposal unit as it is filled.
  10. Active disposal units must not adversely impact closed disposal units.
  11. Only waste containing radioactive materials shall be disposed of at the site.

§ 61.53 Environmental monitoring
- a. Applicant must conduct pre-operational monitoring prior to submission of application.
- b. Licensee must have plans for correction of migration of radionuclides.
- c. Monitoring must be conducted during operational phase.
- d. The licensee shall maintain a monitoring system following closure of the site.

§ 61.55 Waste classification

§ 61.56 Waste characteristics
- a. Minimum requirements for all classes of waste to provide health and safety of personnel at waste site.
- b. Requirements for stability of waste.

Table 1 - 3 (continued)

§ 61.57 Each package must be labeled as Class A, B or C.
§ 61.59 Institutional ownership
a. Land ownership - Disposal is permitted only on land owned in fee by the Federal or a State government.
b. Institutional control - Land owner or custodial agency must control site access; institutional control cannot be relied on for more than 100 years.

Subpart E - Financial Assurances

§ 61.61 Applicant qualifications and assurances
§ 61.62 Funding for disposal site closure and stabilization
§ 61.63 Financial assurances for institutional controls

In concept, the process for licensing facilities regulated by Part 61 is simple and direct. The applicant provides an SAR containing the data and analyses required for staff evaluation of the proposed facility. The staff, on the basis of review and evaluation following the guidance of the SRP, makes a reasonable assurance finding that licensing requirements are met and prepares an SER supporting the issuance of a license. Concurrently, an ER and an EIS are also prepared. The SER and EIS are then forwarded to the Commission for action. Figure 1-2, as previously mentioned, illustrates this process.

Part 61 has been written so that 10 CFR 61.10 to 61.16 specify the information required of the applicant, and 10 CFR 61.23 specifies the standards for issuance of a license, subject to the complementary requirements detailed by Subparts D and E, which identify specific technical and financial criteria. These latter criteria must be considered by the applicant when preparing the application, and by the NMSS staff when reviewing the application. Figure 1-3 illustrates these relationships and Table 1-2 shows how other sections of Part 61, and how other arts of CFR Chapter 10 affect license application and review.

The SRPs which are used to evaluate the application are issue-oriented, but the technical and performance objectives to be met are stated more generally. Thus, correlation of individual SRP sections with the requirements of Part 61 that they satisfy is not always directly apparent. To help in relating SRPs to relevant sections of Part 61, Figure 1-4 has been prepared, and provides one means of ensuring that the SRP evaluations will collectively satisfy the requirements of Part 61.

The recommendation for the issuance of a license ultimately depends on an SER, built on the collective evaluations of the SRPs, and that unifies them into a coherent regulatory document. Figure 1-4 can aid in preparing the necessary unified and coherent SER.

REFERENCES

Essential

1. "Atomic Energy Act of 1954", (AEA).

2. "Low-Level Radioactive Waste Policy Amendments Act of 1985", (LLWPAA).

3. 10 CFR Part 2 - "Rules of Practice for Domestic Licensing Procedures and Issuance of Orders".

4. 10 CFR Part 51 - "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions".

5. 10 CFR Part 61 - "Licensing Requirements for Land Disposal of Radioactive Waste".

6. Regulatory Guide 4.18 "Standard Format and Content of Environmental Reports for Near Surface Disposal of Radioactive Waste", June, 1983.

7. "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility" (NUREG-1199), Revision 2, January 1991 (SFC).

8. "Review Process for Low-Level Radioactive Waste Disposal License Application Under Low-Level Radioactive Waste Policy Amendments Act", August, 1987 (NUREG-1274).

9. "Environmental Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility", April, 1987 (NUREG-1300).

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.1
INTRODUCTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Generalist

1.2 Secondary - None

1.3 Support - Technical Reviewers (as needed)

2. AREAS OF REVIEW

The staff will review the general information supplied by the applicant, which should include name, qualifications, and organizational structure of the applicant; an overview of the purpose and scope of the proposed project; and general information on the applicant's financial and technical qualifications. The applicant should also indicate its level of understanding of the waste disposal rules, regulations, and statutes. The review will include a general assessment of the degree to which the applicant has addressed the major areas suggested in NUREG-1199.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the general information supplied by the applicant in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is informational in nature, and no detailed technical analysis is required. The staff will verify that specific information (e.g., applicant's name, address, and phone number) is accurate and that the information referred to in the introduction is, in fact, present in the SAR and in the appropriate format. The staff will make a qualitative assessment of the

applicant's experience and level of understanding of the nature and complexity of radioactive waste disposal.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is

> 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," as it relates to the general, technical, and financial information to be supplied by an applicant

4.2 Regulatory Guidance

There are no regulatory guides that apply to the review of general information on an applicant for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The information supplied by the applicant should provide contributory evidence as to the applicant's technical, institutional, and financial qualifications and level of understanding of the nature and complexity of low-level radioactive waste disposal, as required by 10 CFR 61.23.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the general information on the applicant for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.1.

The applicant has adequately identified itself, summarized its qualifications, both technical and financial, and demonstrated a general understanding of the nature and complexity of radioactive waste disposal. The applicant has adequately summarized the purpose and scope of the proposed project. The staff concludes that the technical, financial, and institutional information required by 10 CFR 61 is present in the SAR.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1988.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.2
GENERAL FACILITY DESCRIPTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Design Engineer

1.2 Secondary - Operations Engineer

1.3 Support - Other Technical Reviewers (as needed)

2. AREAS OF REVIEW

The staff will review the general facility description supplied by the applicant, which should include (1) scaled drawings showing the location of facility features, (2) the purpose of each feature, (3) the interrelationships of the features, (4) the relationship of facility features to site features, and (5) the movement of personnel, materials, and equipment during facility operations.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the general facility description in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is informational in nature, and no detailed technical analysis is required. The staff will analyze plan and profile drawings submitted by the applicant in conjunction with narrative descriptions. The information will be reviewed for internal consistency and overall logic. Major site operations will be reviewed generally against the material provided to ascertain whether or not they can be conducted safely given the proposed facility layout. The staff will evaluate the feasibility of carrying out emergency procedures, given the proposed layout, using emergency planning information provided by the applicant.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste

4.2 Regulatory Guidance

There are no regulatory guides that apply to a general facility description for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The applicant's description of the facility should provide contributory evidence as to its utility as a waste disposal facility. The description should provide the staff with a clear understanding of the relationships and uses of various facility features. The information should facilitate the review of other, more technically detailed sections of the SAR.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the general facility description for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.2.

The applicant has adequately described (1) the facility so that the staff has an overall understanding of the relationships of the facility features and (2) the function of each feature. The applicant has cross referenced its general description with more detailed descriptions elsewhere in the SAR. The staff concludes that the applicant has complied with the general requirements of 10 CFR 61.11(c).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington; DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.3
SCHEDULES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Construction Engineer

1.2 Secondary - Operations Engineer

1.3 Support - None

2. AREAS OF REVIEW

The staff will review the schedules for the completion of major work items supplied by the applicant, which should include the schedules for the completion of characterization and design and the construction of facility features and generalized schedules for operations and closure. The schedules should indicate time and personnel requirements as well as the interrelationships of work steps. The staff will determine if the applicant has considered the consequences of early start and/or late finish, where appropriate, and the effects of external events (i.e., those over which the applicant has no control) on overall scheduling.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on scheduling in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is informational in nature, and no detailed technical analysis is required. The staff will (1) verify that the applicant's scheduling documents, time-scaled charts, and work progress flow charts are complete, consistent and logical; (2) ensure that adequate time and personnel are allocated for each work step and that the interdependence of work steps has been correctly described; (3) evaluate the accuracy of time requirements for external events (licensing reviews, questioning rounds, hearings); and (4) verify the accuracy

of the applicant's computations related to overall project completion time including the effects of early start and/or late finish of each major work element.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is

10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"

4.2 Regulatory Guidance

There are no regulatory guides that apply to scheduling for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The schedules should provide as complete a picture of overall project progress as is feasible at the time the application is submitted. Scheduling will be a function of time and reviewed accordingly (i.e., out year scheduling may be less detailed than near-term scheduling). The applicant should consider all major steps, associated resource commitments, and the effects of delays related to the completion of each major work element. The applicant should consider and provide for acceptance reviews, hearings, and interrogations by regulatory and public interest groups, and describe contingency actions when these will occur.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the scheduling for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.3.

The applicant has provided schedules that document the major proposed work activities at the facility. The schedules are of sufficient detail and quality so as to support the applicant's estimates of completion times and resource expenditures. The applicant has (1) adequately considered licensing and procedural steps over which it has no control, (2) built in an adequate contingency factor into the work schedules, (3) adequately considered the interdependency of major work elements, and (4) estimated the overall effect of

early start and/or late finish of each work element on the overall completion schedule. The applicant has provided the information required in 10 CFR 61.11(d).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.4
INSTITUTIONAL INFORMATION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Land-Use Planner/Real Estate Specialist

1.2 Secondary - None

1.3 Support - Legal Counsel

2. AREAS OF REVIEW

The staff will review the certification submitted by the applicant that the proposed facility is on land owned by the Federal or State Government and that the applicant is prepared to provide custodial care and accept site ownership on license transfer (or termination). Deeds, leases, agreements, and restrictive covenants should be referenced and/or reproduced in whole or in part. Additionally, the applicant should acknowledge and discuss its responsibilities to authorities other than the primary licensing authority (e.g., Occupational Safety and Health Administration and State and county licensing and permitting authorities).

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the institutional information in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is for the most part informational in nature, and detailed technical analysis is not required. The Division of Low-Level Waste Management and Decommissioning staff will review material of a legal nature, which will then be turned over to OGC for detailed legal interpretation. Material that refers to the applicant's responsibilities to other authorities will be reviewed for completeness. Referenced authorities will be contacted to verify

the applicant's interpretation of the requirements. Potential conflicts or regulatory inconsistencies will be identified to the applicant and OGC as appropriate.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is

> 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," as it relates to institutional information to be supplied in an application

4.2 Regulatory Guidance

There are no regulatory guides that apply to institutional information for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The applicant should present a complete and documentable summary of site responsibility for the entire period during which the facility will be under license. The applicant should clearly acknowledge, by reference to codes, statutes, or regulations, its responsibilities to various authorities for the entire period during which it will be under license. Additionally, certifications of subsequent responsibility should be verifiable and legally binding.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the institutional information for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.4.

The applicant has adequately described and documented institutional arrangements with the site owner, and the staff finds that the applicant is in compliance with 10 CFR 61.14. In addition, the applicant has adequately described its responsibilities to the following licensing and permitting authorities:

Authority	Applicant responsibility	Prevailing statute or regulation

No applicant responsibilities were found to be in conflict with the regulations pursuant to the Atomic Energy Act.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.5
MATERIAL INCORPORATED BY REFERENCE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Project Manager

1.2 Secondary - Other Technical Reviewers (as needed)

1.3 Support - None

2. AREAS OF REVIEW

In certain portions of the SAR, the applicant may have incorporated procedures, designs, components, features, processes, or studies that have been previously approved for or used in other applications. The staff will review the applicant's discussion of the use of this material in the context of the present application and its pertinence and limitations. Applicable portions of such material should be included as an appendix to the SAR, and the entire body of information should be referenced.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on material incorporated by reference in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed, within the context of this SRP, is informational in nature. The general applicability of the referenced material will be verified by the LLOB project manager and the technical reviewer responsible for the detailed review of the section(s) to which it applies. The staff will verify if the applicant has provided pertinent portions of referenced material and has properly annotated references. Where possible, this will be done informally with the originator of the referenced material to determine applicability.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

There are no regulations that apply to this SRP.

4.2 Regulatory Guidance

There are no regulatory guides that apply to this SRP.

4.3 Regulatory Evaluation Criteria

For material incorporated by reference, the applicant should provide contributory evidence that the material so incorporated is germane to the project and is being used within the intended context. Pursuant to this SRP, the staff will determine if the material is generally acceptable and germane to the situation for which it is referenced. In the detailed technical review, pursuant to other SRPs, the staff will make a more rigorous determination about the material's applicability.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the material incorporated by reference in the SAR for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.5.

The staff finds that the material incorporated by reference in the SAR is generally appropriate for the topic for which it was referenced. The applicant has used the material in its proper context and has submitted applicable portions of the referenced material as part of the SAR as well as annotations related to the referenced material.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCE

Essential

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.6
CONFORMANCE TO REGULATORY GUIDES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Project Manager

1.2 Secondary - Other Technical Reviewers (as needed)

1.3 Support -

2. AREAS OF REVIEW

The staff will review the applicant's compliance and degree of compliance with NRC regulatory guides that relate to specific licensing issues. The staff also will evaluate the areas noted by the applicant where the applicant has failed to comply, the reasons for the noncompliance, the degree of noncompliance, and the incorporated alternatives that the applicant feels support the acceptability of the application.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the applicant's conformance to regulatory guides in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is informational in nature, and no detailed technical analysis is required. The staff will verify that the applicant has acknowledged its responsibility to be responsive to specific regulatory guides in the detailed technical analyses for various sections of the SAR. As part of the detailed technical analysis of the various sections, the staff will assess conformance to applicable regulatory guides.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

There are no regulations that apply to this SRP.

4.2 Regulatory Guidance

There are no regulatory guides that apply to this SRP.

4.3 Regulatory Evaluation Criteria

In discussing conformance to regulatory guides, the applicant should state that, except as noted, it has conformed to all the recommendations given in regulatory guides referenced in NUREG-1199. Exceptions should be clearly explained and the effects analyzed. Acceptance criteria for detailed technical reviews, noted in subsequent SRPs, will include the degree to which the applicant should conform to specific regulatory guides.

5. EVALUATION FINDINGS

5.1 Introduction

The staff should integrate the findings of other technical reviewers and verify that sufficient information has been provided to satisfy the guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the applicant's conformance to regulatory guides for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.6.

The applicant has conformed, except as noted below, with applicable NRC regulatory guidance:

Guidance to which applicant has not conformed	Reason(s) for nonconformance

In all cases of nonconformance, the applicant has presented adequate reasons for nonconformance and alternative measures that protect health and safety in a manner consistent with the intent of the regulatory guide.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for

a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCE

Essential

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1.7
SUMMARY OF PRINCIPAL REVIEW MATTERS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Project Manager

1.2 Secondary - Other Technical Reviewers (as needed)

1.3 Support - None

2. AREAS OF REVIEW

The staff will review the applicant's summary of what the applicant considers are principal licensing review matters. The summary will be based on the applicant's experience in similar endeavors and on its efforts in data gathering, analyses, meetings, discussions, and solicitations conducted during the preparation of the SAR. The staff also will review specific areas identified by the applicant which the applicant has dealt with and, from its perspective, has resolved.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the applicant's summary of principal review matters in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is informational in nature, and no detailed technical analysis is required. The staff will generally cross check the principal review matters with pertinent discussions in other portions of the SAR to determine if the applicant has dealt with the issue in a rigorous manner. Matters of a highly technical nature will be referred to the appropriate technical reviewer to be reviewed in accordance with the applicable SRP. Matters of a more subjective nature will be verified by independent communication with the party(ies)

identified by the applicant as the source of the issue. The staff will reserve the right to modify the list of principal review matters on the basis of its detailed review of the entire SAR.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

There are no regulations that apply to this SRP.

7. REFERENCE

Essential

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.1
GEOGRAPHY, DEMOGRAPHY, AND FUTURE DEVELOPMENTS

This SRP consists of the following:

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.1.1
SITE LOCATION AND DESCRIPTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Land-Use Planner

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the location of the proposed near-surface disposal facility with respect to (1) latitude and longitude as well as the universal transverse mercator (UTM) coordinate system, (2) political subdivisions and nearby cities and towns, and (3) prominent man-made and natural features in the vicinity of the site. The description of the site will be reviewed with respect to (1) area, (2) land ownership and/or status of the site and any potential expansion areas, and (3) detailed topography of the disposal site.

The staff will use the information reviewed under SRP 1.2. The staff may also need information obtained from U.S. Geological Survey (USGS) topographic maps, aerial photography or remote sensing imagery, and local and regional planning agencies and by visiting the site.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on site location and description in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will verify that the applicant's data on latitude and longitude, UTM coordinates, and relative location of cities, towns, and political subdivisions are complete and accurate. The staff should become familiar with the site environs, including man-made and natural features, by reviewing the applicant's data and, if necessary, by visiting the site. Accuracy of this information is essential to those sections of the SER that address potential releases of radioactivity and accident scenarios.

The staff also will verify the applicant's data on the site area and the legal status and/or ownership of this area as well as any potential expansion areas.

Topographic maps of the site and environs in an acceptable scale will be reviewed and included in the SER to augment a detailed description of site topography. The staff will review the applicant's data to ensure that sufficient information is contained to support a description of site topographic features such as elevation and relief, slope, and drainage.

1. Any omissions or clarifications of the applicant's submittal should be identified and communicated to the project manager as soon as possible so they can be resolved.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are

(1) 10 CFR 61.11, "General Information," (c)(1), which requires a description of the location of the proposed disposal site

(2) 10 CFR 61.12, "Specific Technical Information," (a), which requires a description of the natural and demographic disposal site characteristics as determined by disposal site selection and characterization activities

4.2 Regulatory Guidance

There are no regulatory guides that apply to site location and description for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The applicant's data will be considered acceptable if (1) they address the content and format guidelines of NUREG-1199 and (2) they are sufficient to meet the requirements for site description contained in 10 CFR 61.11(c)(1) and 61.12(a).

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

In addition to making the findings specified in Sections 3.1 and 3.2 of this SRP, the staff will prepare summary descriptions of the site location, the site itself, and transportation routes on or near the site for inclusion in the SER. Any deficiencies of site parameters with respect to the proposed facility will be noted.

The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the site location and description for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.1.1.

The applicant's data are acceptable because they address the content and format guidelines of NUREG-1199 and because they are sufficient to meet the requirements for site description in 10 CFR 61.11(c)(1) and 10 CFR 61.12(a).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of a license application for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.1.2
POPULATION DISTRIBUTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Land-Use Planner

1.2 Secondary - None

1.3 Supporting - Environmental Planner/Engineer

2. AREAS OF REVIEW

The staff will review current and projected population distributions to a radial distance of 10 km from the proposed site, populations of cities and towns within a 10-km radius of the proposed site, distance to nearest resident, location and population of any cities and towns in excess of 10,000 persons within a radius of 50 km, and the location and nature of any significant transient populations within 10 km of the site. The staff will use information reviewed under SRP 2.1.1, "Site Location and Description," while conducting this review.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on population distribution in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will select and emphasize various aspects of the subjects covered by this SRP for each application. 10 CFR 61 does not specify numerical demographic criteria for acceptance. However, 10 CFR 61.50 indicates that disposal facilities should be sited so that projected population growth and future developments are not likely to affect the ability of the facility to meet the performance objectives of the rule. For this reason, each staff reviewer will have to make individual judgments regarding current and future demographic conditions. The staff should (1) determine that the applicant's data are presented in the detail and format specified in NUREG-1199; (2) ensure that the applicant has provided a map of current and projected population by principal compass sectors adequate for conducting dose assessment via atmospheric pathways; (3) compare the applicant's present population data

against available independent population data (e.g., information from the Census Bureau including any special census that may have been conducted, local and State agencies, and regional Councils of Government); and (4) note any significant differences that require clarification.

The staff will compare the applicant's population projections with independent population projections (e.g., projections from the Census Bureau, local and State agencies, and regional Councils of Government) and note any significant underestimates in the applicant's data that require clarification.

The staff will further (1) ensure that significant transient populations within 10 km of the site have been considered by the applicant; (2) evaluate the characteristics of the land area between the proposed near-surface disposal facility and the nearest population grouping which has, or is projected to have, a population of 10,000 or more during the operational life of the facility; and (3) use available data on land use, plans and trends in land use, land use controls (such as zoning), potential for growth, or other factors likely to inhibit or stimulate growth in the area between the facility and the population grouping.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is

> 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(3), which requires that a disposal site be selected so that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of Subpart C of this part

4.2 Regulatory Guidance

There are no regulatory guides that apply to demographic conditions for a lowlevel waste disposal facility.

4.3 Regulatory Evaluation Criteria

As noted above, 10 CFR 61 does not specify technical licensing criteria for demographic conditions. However, the staff should attempt to independently determine that projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of Subpart C of 10 CFR 61.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the population distribution for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.1.2.

The staff concludes that the population data provided by the applicant are acceptable and meet NUREG-1199 because the applicant has provided an acceptable description and safety assessment of the site which contain present and projected population densities. In addition, the staff has reviewed and confirmed, by comparison with independently obtained population data, the applicant's estimates of the present and projected populations surrounding the site, including transients.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plants for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive waste Disposal Facility," Rev. 2, January 1991.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection and Characterization," 1982.

U.S. Nuclear Regulatory Commission, Regulatory Guide 4.19, "Guidanace for Selecting Sites for Near-Surface Disposal of Low-Level Radioactive Waste," 1988.

U.S. Nuclear Regulatory Commission, NUREG-1388, "Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility," 1989.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.2
METEOROLOGY AND CLIMATOLOGY

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Meteorologist/Climatologist

1.2 Secondary - Design Engineer, Performance Assessment Specialist

1.3 Supporting - Land-Use Planner, Hydrologist

2. AREAS OF REVIEW

The staff will review the averages and extremes of climatic conditions and regional meteorological phenomena affecting the safe design, construction, operation, and closure of the proposed low-level waste disposal facility. The review will cover the specific areas given in the following sections.

2.1 Regional Data

(1) a description of the general climate of the region with respect to types of air masses, synoptic features (high- and low-pressure systems and frontal systems), general air-flow patterns (wind direction and speed), temperature and humidity, precipitation, and relationships between synoptic-scale atmospheric processes and local meteorological conditions

(2) seasonal and annual frequencies of severe weather phenomena including tornados, water spouts, thunderstorms, lightning, hail, and high air pollution potential

2.2 Local Data

(1) meteorological conditions used as design operating and performance assessment bases including

(a) the maximum snow and ice load that the roofs of safety-related structures must be capable of withstanding during facility operation

(b) weather-related radionuclide transmission parameters including average and extreme wind vectors and average and extreme duration and intensity of precipitation events

(c) routine weather-related site deterioration parameters including precipitation intensity and duration, wind vectors, and temperature and pressure gradients

(d) extreme weather-related site deterioration parameters including tornados, water spouts, thunderstorms, hail, and extreme air pollution (from offsite sources)

(2) a description of the local (site) meteorology in terms of air flow, temperature, atmospheric water vapor, precipitation, fog, atmospheric stability, and air quality

(3) an assessment of the influence of the facility, if any, on the local meteorological parameters listed in item (1), including the effects of facility construction and operation and terrain modification

(4) a topographical description of the site and its environs, as modified by the facility construction, including the site boundary and buffer zone

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on meteorology and climatology in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluations

The staff will review the summaries in the meteorology and climatology section of the SAR for completeness and adequacy of basic data. The wind and atmospheric stability data should be based on onsite data because air flow and vertical temperature structure can vary substantially from one location to another and are included as inputs to the assessment of atmospheric diffusion conditions at the site. The other summaries should be based on nearby representative stations with long record retention periods because the locally measured extremes in intensity and frequency will be compared with design-basis values in the SAR or will be used by other branches to determine whether these meteorological conditions are limiting conditions for design and emergency procedures. When offsite data are used, the staff will determine how well the data represent site conditions and whether more representative data are available. The staff will use National Oceanic and Atmospheric Administration (NOAA) (U.S. Department of Commerce) State meteorological summaries ("State Climatological Summary"), local climatological data ("Local Climatological Data" Annual Summary with Comparative Data"), and NOAA Environmental Data Service summaries pertinent to the site to evaluate the representativeness of stations and periods of record. The staff should be familiar with all primary meteorological data collection locations.

The staff will ensure that all topographic maps and topographic cross-sections presented by the applicant are legible and well-labeled so that the information needed during the review can be readily extracted. Points of interest such as facility structures, site boundary, and buffer zone should be marked on all maps and diagrams.

The staff will compare the applicant's assessment of the effect of topography with standard assessments such as those presented in "Meteorology and Atomic Energy - 1968" (Slade, 1968) and decide whether the standard regulatory atmospheric diffusion models are appropriate for this site.

The staff will review for completeness and authenticity the general climatic description of the region in which the site is located. Climatic parameters such as air masses, general air flow, pressure patterns, frontal systems, and temperature and humidity conditions reported by the applicant will be checked against standard references (Thom, 1968; U.S. Department of Commerce, 1968) for appropriateness with respect to location and period of record.

The staff will verify the applicant's description of the role of synoptic-scale atmospheric processes on local (site) meteorological conditions against the descriptions provided in "Climatic Atlas of the United States" and "Local Climatological Data - Annual Summary With Comparative Data" (both published by the U.S. Department of Commerce).

Because meteorological averages and extremes can only be obtained from stations in the region of the site that have long record retention periods and the stations are not usually very close to the site, the staff will first determine the representativeness of the data to site conditions and then ascertain the adequacy of the stations and their data.

The staff will verify (1) recorded meteorological averages and extremes using standard publications such as "1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Technical Branch (LLTB)

1.2 Secondary - None

1.3 Supporting - Low-Level Waste and Uranium Recovery Projects Branch (LLOB)

2. AREAS OF REVIEW

The staff will review the information on the fire protection system to ensure that the system can adequately respond to the accidental fires that could occur at the facility. Fire protection measures unique to a facility that handles radioactive materials have to be satisfactorily addressed by the applicant. The fire protection system includes the equipment, procedures, training, management, and emergency planning designed to provide fire protection at the facility. The review will include the following areas:

(1) the postulated accidental fires that could possibly occur in all important areas of the facility, which would include, as a minimum, the waste receipt area, the waste handling area, the waste storage area, and the disposal unit areas

(2) the equipment to be used for responding to a fire emergency

(3) the emergency response plan with established procedures to be implemented in case of a fire emergency

3. REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that the review procedure is complete and will use and emphasize the material from this SRP that may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on the fire protection system in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the information on the fire protection system in the SAR to determine if the applicant has followed the regulations and the guidance of applicable references and industry standards and has demonstrated that the methods used will provide reasonable and acceptable protection in the event of an accidental fire. The areas discussed in the following sections will be reviewed.

3.2.1 Accidental Fire Analysis

The staff will review the information on the accidental fires postulated to occur at the facility. In its postulation of accidental fires, the applicant should consider the initiation of fires under normal operating conditions as covered in SRP 3.2 for the waste receipt area, the waste handling area, the waste storage area, and the waste disposal area. The applicant also should consider and describe the anticipated chemical environment at the disposal facility and demonstrate with supporting information how the proposed fire protection system in the anticipated environment will safely control accidental fires and protect the health of facility personnel and the public.

3.2.2 Fire Protection System

The staff will review the information on the fire protection system for the disposal facility giving special attention to the management plan on response to a fire emergency; the procedures, materials, and equipment to be available for responding to a fire emergency; the procedures and equipment for providing offsite alarms in response to a fire emergency; and the training provided to facility personnel related to the prevention of fire and to protection during a fire emergency. The staff will review these aspects of the fire protection system and will determine if they are consistent with the specified methods recommended in NFPA 901-1981, "Uniform Coding for Fire Protection," of the National Fire Protection Association and other applicable guidance and are adequate to safely handle all types of fires and scenarios that could result from the postulated accidental fires.

3.2.3 Emergency Response

The staff will review the information on the response to a fire emergency to ensure that adequate measures are in place to evacuate facility personnel effectively and to provide sufficient public notification of potential radiological hazard, should this contingency be necessary. The results of the review conducted by the LLOB staff under SRP 8.4 will be used as input into the staff's conclusions in this area.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.11, "General Information," (b)(3) and (4), which require that information submitted by the applicant include a description of the applicant's personnel training program and a plan to maintain an adequate complement of trained personnel to carry out waste receipt, handling, land disposal in a safe manner

(2) 10 CFR 61.12, "Specific Technical Information," (k), which requires that information submitted by the applicant include a description of the radiation safety program for control and monitoring of radioactive effluents to ensure compliance with the performance objective in 10 CFR 61.41 and occupational radiation exposure to ensure compliance with the requirements of 10 CFR 20 and to control contamination of personnel, vehicles, equipment, buildings, and the disposal site; both routine operations and accidents must be addressed, and the program description must include procedures, instrumentation, facilities, and equipment

(3) 10 CFR 61.43, "Protection of Individuals During Operations," which requires that operations at the land disposal facility be conducted in compliance with the standards for radiation protection in 10 CFR 20 and that every reasonable effort be made to maintain radiation exposures as low as is reasonably achievable

4.2 Regulatory Guidance

Guidance is provided in the following national fire codes published by the National Fire Protection Association:

(1) NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials"

(2) NFPA 901-1981, "Uniform Coding for Fire Protection"

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 2 of this SRP are given in the following sections.

4.3.1 Accidental Fire Analysis

The information on the accidental fire analysis is acceptable if fires and their effects in the presence of radioactive substances are postulated for the waste receipt area, the waste storage area, and the waste disposal area, at a

minimum. The analysis should consider the location where the most severe fire could occur, the materials likely to be consumed, the construction arrangement of any buildings or areas likely to be consumed, and the harmful effects of smoke and heat associated with the fire.

4.3.2 Fire Protection System

The information on the fire protection system is acceptable if (1) the procedures, materials, equipment, and systems for fire protection will protect workers and the public from radiation and fire hazards, (2) there is a suitable program for the prevention of hazards from radiation and fire, and (3) there is a program to adequately train facility personnel to respond to fire emergencies and to prevent fires. The methods proposed to provide this system should meet the prescribed recommendations of NFPA 801-1986 and NFPA 901-1981, including the referenced recommended practices, especially in regard to the equipment for the detection of fires; equipment for the prevention of fire hazards (sprinklers, etc.); onsite and offsite alarm systems; wet, dry, and chemical fire extinguishers; foam-extinguishing systems; personnel training; building materials; and facilities handling radioactive wastes. Buildings on site should meet the requirements of the Uniform Fire Code for their intended purposes, especially the waste receipt and storage areas, the vehicle washdown facility, and the waste repackaging areas.

4.3.3 Emergency Response

The information on the emergency response in the event of a fire is acceptable if the accidental fire analysis does not indicate any conditions that may adversely affect the results of the review and conclusions drawn under SRP 8.4. The emergency response plan reviewed under SRP 8.4 should contain adequate measures for the notification and evacuation of workers and nearby residents if a fire should occur.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the fire protection system for the [name of facility] low-level waste disposal facility according to Standard Review Plan 3.4.3. The staff concludes that the fire protection system has been designed (1) to maintain occupational exposures as low as is reasonably achievable if an accidental fire should occur and (2) to be compatible with the facility's radiation safety and emergency planning programs. The applicant has provided provisions for an adequate training program for personnel in fire prevention and protection. The fire protection system, therefore, meets 10 CFR 61.11(b)(3) and (b)(4), 10 CFR 61.12(k), and 10 CFR 61.43 as they relate to fire protection.

In meeting these requirements, the applicant has used the recommended methods in the following national fire codes published by the National Fire Protection Association (NFPA):

(1) NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials"

(2) NFPA 901-1981, "Uniform Coding for Fire Protection

On the basis of its review, the staff concludes that the proposed fire protection system is reasonable and acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

Slade, D. H., ed., "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, U.S. Atomic Energy Commission, Washington, DC, 1968.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

Regulatory Guide 1.23, "Onsite Meteorological Programs (Safety Guide 23)."

U.S. Nuclear Regulatory Commission, NUREG-1388, "Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility," 1989.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection and Characterization," 1982.

General

Thom, H. C. S., "New Distribution of Extreme Winds in the United States," Journal of the Structural Division, Proceedings of the American Society of Civil Engineers, pp. 1787-1801, July 1968.

U.S. Department of Commerce, "Climatic Atlas of the United States," Environmental Data Service, National Oceanic and Atmospheric Administration, Washington, DC, June 1968.

---, "Local Climatological Data - Annual Summary With Comparative Data," Environmental Data Service, National Oceanic and Atmospheric Administration, Washington, DC, published annually for all first-order National Weather Service stations.

---, "State Climatological Summary," Environmental Data Service, National Oceanic and Atmospheric Administration, Washington, DC, published annually by State.

---, "Storm Data," Environmental Data Service, National Oceanic and Atmospheric Administration, Washington, DC, published monthly.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.3
GEOLOGY AND SEISMOLOGY

This SRP Consists of the following:

SRP 2.3.1 Geologic Site Characterization
SRP 2.3.2 Seismic Investigation

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.3.1
GEOLOGIC SITE CHARACTERIZATION PLAN

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Geologist

1.2 Secondary - None

1.3 Supporting - Civil Engineer, Hydrologist, and Seismologist

2. AREAS OF REVIEW

The staff will review the information on geologic site characterization in the SAR to determine if it is adequate to support the applicant's conclusions with regard to the suitability of the proposed facility. The information will have to demonstrate adequately and clearly that the conditions at the proposed site are such that tectonic and geologic processes allow the site to meet the performance objectives in 10 CFR 61. Specific areas of review will include the following:

(1) With regard to the applicant's characterization of geologic structure, tectonic history, regional stress regime, and seismic history, the staff will review all regional geologic structures and tectonic activity that are significant in determining the earthquake potential of the region and the reactivation of existing geologic structures in the site vicinity.

(2) For facilities in areas of moderate to high seismicity, the staff will evaluate patterns of seismicity to determine if there is a possible association with geologic structure that might indicate capable faulting or fault-related folding. For cases in which seismicity is associated with geologic structure, the maximum earthquake that could occur on that structure should be evaluated, taking into account such factors as the type of faulting, fault length, fault displacement, fault slip rate, sense of fault movement, earthquake history, and history of fault movement.

(3) The staff will review the tectonic setting in which the site is situated and analyze, when applicable, the volcanic history of the site region for possible indications of renewed volcanism. It will analyze the description of each major period of volcanism and the

composition and age of the volcanics and the stratigraphy of the surrounding rocks. The staff also will evaluate the mineralogy and geochemistry of each volcanic unit provided by the applicant and any associated fracturing or faulting and its origin.

(4) The staff will review the geomorphic investigations for evidence of: (a) destructive geologic processes such as mass wasting, excessive erosion rates, landslides, and rockslides; and (b) fault activity and crustal deformation. For example, escarpments, shutter ridges, oversteepened valleys, and sharply incised streams may be evidence of destructive geologic processes that may result in unacceptable site conditions.

The staff will coordinate its review with other staff reviews that are related to the geologic aspects discussed in the SAR. Multidisciplined reviews discussed below include evaluations or determinations of the geohydrologic units, surface and groundwater pathways or barriers, liquefaction potential, and mass wasting.

The staff's concurrence in the applicant's characterization of the stratigraphy, lithology, and geomorphology of the site is essential to the development of acceptable geohydrologic models used to describe the surface and ground water regime. The staff will judge the adequacy of the information presented in support of the applicant's description of the geohydrologic units and the surface and groundwater pathways. Knowledge of the groundwater regime is essential to provide assurance that the offsite radionuclide transport will not exceed the limits in 10 CFR 61. For the review under SRP 2.5, the staff will use the review results on geologic information to determine the adequacy and acceptability of field investigations and laboratory tests in establishing the soil and rock layering, profiles, and cross-sections, and the engineering properties of the site and borrow materials to be used in the design of the disposal facility.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on geologic site characterization in the SAR in accordance with 10 CFR 61 and NUREG-1199. If the information referred to in Section 2 of this SRP reflects the results of a thorough literature search and an adequate reconnaissance and physical examination of the regional and site conditions by the applicant, the SAR will be considered acceptable. Consultations with commercial companies and Federal, State, and local government agencies that may have had occasion to characterize the site will help ensure the adequacy of the characterization in the SAR.

The review can be completed quickly if the SAR contains sufficient information to allow the staff to make an independent assessment of the applicant's assumptions, analyses, and conclusions. That is, the staff should be led in a logical manner from the data and premises given in the SAR to the conclusions that are made, without having to make an extensive, independent literature search. The objective of the sections entitled "Regional Geology" and "Site Geology" of NUREG-1199 is to describe the geologic features as they affect the site, and all information, data discussions, interpretations, and conclusions

shall be directed to this objective. Inadequate presentation of information will result in time-consuming requests for additional information or outright rejection of the SAR.

3.2 Safety Evaluation

After the SAR for a low-level waste (LLW) disposal site is judged to be complete and is accepted and docketed, the staff will conduct its review in three phases.

Phase 1

The staff will thoroughly review the information in the SAR to determine if all interpretations and conclusions are founded on sound geologic practice and do not exceed the limits of validity of the data in the SAR or of other data published in the literature. This phase of the review will usually involve meetings with the applicant to clarify questions and to present new data. The meetings usually will be held at the proposed site. In any event, a site visit will be required.

The staff may, as a result of its review of the SAR and site inspection, find it necessary to request additional information from the applicant. The questions and comments to the applicant will identify issues that have not been adequately addressed or sufficiently documented to permit the staff to concur in interpretations or conclusions reached by the applicant.

Phase 2

The staff will evaluate the applicant's responses to questions raised in the first phase and then write a Safety Evaluation Report (SER) in which it either concurs in the applicant's positions or presents the unresolved issues to be resolved in a supplement to the SER. If the licensing schedule does not permit unresolved issues to be addressed in a supplement, the issues may be settled by writing staff positions in the SER. A staff position is a requirement that the applicant accept a specific interpretation or condition in a way that the staff considers sufficiently conservative and consistent with the performance objectives in 10 CFR 61.

Phase 3

The staff will evaluate the performance confirmation program established by the applicant. This program will provide information indicating whether actual surface and subsurface conditions encountered during construction or waste emplacement operations are within the modeling limits assumed in the staff's licensing review. The program should start during site construction operations and continue during trenching for waste emplacement until permanent closure of all trenches. Each trench or excavation should be mapped and analyzed for changed conditions, and the results will be reviewed by the staff according to an established plan.

4. ACCEPTANCE CRITERIA

The information in the SAR is acceptable if it meets the requirements of 10 CFR 61 and other guidance given below.

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information,"(a) as it relates to the description of the geologic features of the disposal site and vicinity

(2) 10 CFR 61.13, "Technical Analyses,"(a) as it relates to clearly identifying and differentiating the role performed by the natural disposal site characteristics

(3) 10 CFR 61.23, "Standards for Issuance of a License,"(b), (e), and (f) which require findings that the applicant's proposed disposal site provides protection of the public health and safety and reasonable assurance that the performance objectives in 10 CFR 61, Subpart C, and the technical requirements in Subpart D will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 and 10 CFR 61.44 which present the performance objectives of which the sited disposal facility must contribute toward the achievement

(5) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal,"(a)(1) which specifies the minimum characteristics a disposal site must have to be acceptable for use as a near-surface disposal facility.

(6) 10 CFR 61.50(a)(2), which requires that the disposal site be capable of being characterized, modeled, analyzed, and monitored

(7) 10 CFR 61.50(a)(9), which requires that areas be avoided where tectonic processes such as faulting, folding, seismic activity, or volcanism may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of Subpart C or 10 CFR 61 or may preclude defensible modeling and prediction of long-term effects

(8) 19 CFR 61.50(a)(10), which requires that areas be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of Subpart C of 10 CFR 61 or preclude defensible modeling and prediction of long-term effects

(9) 10 CFR 61.53(a), "Environmental Monitoring," which requires the obtainment of information on geology to provide basic environmental data on disposal site characteristics

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in NUREG-0902. The sections that pertain to site geologic characteristics will be applied.

4.3 Regulatory Evaluation Criteria

In meeting the requirements of 10 CFR 61.50(a)(2), (9), and (10), the staff will accept the application if the geologic information in the sections entitled "Regional Geology" and "Site Geology" is complete and well documented. The information should address the regional and site physiography, geologic history, geomorphology, stratigraphy, lithology, structure, and tectonics. Specifically, it should address the following site characteristics: indications of liquefaction-induced flowage features; karst terrain; faulting; crystal deformation and differential subsidence; mass wasting; regional stress regime; and the effects of human activities in the site area. With specific reference to site geology, the following subjects should be reviewed as they relate to the above conditions: topography; slope stability; fluid injection or withdrawal; bedrock solutioning; shearing; jointing; fracturing; and seismicity. The information needed to evaluate the above regional and site conditions is presented and discussed in NUREG-1199.

The above information should be documented by appropriate references to all relevant published and unpublished data and materials and personal communications. Illustrations should include tectonic, geologic, geomorpohologic, topographic, and structural maps; stratigraphic sections; boring logs; electrical logs; and aerial photographs. When applicable, certain sites will require maps showing oil or gas wells, faults, karst features, and seismic reflection profiles.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

If the staff's evaluation confirms that the SAR meets the requirements and guidelines described in the acceptance criteria, the conclusion in the SER will state that the information in the SAR adequately supports the applicant's conclusions. Any unresolved issues or reservations about any significant deficiency in the SAR will be clearly stated in the SER to define precisely the nature of the concern. If no outstanding issues or concerns remain, the staff will conclude that the site is acceptable from a geologic standpoint and meets 10 CFR 61.

5.2 Sample Evaluation Findings

The staff has reviewed the geologic site characterization for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.3.1.

The geology of the proposed site has been adequately characterized, modeled, and analyzed to ensure that the long-term performance objectives of Subpart C of 10 CFR 61 are met as required in 10 CFR 61 as required in 10 CFR 61.50(a)(2).

The tectonic and geologic processes and seismic activity do not occur with such frequency and to such an extent that they significantly affect the ability of the disposal site to meet Subpart C of 10 CFR 61 as required in 10 CFR 61.50(a)(9) and (10).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection, and Characterization," April 1982.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.3.2
SEISMIC INVESTIGATION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Seismologist

1.2 Secondary - Civil Engineer

1.3 Supporting - Geologist

2. AREAS OF REVIEW

The staff will review the seismological and geophysical investigations required to ensure that a low-level waste (LLW) disposal site operates safely and meets the performance objectives. These investigations should concentrate on the evaluation of the maximum earthquake potential taking into consideration the regional and local geology of the area.

The staff will review the following areas that are subject to the primary investigations that should be carried out by the applicant: seismicity, tectonic characteristics of the site and region, correlation of earthquake activity with geologic structures or tectonic provinces, maximum earthquake potential, seismic wave transmission characteristics of the site, design earthquake, settlement and liquefaction potential, and geophysical methods.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on seismic investigation in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluations

After the license application is accepted and docketed, the staff will conduct its review as follows:

(1) The staff will evaluate the seismological and geophysical information to determine if it is acceptable and in accordance with the criteria given in Section 4 of this SRP. The staff will meet with the applicant if the information has to be clarified.

(2) The staff will visit the site (a) to clarify and confirm some of the geophysical and seismological information in the SAR; (b) to inspect the geological structures around the site; and (c) to evaluate core borings, exploratory trenches, and geophysical data.

(3) On the basis of the information supplied by the applicant and obtained from the site visit and literature sources, the staff will prepare a request for additional information if needed and formulate positions that may agree or disagree with those of the applicant.

(4) The staff will evaluate the response(s) to the request for additional information for adequacy and completeness and then write a Safety Evaluation Report (SER), in which it will include any open issues that may require further investigation. These open issues should be addressed in a supplement to the SER.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (a) as it relates to natural disposal site characteristics and seismic activity

(2) 10 CFR 61.12(d) as it relates to the design basis earthquake and its relationship to the principal design criteria

(3) 10 CFR 61.13, "Technical Analyses," (a) and (d) as they relate to analyses needed to clearly identify and differentiate the role performed by the natural disposal site characteristics and to demonstrate long-term stability of the disposal site without the need for ongoing active maintenance after closure

(4) 10 CFR 61.23, "Standards for Issuance of a License," (b),(e) and (f) which require findings that the applicant's proposed disposal site provides protection of the public health and safety and reasonable assurance that the performance objectives in 10 CFR 61, Subpart C, and the technical requirements in Subpart D will be met

(5) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 and 10 CFR 61.44 which present the performance objectives of which the sited disposal facility must contribute toward the achievement

(6) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(1), (a)(2), (a)(9) and (a)(10) which require: (a) disposal site features that ensure that the long-term performance objectives will be met; (b) a disposal site that is capable of being characterized, modeled, analyzed and monitored; (C) the avoidance of areas where seismic activity could occur with such frequency to significantly affect the ability of a disposal site to meet the performance objectives; and (d) the avoidance of areas where geologic processes could occur with such frequency and extent to significantly

affect the ability of a disposal site to meet the performance objectives.

(7) 10 CFR 61.53, "Environmental Monitoring," (a) which requires the obtainment of information on the seismology of the disposal site for environmental monitoring purposes

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the following documents:

(1) NUREG-0902, "Site Suitability, Selection and Characterization," as it relates to characterizing the regional framework including stratigraphy, tectonics, structure, and seismic and volcanic risk at the disposal site and vicinity, and which provides guidance and recommendation for site-specific investigations

(2) "Standard Review Plan for UMTRICA Title 1 Mill Tailing Remedial Action Plans," Low-Level Waste Management and Decommissioning, as it relates to characterizing the seismic and tectonic hazards at the disposal site and vicinity, and which provides guidance and recommendations for site-specific investigations

(3) 10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants," as it relates to the design of any safety-related portions of the structures important to safety to withstand the effects of earthquakes

(4) 10 CFR 100, Appendix A, "Seismic and Geologic Criteria for Nuclear Power Plants," as it relates to the investigations required to obtain the seismic data necessary to determine site suitability and as it identifies geologic and seismic factors that have to be taken into account in the siting of the low-level waste disposal facility

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review in this SRP are given in the following sections.

4.3.1 Seismicity

The applicant should evaluate all available historical data and list all available parameters for earthquakes within 200 miles of the site having a modified Mercalli intensity (MMI) greater than or equal to IV or a magnitude greater than or equal to 3.0. The applicant should provide an epicentral map showing the distribution of these earthquakes and large-sale maps showing earthquakes within 50 and 5 miles of the site and areas of high seismicity. The listing should include origin time, focal depth, epicenter coordinates, highest intensity, magnitude, and distance from the site. The magnitude designations such as m_b, m_L, and M_S should be identified, and the sources of this information should be indicated. Any other relevant information on landsliding, fracturing, and liquefaction should be mentioned.

4.3.2 Tectonic Characteristics of Site and Region

The applicant should identify accurately all the geologic structures and the tectonic activity within the region that are important in determining the earthquake potential. On the basis of the geologic structure and the distribution of earthquakes in the area, the applicant should identify, with documentation, the tectonic provinces in the vicinity of the site. Tectonic provinces are regions of uniform earthquake potential. The tectonic provinces may be identified on the basis of seismicity study, differences in geologic history, and differences in the current tectonic regime. In addition, when capable faults are identified in the vicinity of the site, a regional map should be provided showing the tectonic provinces, the location of the earthquakes with respect to these faults, and the location of geologic structures associated with these faults.

4.3.3 Correlation of Earthquake Activity with Geologic Structures or Tectonic Provinces

Whenever the SAR demonstrates the association of earthquakes with either geologic structures or tectonic provinces, the applicant should provide the rationale for the association taking into consideration the characteristics of the geologic structures and the regional tectonic model and the historical seismicity of the area. The coordinates of the earthquake location and its focal depth should be provided, and the methods used to locate it should be identified. The presentation should be augmented by regional maps showing the tectonic provinces, the earthquake epicenters, the location of geologic structures, and measurements used to define tectonic provinces. All the maps should be of the same scale.

4.3.4 Maximum Earthquake Potential

The applicant should examine the literature to identify the maximum credible earthquake associated with each geologic structure or maximum historical earthquake associated with each tectonic province. The maximum credible earthquake is the largest earthquake that can be reasonably expected to occur on a geologic structure in the tectonic regime.

When new geological or seismological evidence becomes available that may warrant the determination of an earthquake larger than the maximum historical earthquake, a discussion should be provided and the magnitude of such an earthquake should be estimated. When an earthquake is associated with geologic structure, the maximum earthquake that could occur on that structure should be estimated taking into consideration the earthquake rupture length and type of faulting (normal, reverse, etc.). Also, the frequency content of the earthquake should be discussed, when possible. For the maximum historical earthquakes associated with tectonic provinces within a 200-mile radius of the site, isoseismal maps should be presented for the earthquakes having a magnitude greater than or equal to 3. The ground motion at the site should be estimated using appropriate attenuation models for the area. In the estimation of ground motion, the maximum earthquakes associated with these tectonic provinces should be placed where the tectonic province is closest to the site.

For the floating earthquake within the same tectonic province of the site, the earthquake should be placed at an appropriate distance from the site and the acceleration should be estimated.

4.3.5 Seismic Wave Transmission Characteristics of the Site

To estimate the ground motion at the site, a knowledge of the seismic wave transmission from the sources to the site is essential. In addition, material overlying the bedrock at the site should be described because this material will amplify or deamplify the upcoming seismic waves. Information on the compressional and shear wave velocities, bulk densities, and shear moduli should be addressed under SRP 6.3 for this overlying material and the bedrock. The methods used to calculate the values should be discussed.

4.3.6 Design Earthquake

The applicant should describe the vibratory ground motion resulting from the maximum earthquake at the free surface and at the depth of concern for the location of the facility. For this earthquake, the peak horizontal and vertical accelerations at the site should be estimated by using applicable attenuation relationships. Attenuation equations that may be applicable to the site are listed in NUREG/CR-3756, Appendix C.A. The potential for amplification of vibratory ground motion in the overburden should be addressed. In some instances site-specific response spectra may have to be compared with the design spectra of the structures.

If possible, probabilistic seismic hazard estimates should be provided. The assumptions and uncertainties associated with these estimates should be documented. The results from the probabilistic seismic hazard study should highlight which seismic sources are of significance to the site.

4.3.7 Settlement and Liquefaction Potential

Deformation and differential settlement of subsurface and fill materials under both static and seismic conditions, analysis for liquefaction potential, and consequences of liquefaction of subsurface soil affecting the stability of the cover materials should be analyzed and addressed under SRPs 5.1.2 and 6.3.

4.3. Geophysical Methods

The applicant should provide adequate information about the geophysical methods used to support the geological suitability of the site. The applicant should explain the capabilities of the geophysical methods used and the methods of obtaining, processing, and interpreting geophysical data. The applicant should integrate all the geophysical data and present a coherent section of the geological structure in the area with the rationale used to arrive at this interpretation.

A few of the geophysical survey methods that can be useful in the study of most of the subsurface geologic problems are the electrical, reflection, refraction, gravity, and magnetic methods. Borehole data will also support the interpretation generated from the use of the above-mentioned geophysical methods.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

The staff's evaluation in the SER will address issues such as tectonic provinces, capabilities of faults in the region, maximum credible or historical earthquake, estimated ground acceleration at the site, settlement and liquefaction, and suitability of the site for licensing.

If the evaluation by the staff confirms that the applicant has met all the requirements for a license, the staff will state in the SER that the information provided by the applicant adequately supports the applicant's conclusion regarding the seismic integrity of the site.

In addition, the SER should include any concern the staff may have and state in sufficient detail any open issues that may require further discussion.

5.2 Sample Evaluation Findings

The staff has reviewed the information on seismic investigation for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.3.2.

As a result of this review, the staff concludes the following:

(1) The seismologic information provided by the applicant is adequate, and no capable faults exist at the site that would adversely affect the safety of the site.

(2) The design-basis earthquake is adequately defined, and the potential for amplification is addressed.

(3) Adequate geophysical investigations have been carried out to characterize the site.

(4) The applicant has met performance objectives in 10 CFR 61.41 through 61.44 and the technical requirements for land disposal facilities in 10 CFR 61.50(a)(1), (a)(2), (a)(9), and (a)(10).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commissions regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability Selection and Characterization," April 1982.

---, NUREG-1199, "Standard Format and Content Guide of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-3756, "Seismic Hazard Characterization of the Eastern United States, Methodology and Interim Results for Ten Sites," D. L. Bernreuter, J. B. Savy, R. W. Mensing, and D. H. Chung, Lawrence Livermore National Laboratory, April 1984.

General

U.S. Nuclear Regulatory Commission, NUREG/CR-3756, "Standard Review Plan for UMTRCA Title 1 Mill Tailings Remedial Action Plans," Low-Level Waste Management and Decommissioning, October 1985.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.4
HYDROLOGY

This SRP Consists of the following:

SRP 2.4.1 Surface Water Hydrology
SRP 2.4.2 Groundwater Characterization

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.4.1
SURFACE WATER HYDROLOGY

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Surface Water Hydrologist/Hydraulic Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information on surface water hydrology in the SAR pertaining to (1) the relationships of the site to surface water features in the site area, (2) events such as floods and dam failures that may require implementation of special design features, (3) surface water users that may be affected during the operational and postclosure periods, and (4) ability of the site to meet the site suitability requirements of 10 CFR 61.50.

3. REVIEW PROCEDURES

The staff will obtain and use such information as is necessary to ensure that the review procedure is complete. The staff will use and emphasize material from this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on surface water hydrology in the SAR in accordance with NUREG-1199 and this SRP. If the applicant's information is inadequate or insufficient, the staff may request that the applicant supply further information or an explanation. The staff may recommend that the SAR be rejected or accepted for documentation, pending the submittal of the requested information. If the information furnished by the applicant is found to be adequate, the technical evaluation of the surface water hydrology aspects of the site will begin.

3.2 Safety Evaluation

The staff will determine whether the applicant has met the site suitability requirements of 10 CFR 61.50. The staff will verify that

coastal high-hazard area, or wetland, as required by 10 CFR 61.50(a)(5)(2) upstream drainage areas are minimized (that is, the site is not susceptible to flooding by a stream with significant flooding potential), as required by 10 CFR 61.50(a)(6)

(3) active erosion is not occurring in the site area to the extent that the site cannot be protected from potential effects of erosion, as required by 10 CFR 61.50(a)(10)

The review procedure will consist of evaluating the completeness of the information and data by sequential comparison with information available from references. On the basis of the description of the hydrosphere (e.g., geographic location and regional hydrologic features), potential site flooding mechanisms will be identified. If the proposed site is located in an area about which published information on the potential for flooding is not available, the staff may need to review the flooding and erosion analyses performed by the applicant. Such reviews will be performed in accordance with the procedures in SRP 6.3.1. Review guidance regarding site suitability requirements on flooding and floodplains is presented in Appendix A to this SRP. Additional information regarding minimization of upstream drainage areas is presented in "Response to Public Comments" and summarized in Section 4.3 of this SRP.

The site visit is an essential facet of the review procedure under this SRP and other SRPs pertaining to hydrologic areas. The site visit will provide the staff with independent confirmation of the hydrologic characteristics of the site and adjacent environs. The purposes of surface water hydrology site visits are to:

(1) acquaint the staff with general site and regional hydrologic characteristics and topography;

(2) allow the staff to observe features and relationships that are not easily quantified or are variable;

(3) allow the staff to observe the behavior of hydrologic systems during periods
of stress, such as immediately following heavy rainfall, when practical;

(4) confirm the applicant's evaluation and description of the site/facility hydrologic interfaces;

(5) review specific hydrologic problem areas with the applicant, as well as the applicant's engineers and consultants.

The site visit objectives will have been achieved if, in addition to viewing pertinent hydrologic features, the staff has had the opportunity to discuss specific questions and concerns with the applicant's design engineers and has been assured that the staff's questions and concerns are understood. In addition, generally acceptable techniques and procedures necessary to respond to staff concerns should be discussed.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(5), as it relates to siting in frequently flooded areas and showing compliance with Executive Order 11988, "Floodplain Management Guidelines"

(2) 10 CFR 61.50(a)(6), as it relates to minimizing upstream drainage areas, where possible

(3) 10 CFR 61.50(a)(10), as it relates to avoiding areas where active erosion is occurring

4.2 Regulatory Guidance

Guidance on site suitability requirements related to floodplains and flooding is available in Appendix A to this SRP. Additional guidance on site selection and surface water hydrology considerations is provided in NUREG-0902.

4.3 Regulatory Evaluation Criteria

Acceptance of the information in the SAR will be based in part on a qualitative evaluation of the completeness and adequacy of the information and of maps. Descriptions and evaluations of structures, facilities, and erosion protection designs are adequate if they are sufficiently complete to allow independent evaluations of the effects of flooding and intense rainfall. Site topographic maps are acceptable if they are of good quality and of sufficient scale to allow independent analysis of pre- and post-construction drainage patterns.

The information presented forms the basis for subsequent hydrologic engineering analyses that are assessed in SRPs 3.4.4, 5.1.1, and 6.3.1. Therefore, completeness and clarity of data are very important. Maps are adequate if they are legible and adequate in coverage to substantiate applicable data and analyses. The descriptions of the hydrologic characteristics of surface water features and water use are acceptable if they are detailed and generally correspond to those of the U.S. Geologic Survey (USGS), National Oceanographic and Atmospheric Administration, Soil Conservation Service, Corps of Engineers, or appropriate State and river basin agencies. Adequate descriptions of existing or proposed reservoirs and dams that could influence conditions at the site may be obtained from reports of the USGS, U.S. Bureau of Reclamation, Corps of Engineers, and others; these descriptions normally include tabulations of drainage areas, types of structures, appurtenances, ownership, seismic and spillway design criteria, elevation-storage relationships, and short- and long-term storage allocations.

The information and analyses presented are acceptable if the staff determines that the data clearly indicate that the following site suitability requirements have been met:

(1) The site is not located in an area subject to frequent flooding (10 CFR 61.50(a)(5)), and the requirements of Executive Order 11988, "Floodplain Management Guidelines," are met.

(2) Upstream drainage areas are minimized (10 CFR 61.50(a)(6)) to the extent that

(a) sites are located where there is little potential for significant inundation,

(b) flood protection measures needed to mitigate flood problems are relatively minor, and

(c) engineering measures are considered to be enhancements rather than significant compensation for site inadequacies.

(3) Active erosion is not occurring in the site area to the extent that the site cannot be protected from the potential effects of erosion (10 CFR 61.50(a)(10)).

Acceptance criteria for flood analyses presented by the applicant are given in SRP 6.3.1.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

Findings will consist of a brief general description of the site with respect to the general hydrosphere, a determination of the nearby users of surface water, and a determination of the suitability of the site as given in 10 CFR 61.50.

5.2 Sample Evaluation Findings

The staff has reviewed the surface water hydrology for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.4.1.

The site is located in Waste City, Pennsylvania, along the right bank (looking downstream) of XYZ Creek. XYZ Creek has a drainage area of approximately 91.0 mi* at the site. The stream flows in a northeasterly direction with an average channel slope of about 0.0012. The XYZ Creek watershed is heavily vegetated and consists largely of agricultural and wooded lands surrounding the residential and industrial areas [supply reference].

Flooding data for XYZ Creek have been recorded since the 1880s. The flood of record occurred in September 1912; other major floods occurred in August 1956, April 1961, March 1963, and February 1966.

Streamflow data for low flows in XYZ Creek have also been recorded since 1907. The lowest flow of record (8.7 ft*/sec) occurred in October 1936. The 7-day 10-year flow rate has been estimated to be approximately 16.7 ft*/sec [supply reference].

Surface-water quality monitoring has been performed by the U.S. Geological Survey (USGS) at two gauging stations located on XYZ Creek from about 1950 to the present. The USGS analyses generally include all of the more common water quality parameters. In general, levels of alkalinity, as calcium carbonate, exceeded the U.S. Environmental Protection Agency (EPA) domestic water supply standard of 20 mg/l for the entire sampling period. Levels of sulfate exceeded the EPA standard of 250 mg/l during periods of low flow.

Two sets of samples were collected by the applicant from XYZ Creek at locations immediately adjacent to site. Results of analyses at these stations indicate no perceptible contamination of the river water resulting from groundwater discharge into the river. The decrease in major and trace constituents from March to June is associated with the increased flow during that period.

Surface water use downstream of the facility is limited, and the nearest surface water user is approximately 1.7 miles downstream. The principal use of this water is for irrigation, and the rate of use is 0.14 million gallons per day.

Data provided by the applicant document that the immediate site area is generally well drained and free of low-lying-swampy areas. Applicant analyses and independent staff estimates indicate that the disposal area is above the level of the probable maximum flood on XYZ Creek and thus is located well above the elevation of the 100-year and 500-year floods. On the basis of these data and analyses and the NRC staff site visit, the staff, therefore, concludes that the requirements of 10 CFR 60.50(a)(5) have been met. Additionally, because the site is located well above any credible flood level, the requirements of 10 CFR 61.50(a)(6) also have been met.

On the the basis of information provided in [supply reference] and the staff site visit, there is no evidence that surface processes such as erosion, slumping, and landsliding are currently active in the immediate site area. The staff, therefore, concludes that the requirements of 10 CFR 60.50(a)(10) have been met.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

---, U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection and Characterization," 1982, reprinted 1986.

---, U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

Because of the geographic diversity of sites and the large number of hydrologic references, no specific tabulation is given here. In general, maps and charts by the USGS, NOAA, Army Map Service, and Federal Aviation Administration; water-supply papers of the USGS; river basin reports of the Corps of Engineers; and other publications of State, Federal, and other regulatory bodies describing hydrologic characteristics in the site vicinity and region are used.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.4.1 - APPENDIX A GUIDANCE ON SITE SUITABILITY REQUIREMENTS RELATED TO FLOODPLAINS, FLOODING, AND WETLANDS

1 INTRODUCTION

10 CFR 61.50(a)(5) states "The disposal site must be generally well-drained and free of areas of flooding or frequent ponding. Waste disposal shall not take place in a 100-year floodplain, coastal high-hazard area or wetland, as defined by Executive Order 11988, 'Floodplain Management Guidelines'." SRP 2.4.1, Section 4.3 provides criteria for determining if a proposed site meets these requirements. The SRP states that the basis for acceptability is that the site is not located in an area of frequent flooding and that the requirements of Executive Order (E.O.) 11988 are met.

The purpose of this guidance is to supplement previous NRC guidance and to provide information regarding the NRC staff's position on siting in floodplains and wetlands and meeting the requirements of 10 CFR 61.50(a). The guidance and procedures presented in this document are not requirements and provide one acceptable method for meeting NRC regulations. Exceptions to the staff's guidance recommendations will be considered on a case-by-case basis.

2 DISCUSSION

In evaluating the requirements of 10 CFR 61.50(a)(5), the staff considers it important to provide clarifying definitions and interpretations of terms used in that regulation which may not be clear or are not specifically defined. For clarification, the following staff definitions and interpretations are provided.

Waste Disposal Area. While 10 CFR 61.50 states that waste disposal shall not take place in a floodplain or wetland, no specific definition of the waste disposal area is provided in the siting regulations. For clarification, the area of waste disposal is considered by the staff to be the immediate area of waste emplacement (e.g., trenches and vault structures); the disposal site is defined in the regulations (10 CFR 61.2) as the area designated for waste disposal activities and includes the immediate area of waste emplacement and the buffer zone.

Wetland. While 10 CFR 61.50 states that waste disposal may not take place in a wetland, as defined by E. O. 11988, it should be pointed out that this Executive Order did not provide a definition of a wetland. A wetlands definition was,

however, provided in E. O. 11990, "Protection of Wetlands," which was issued at approximately the same time as E. O. 11988. As defined in E. O. 11990, wetlands are:

> "those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds."

The NRC staff seeks to be consistent with the approach for defining wetlands that will be employed by other federal agencies. Accordingly, the staff will follow the approaches for defining wetlands and implementing the Executive Orders that are used by agencies such as the Corps of Engineers. The Orders cited in 10 CFR Part 61 were issued to protect floodplains and wetland areas from unnecessary use and development. The staff considers that the environmental considerations related to development in floodplains and wetlands would need to be satisfied through the issuance of a permit from another Federal or State agency. The safety intent would need to be satisfied by meeting the requirements of Part 61.

The staff is also aware that criteria used by other agencies for delineating wetlands are often controversial and are currently being considered for revision. Presently, it appears that very small puddle-like areas could possibly be designated as wetlands. It is possible that there may be certain small wetland areas that: would have little significance to safety at a low-level waste facility; could be permanently eliminated by normal site grading practices; and would not re-occur at a later time. The intent of NRC's wetland provision in 10 CFR 61.50 is to avoid sites with poor drainage to minimize the risk of contact between water and waste. When 10 CFR Part 61 was promulgated, the staff did not envision that small inconsequential areas could be designated as wetlands. The regulations intended to avoid the placement of waste in submerged and relatively large wetland areas, such as marshes, bogs, swamps, and tidal areas.

Based on the definitions and discussions above, and in accordance with 10 CFR 61.50 (a)(5), the staff concludes that a disposal unit should not be located in a 100-year floodplain or wetland area. However, the staff considers that other portions of the disposal site (e.g., a portion of a buffer zone) may be located in a 100-year floodplain or wetland area, provided that Part 61 requirements are met. In such cases, conclusive documentation should be provided to justify that the floodplain or wetland area is insignificant to the safety and performance of the site. Further, as discussed in Section 2.2, below, the final conclusions regarding acceptability of a specific site will depend on the ability of an applicant to justify that <u>all</u> of the siting requirements are met. A site with numerous wetland areas or wetland areas formed by discharge of groundwater onto the site surface will generally not meet the other requirements of 10 CFR 61.50(a).

An applicant may seek an exemption from the floodplain or wetland requirements, if the applicant concludes that the placement of a facility in a particular

location does not violate the intent of NRC regulations. The staff will review such requests on a case-by-case basis.

2.1 Floodplains

In the development of the siting requirements in 10 CFR 61.50, the NRC staff emphasized (USNRC, 1981) the need for avoidance of the 100-year floodplain, indicating that avoiding the floodplain and coastal high hazard areas will reduce the potential for flooding and erosion of the disposal site. The siting requirements, as finally promulgated, express two general criteria related to flooding:

(1) the site must meet the requirements of E.O. 11988, related to the 100-year floodplain; and

(2) flooding potential must be reduced by precluding the use of a site that has obvious flooding and drainage problems, is located in a flood-prone (or frequently-flooded) area, or could be affected to a significant degree by flooding from a large upstream drainage area.

NUREG-0902 (USNRC, 1982) was developed to provide guidance regarding siting in floodplains and to expand on other site suitability requirements. In NUREG-0902, the staff noted that there are other considerations which should be evaluated, in addition to the 100-year floodplain requirement. These considerations include a determination of whether the site is located in an area which is subject to flooding, a determination of the extent of engineering measures needed to protect sites in flood-prone areas, and a determination of the degree to which natural processes (in this case, processes such as erosion and deposition) could invalidate the use of certain predictive models.

2.1.1 Floodplain Determinations

Based on NRC staff review of E.O. 11988 and United States Water Resources Council (USWRC) guidelines (USWRC, 1978) for implementing the Order, it appears that very little flexibility exists in interpreting the Order. The guidelines discuss the need to avoid development in a floodplain, if there is a reasonable or practicable alternative for doing so. The Order also requires consideration of various alternatives to developing, inhabiting, and otherwise using land that is considered to be in the 100-year floodplain. Therefore, the principal finding to be made is whether or not the site is actually located in the 100-year floodplain.

The 100-year floodplain is normally defined as the lowland and relatively flat areas adjacent to stream channels or waterways which are subject to flooding by a flood having a probability of occurrence of 1 in 100 in any particular year (USWRC, 1978). Such a definition, however, requires some interpretation, since practically any land area will be covered with runoff during a storm event. The differentiation is normally made on the basis of the degree of inundation, where flood depths above specified minimum values are used to define a flood-

plain. Such differentiation can be made using guidelines developed by the Federal Emergency Management Agency (FEMA) related to floodplain studies (FEMA, 1985). In general, land areas are classified as hazard zones in various categories, depending on the depth of flooding.

There are also distinctions to be made regarding types of floodplains and exactly what constitutes a floodplain. Clarification may be provided by examining USWRC guidelines, which address riverain floodplains, coastal floodplains, and special floodplains (such as alluvial fans). Depending on the type of floodplain, computational procedures and determination of the floodplain may be different.

For many areas of the United States, maps have been developed which delineate floodplain boundaries. These maps may be used, when available. E.O. 11988 states: "...Before taking action, each agency shall determine whether the proposed action will occur in a floodplain...This determination shall be made according to a Department of Housing and Urban Development (HUD) floodplain map or a more detailed map, if available. If such maps are not available, the agency shall make a determination...based on the best available information..."

Based on staff review of the requirements of the Order, the first step in determining if a site is located in a floodplain is to consult published maps. If such maps are not available, detailed maps should be developed by the applicant in accordance with USWRC guidelines. If the immediate area of waste disposal is located in a 100-year floodplain, as defined by the maps, the site is not acceptable; if other portions of the site, such as the buffer zone, are located in a floodplain, the site may not be acceptable. The final determination is made by meeting the requirements of E.O. 11988, which defines many general goals and requirements related to siting in floodplain areas. The USWRC guidelines provide criteria for implementing the requirements of the Order. The USWRC guidelines provide a step-by-step method for evaluating any proposed floodplain action, including evaluation of alternatives. NRC staff consideration of these guidelines indicates that one of major provisions is to minimize the occupation and development of floodplains, if there is a reasonable and practicable alternative. If an applicant proposes to use floodplain lands, a detailed analysis and justification, following the USWRC procedures, should be developed.

If the site is not located in the mapped 100-year floodplain, this does not necessarily indicate that the site is acceptable. The USWRC procedures are intended to merely identify the 100-year floodplain for insurance and hazard classification purposes. They are not necessarily intended to identify every flood-prone, low-lying, or poorly-drained area (particularly for small streams). For example, any area flooded by a stream with a drainage area of less than one square mile is not considered to be in the 100-year floodplain, according to FEMA procedures. However, such a low-lying area could be inundated with several feet of water from a 100-year flood and have a drainage area of less than one square mile. This area may also be subject to frequent ponding if site soils are relatively impermeable. In such a case, the staff would consider this area to be flood-prone and thus, likely not acceptable, particularly if other siting requirements (such as wetlands, high groundwater levels, etc.) are questionable. Therefore, an applicant may need to make a further determination, as discussed

below, that the site is not located in a flood-prone or high-hazard area. This determination should be made very early in the site selection process, if possible.

2.1.1.1 Flood Hazard Determinations

Based on review of FEMA guidelines, a floodplain classification is related to the hazards associated with flooding. The mere presence of shallow flow does not require a floodplain classification, since the hazards associated with such flows may be minimal and easily mitigated. Based on these risks and hazards, FEMA has provided extensive discussion of hazard zones and has developed procedures for delineating 100-year floodplains, including procedures for special areas (such as alluvial fans).

However, the staff considers that FEMA 100-year floodplain analyses alone do not necessarily address potential problems related to flood hazards at low-level waste sites. In most cases, additional analyses will be needed to document the acceptability of the site. Other areas which should be addressed include: (1) use of special procedures for certain areas; (2) other flooding requirements of 10 CFR 61.50; and (3) significance of flood hazards caused by floods larger than the 100-year flood and use of engineering measures to mitigate flood hazards.

2.1.1.2 Use of Special Procedures for Certain Areas

NRC staff analysis of the FEMA guidelines indicates that additional considerations may be required with regard to determination of floodplains in high-hazard or flood-prone areas. Since the guidelines present only generalized procedures for determining flow depth and velocity, it appears that specialized analyses may be needed to more accurately compute flood depths and velocities in certain areas. In addition, the use of other, more detailed hydrologic computational techniques and special geomorphic studies may be needed to evaluate flooding depths and velocities and the potential for rapid changes to occur. Such changes could include erosion, deposition, channel avulsions, and other potential problems. For example, if a channel avulsion were to occur, the new channel location could occur in the area of waste emplacement or could result in the need to redefine the 100-year floodplain. The overall assessment, therefore, necessitates the use of a systematic approach which identifies the hydrogeomorphic processes in a specific site area. An example of such an approach is discussed by Rhoads (1986).

2.1.2 10 CFR 61 Requirements Related to Flooding

Other NRC regulations address the need to avoid disposal sites which are subject to flooding and/or erosion, or are located in unstable areas. 10 CFR 61.50(a)(6) requires that upstream drainage areas be minimized. 10 CFR 61.50(a)(10) requires that unstable areas be avoided. The staff concludes that the siting requirements must be considered collectively, in order to reach any meaningful conclusions regarding flood potential and flood hazards. The staff considers that the

potential for significant inundation and erosion of a site can be essentially eliminated by meeting several siting requirements, as follows:

(1) minimizing upstream drainage areas, in accordance with 10 CFR 61.50(a)(6), preferably to the extent that the site is well above flood levels in nearby streams, and insignificant sheet flow is the only runoff past the disposal site (even for large floods such as the probable maximum flood [PMF]), resulting in the need for only minor engineering enhancements to protect the site from flooding and erosion;

(2) locating a disposal site in a well-drained area free of significant ponding outside the 100-year floodplain, in accordance with 10 CFR 61.50(a)(5), to minimize the potential for large volumes of runoff to contact waste;

(3) locating a disposal site where flood velocities are insignificant, in accordance with 10 CFR 61.50(a)(10), to minimize potential for erosion; and

(4) locating a disposal site in an area that is not undergoing changes which could invalidate predictive performance models, in accordance with 10 CFR 61.50(a)(10), to provide confidence in the disposal site's ability to isolate waste, or to accurately monitor potential waste migration.

If a disposal site is poorly-drained, in a low-lying area, or could be affected by floods, it will also be necessary to evaluate the impacts of floods on groundwater levels. 10 CFR 61.50(a)(7) prohibits waste disposal in the zone of fluctuation of the water table. If a disposal site is located in an area where floods can cause groundwater levels to rise and come into contact with waste, the disposal site would be unacceptable. In such cases, a transient analysis of flooding and groundwater levels would be needed to verify the adequacy of the site.

The staff recognizes that the siting requirements of 10 CFR 61.50 may be general. In particular, requirements such as those related to minimizing upstream drainage areas can be subject to different interpretations, and there will always be some question regarding how much minimization is enough. The staff considers that, in those cases where there is some subjectivity in the regulations and no specific minimum or maximum criteria are stated, the siting requirements will need to be analyzed in conjunction with each other. With few exceptions, sites that have met the requirement to minimize upstream drainage areas, for example, will not be subject to significant flooding, are likely to be well-drained, will be out of the 100-year floodplain, will not be located in an area of frequent ponding, and will not be located in an area of erosion.

2.1.3 Significance of Hazards Associated with Large Floods and Use of Engineering Measures for Flood Hazard Mitigation

Another important question that should be resolved regarding flooding and floodplains is whether the hazards posed by floods or flood velocities are significant to the long-term performance of the disposal site. As discussed above, the determination of a floodplain location (using FEMA guidelines, for example) is

principally dependent on the degree of inundation and the risks associated with flooding. However, the staff considers that there may be many proposed disposal sites which may meet the depth and velocity guidelines, but may be significantly inundated if a large flood (e.g., greater than the 100-year flood) occurs. This factor should be considered in selecting a waste disposal site.

The staff considers that the major risks associated with flooding would not be produced by a 100-year flood. The purpose of providing siting criteria for broad screening of sites is to avoid, if possible, disposal sites that would be inundated or significantly affected by "smaller" floods such as the 100-year flood. It is expected that LLW sites will be designed and protected from the effects of much larger floods; such design floods may be as large as the PMF.

Therefore, another important decision regarding site acceptability is related to the extent that engineering measures would be needed to mitigate flood hazards. Since it is generally recognized that some protection and enhancement will always be needed against flood runoff, the degree of site enhancement and flood protection may become a very important issue. The staff further considers that the intent of the siting requirements is to direct the site selection process towards a site where flood protection is provided to the maximum extent by virtue of the site location. Such a site would be well above flood levels and would be insignificantly affected by major floods. Acceptable sites, while needing some minor drainage enhancements and minimal flood protection, would not rely on extensive engineering measures to provide flood protection, especially after site closure. Sheet flow and minor gully flows at disposal sites located near the upstream portion of a drainage basin (where drainage areas have been minimized) could be easily diverted away from disposal units using very simple, low-cost berms and diversion channels, even if major floods were to occur. Such engineering measures are considered to be acceptable. However, significant flood flows resulting in several feet of inundation (or high velocities) in the waste disposal area, particularly for floods larger than a 100-year flood (including the PMF), may not be easily mitigated. Elaborate and extensive embankments and diversion structures, used to provide the required flood protection, may be unacceptable. Because of the possible degradation and ultimate failure of extensive engineered structures over the long-term, the staff is less confident that the performance objectives of 10 CFR 61 Subpart C can be met if such measures must be relied upon following site closure. The staff concludes that the bulk of the erosion protection should be provided by the disposal site's natural location and elevation. Given the obvious fact that many sites exist which do not require significant flood protection measures, the staff concludes that such sites are preferable and that low-lying, flood-prone, and poorly-drained sites should be rejected, whenever practicable.

The burden of proof is placed on the applicant to justify that the flood protection measures that will be employed are not extensive or elaborate. Applicants will be expected to demonstrate that flood protection designs are reasonable enhancements to the disposal site's capability to isolate the waste in accordance with the performance objectives of Subpart C of 10 CFR 61. In order to determine the reasonableness of flood protection measures, a comparison with "expected" or "typical" measures, as discussed by the NRC staff (NRC, 1981),

may be used. Another test of the reasonableness of engineering measures is a comparison of the required measures at a proposed disposal site with the designs that would be needed for a well-drained site located near a drainage divide (where only minimal engineering measures, such as small drainage channels and low berms, would be needed).

2.2 Wetlands

In developing the wetland requirements of 10 CFR 61.50, the principal concerns of the staff were to (1) avoid contact of waste with standing water in poorly drained, low-lying, and/or swampy areas, and (2) meet the requirements of all applicable Executive Orders. Of particular concern were large, low-lying areas which would be frequently saturated and difficult to eliminate by normal site grading practices.

However, the staff has become aware that the use of guidance recently developed by Federal agencies (FICWD, 1989; EPA, 1991) for determining wetlands can result in delineation of wetlands which are extremely small (e.g., less than 100 square feet). It is not the staff's intention, under the provisions of 10 CFR 61, to restrict siting where wet soils are located in small isolated areas, such as localized wet areas, surface depressions, or puddles. Waste disposal in these isolated wet areas may be acceptable, if the condition is determined to be unimportant to safety or to meeting the performance objectives. The burden of proof is on the applicant to (1) determine if wetlands exist onsite, (2) demonstrate conclusively that all siting requirements of 10 CFR 61.50 have been met, and (3) determine the significance of the wetland to safety and performance, on a site-specific basis.

2.2.1 Determination of Wetlands

Detailed guidance for wetlands has been developed by the Federal Interagency Committee for Wetland Delineation (FICWD) and was presented in "Federal Manual for Identifying and Delineating Jurisdictional Wetlands," (FICWD, 1989). Revisions to this report were developed in "Proposed Revisions to the Federal Manual for Delineating Wetlands (EPA, 1991). The procedures presented in the interagency report and the subsequent revisions provide detailed guidance for determining wetland areas. These procedures should be followed for wetlands at a proposed LLRW disposal site.

2.2.2 10 CFR 61 Requirements Related to Wetlands

The staff considers that the requirements of 10 CFR 61.50(a)(5) were developed to avoid sites with poor drainage and especially to avoid any sites with drainage so poor that wetland areas exist. The staff further recognizes that wetlands located in the buffer zone are likely to be less important to safety and performance than those located in the immediate waste disposal area, since the main thrust of the requirements is to avoid contact of water and waste.

2.2.2.1 Buffer Zone

Similar to floodplains, the staff concludes that certain portions of the site, such as small portions of the buffer zone, may be located in a wetland area if a permit is obtained from the appropriate permitting agency and all of the other siting requirements of 10 CFR 61 are met. It should be emphasized that the wetlands siting requirement and the other siting requirements must be analyzed collectively. For example, a wetland area onsite, even though small in areal extent, may be indicative of high groundwater levels or indicative of poorly-drained areas; thus, it may be difficult to show that the depth to groundwater requirement of 10 CFR 61.50(a)(7) and the well-drained requirement of 10 CFR 61.50(a)(5) have been met. Additional information is presented in Section 2.2.3, below, regarding all of the other requirements which must be met.

2.2.2.2 Area of Waste Emplacement

As discussed above, the staff concludes that the immediate waste disposal area may not be located in a wetland area. An exemption from the regulations will be required if such actions are proposed.

2.2.3 Significance of Wetlands

Similar to floodplains, an important decision regarding site acceptability is related to the extent that engineering measures are needed to mitigate drainage, ponding, and wetland problems. While some site grading will always be performed to enhance site drainage, the degree of site enhancement and drainage improvement may become an important issue. The staff further considers that the intent of the siting requirements is to direct the site selection process towards a site where the site itself is well-drained and free of areas of significant ponding. Acceptable sites, while needing some minor drainage enhancements, would not rely on extensive engineering measures to prevent the reoccurrence of drainage problems, especially after site closure when active maintenance cannot be relied upon. Elaborate systems to mitigate drainage problems (such as gravel drains, pumpback systems, re-channelization, and diversion structures) are considered by the staff to be generally unacceptable. Because of the possible degradation and ultimate failure of extensive engineered structures over the long-term (greater than 100 years), the staff is less confident that the performance objectives of 10 CFR 61 Subpart C can be met if such measures are relied upon following site closure. The staff concludes that adequate drainage should be provided by the disposal site's natural slopes, location, and elevation. Given the obvious fact that many sites exist which do not require significant drainage enhancement measures, the staff concludes that such sites should be preferentially selected and that low-lying, poorly-drained sites should be rejected.

The staff recognizes that certain designated wetlands of limited areal extent may be easily remediated and eliminated as a problem. If the engineering measures needed to eliminate drainage problems at a site are very minor, such as regrading in a small area, and a wetlands permit can be obtained, the staff would likely conclude that portions of the site may be located in this small area. However, if there is a potential for re-formation of the wetland or for high groundwater levels to occur, the disposal site would not be considered to be acceptable,

since reliance must be placed on active maintenance and/or monitoring of the wetland condition. This may be particularly important for the buffer zone, for example, where an area is set aside for observation and possible mitigation of problems, which could be complicated by wetlands, poor drainage, or high groundwater tables. In such instances, it may be difficult for an applicant to justify that all siting requirements have been met.

Further, the staff considers that if a permit can be obtained from the responsible governmental agency to eliminate designated wetland areas, the environmental intent of the regulation has also been met. The environmental intent of the siting regulation is to comply with the requirements of E.O. 11988 and E. O. 11990, and the staff considers that intent to be adequately satisfied by complying with applicable requirements of those orders, as related to wetlands.

When very small areas of designated wetlands exist prior to construction and are proposed for permanent removal, the process for reviewing applicant's information, data, and analyses that demonstrate compliance with the siting regulations will be very site-specific. However, the staff will request additional information and will generally review this supporting information to determine compliance with other requirements, as follows:

1. Compliance with Applicable Environmental Requirements. The applicant should verify that all necessary permits have been obtained from the Corps of Engineers or other appropriate permitting agency. Such permits authorize elimination of the wetland areas.

2. Compliance with 10 CFR 61.50(a)(5). The applicant should verify that there is no mechanism by which the wetlands and areas of poor drainage could recur. Site grading alone (minor cuts and fills) should be the only measures taken to eliminate the wetland and prevent recurrence.

3. Compliance with 10 CFR 61.44. The applicant should verify that active maintenance is not needed to prevent recurrence of the wetlands. Measures such as pumping and gravel drains are not acceptable. The applicant should demonstrate that the placement of additional fills at a later date will not be needed, due to any special or unique site configurations.

4. Compliance with 10 CFR 61.50(a)(7-8). The applicant should verify that sufficient depth to groundwater exists, prior to placement of engineered fills; that there is no hydrogeologic mechanism which is producing or exacerbating the wetland situation; and that there is no discharge of groundwater onto the surface of the site.

5. Compliance with 10 CFR 61.50(a)(10). The applicant should verify that the occurrence of the wetland areas is not a result of surface slumping, subsidence, flooding/erosion, or other phenomena which could result in significant changes to the site following closure. Karst topography, for example, would not be acceptable, since future

subsidence could potentially create wetland areas. It would also be unacceptable to locate a site in a relatively level area just outside the 100-year floodplain, if it is determined that flooding/erosion/subsidence originally caused the ponding and drainage problem. Also, a flood larger than the 100-year flood could result in flooding and erosion of the site area, causing reoccurrence of ponding and wetland problems.

6. Compliance with 10 CFR 61.52(a)(8) and 61.53. The applicant should verify that any wetlands on or near the site will have no adverse effects on the ability to carry out an adequate monitoring program or to take corrective actions, if needed.

3 RECOMMENDATIONS

3.1 Floodplains

Based on staff review of applicable criteria and implementation guidance, the following procedures should be followed to determine if a site meets the requirements of 10 CFR 61.50(a) and E.O. 11988, with respect to flooding and other related siting factors.

1. The license applicant should consult published floodplain maps (such as those developed by HUD or FEMA). If the area of waste emplacement is located in the floodplain, it is not acceptable, in accordance with 10 CFR 61.50(a)(5). If other portions of the disposal site (e.g., small portions of the buffer zone) are located in the mapped floodplain, it may or may not be acceptable; justification for use of floodplain lands, and evaluation of alternatives, should be provided in accordance with E.O. 11988 and USWRC guidelines. The evaluation is a rather complex one and includes the following steps:

1. Determination of floodplain(s)

2. Early public review of proposed action

3. Identification and evaluation of alternatives

4. Identification of impacts

5. Determination of methods to minimize, restore, and preserve floodplains

6. Reevaluation of alternatives

7. Publication of findings

8. Implementation of proposed action.

If the disposal site is not located in a designated floodplain, the initial screening test has been met. However, if well-defined streams or dry stream channels exist nearby, the disposal site will need to be evaluated, since HUD or

FEMA maps may not be sufficiently detailed to adequately define floodplains in the proposed site area.

2. The applicant should conduct detailed site-specific flooding analyses to verify that the immediate area of waste emplacement is not located in 100-year floodplain or a flood-prone area. If other portions of a disposal site are proposed in the 100-year floodplain, the disposal site is acceptable only if the applicant can demonstrate that all requirements of E. O. 11988 have been met. The justification should follow the USWRC guidelines related to evaluation of alternatives and justification of the proposed action. If the disposal site is located in a flood-prone area, it may not be acceptable; the final determination of acceptability is based on the applicant's justification that engineering measures to be used are reasonable enhancements to the disposal site's natural capabilities to provide adequate flood protection. If a disposal site is located adjacent to a stream with a drainage area of less than one square mile (even though it may be technically out of the FEMA 100-year floodplain), analyses should be performed to show that the disposal site will not be frequently flooded by floods from this stream.

3. The applicant should evaluate the disposal site with respect to the other criteria contained in 10 CFR 61.50 related to minimizing upstream drainage areas, avoiding areas of erosion/deposition, and avoiding the contact of waste with flood-induced groundwater levels. The applicant should also demonstrate that site flooding problems and other related phenomena will be easily mitigated by minor engineering modifications and that flood flows reaching the disposal site from upstream drainage areas are minor and can be easily diverted. The applicant should also demonstrate that active site processes (such as erosion, deposition, etc.) will not affect the long-term performance of engineered design features and will not invalidate the use of predictive performance models.

3.2 Wetlands

The staff concludes that the waste emplacement area or disposal units may not be located in an area designated as a wetland, as required by 10 CFR 61.50(a)(5). However, if a wetland permit can be obtained and all other siting requirements are met, other portions of the disposal site (such as small portions of the buffer zone) may be located in a wetland area. If portions of the disposal site are located in an area determined to be a wetland, the applicant should demonstrate that the areal extent of the wetland is small, that engineering measures needed to alleviate and/or eliminate the wetland situation are of limited extent, and that long-term maintenance is not required to prevent reoccurrence of the wetland condition. Since wetlands may be indicative of high groundwater levels and/or poor drainage, justification should also be provided that all of the other siting requirements and requirements of the Executive Order have been met. These requirements include those listed in 2.2.3 of this Appendix.

4 REFERENCES

Essential

Environmental Protection Agency, "Proposed Revisions to the Federal Manual for Delineating Wetlands," 56 FR 40446, August 14, 1991.

Executive Order 11988, "Floodplain Management," 42 FR 26951, May 24, 1977.

Executive Order 11990, "Protection of Wetlands," 42 FR 26961, May 24, 1977.

Federal Emergency Management Agency (FEMA), "Flood Insurance Study, Guidelines and Specifications for Study Contractors," September, 1985.

Federal Interagency Committee for Wetland Delineation (FICWD), 1989, "Federal Manual for Identifying and Delineating Jurisdictional Wetlands," U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, D.C. Cooperative technical publication.

Rhoads, Bruce L., Flood Hazard Assessments for Land-Use Planning near Desert Mountains," Environmental Management, Vol. 10, No. 1, 1986.

U. S. Nuclear Regulatory Commission (USNRC), "Draft Environmental Impact Statement on 10 CFR Part 61, Licensing Requirements for Land Disposal of Radioactive Waste," September, 1981.

---"Site Suitability, Selection, and Characterization," NUREG-0902, 1982, reprinted 1986.

U. S. Water Resources Council (USWRC), "Floodplain Management Guidelines," 43 FR 6030, February 10, 1978.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.4.2
GROUNDWATER CHARACTERIZATION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrogeologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the areas of the SAR given in Sections 2.1 through 2.4 of this SRP as they relate to the description and characterization of the saturated and unsaturated flow regime and the methodology used for collecting these data. Moreover, the review will cover the strategy, rationale, and results of the numerical analysis used to characterize both the saturated and unsaturated zone.

The findings and conclusions pertaining to the numerical simulation of the saturated zone will be used to analyze information and associated data that will be reviewed under SRP 2.7.2, "Water Resources," by the LLTB staff. Specifically, this information includes a description of the input data, initial boundary conditions, and simulated physical processes in the numerical model. Findings pertaining to the physical characteristics of the unsaturated zone will also be used to substantiate the conclusions reached by the LLTB staff under SRP 6.1.2, "Infiltration," and under SRP 6.1.5.1, "Transfer Mechanism - Groundwater." Specifically, this information includes the temporal and spatial distribution of recharge and the volume of water that reaches the saturated zone.

2.1 Characterization of the Saturated Zone

Aspects of the site characterization of the saturated zone reviewed include the following:

(1) the protocol used in measurement and sampling, the applicant's quality control program adequate to meet the requirements of 10 CFR 61.12(j), the rationale for choosing the particular sample locations and frequency, the equipment used for measurements, and the construction specifications for monitor wells

(2) the procedures used to analyze field and laboratory data

(3) the description of all potentially affected aquifer systems, the spatial and stratigraphic distribution of hydrologic parameters, and the lateral extent and thicknesses of all saturated strata adequate to meet the requirements of 10 CFR 61.12(a)

(4) the applicant's proposed conceptual model, including recharge and discharge zones, assessments of the lateral and stratigraphic extent of major aquifer systems, interactions (communication) between these aquifers, and the model's adequacy with respect to reaching conclusions relevant to the applicable siting guidelines of 10 CFR 61.50(a)(2), (7), and (8).

2.2 Characterization of the Unsaturated Zone

Aspects of the site characterization of the unsaturated zone reviewed include the following:

(1) the protocol used in measurement and sampling, the applicant's quality control program adequate to meet the requirements of 10 CFR 61.12(j), the rationale for choosing the particular sample locations and frequency, and the equipment used for measurements

(2) the procedures used to analyze field and laboratory data

(3) the description of all potentially affected unsaturated zones and the spatial and stratigraphic distribution of hydrologic parameters, including the characteristic curves and infiltration rates, so that the requirements of 10 CFR 61.12(a) are met

(4) the applicant's proposed conceptual model, including fluctuations in soil moisture, characteristic curves of the porous media both laterally and stratigraphically, infiltration and percolation rates, overall movement of the fluid in the unsaturated zone, and the model's adequacy with respect to reaching conclusions relevant to the applicable siting guidelines of 10 CFR 61.50(a)(2), (7), and (8)

2.3 Numerical Analysis of the Saturated Zone

Aspects of the numerical analysis of the saturated zone reviewed include the following:

(1) the methodology, rationale, and bases for the development of the numerical model, including documentation of the model type, verification, calibration, and other associated information

(2) the input data used in the model, including data recorded from field and laboratory measurements and analyses, data generated using geostatistical or other data-generation techniques, data from outside sources, and any modifications to field data

(3) demonstration that the results of the model adequately represent, to the extent practicable, the physical system

(4) the results of modeling, including simulated head distributions, velocity distributions, and groundwater flow directions for all potentially affected aquifers adequate to reach conclusions relevant to the applicable parts of 10 CFR 61.50(a)(2), (7), and (8).

2.4 Numerical Analysis of the Unsaturated Zone

Aspects of the numerical analysis of the saturated zone reviewed include the following:

(1) the methodology, rationale, and bases for the use of an analytical model, or, if necessary, a numerical model, including the model type, documentation, verification, calibration, and other associated information

(2) the input data used in the model, any data generation or reduction requirements, data from outside sources, and any modifications to field or laboratory data

(3) simulation results, including direction of water movement, amount of infiltrated water, spatial and temporal distribution of deep percolation to the saturated zone, and zone of anomalously high or low infiltration

(4) demonstration that, to the extent practicable, the results of the model adequately represent the physical system

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on groundwater characterization in the SAR in accordance with NUREG-1199 and this SRP. The staff will address data gaps, discrepancies, and inadequacies using the standard comment process. If the information presented by the applicant is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or an explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending submittal of the additional information.

3.2 Safety Evaluation

3.2.1 Characterization

The staff will confirm the description of the hydrogeology by a site visit and discussions with technical experts and by comparing the applicant's data with that in the relevant scientific literature.

(1) Saturated Zone

The staff will review the information on the saturated zone by evaluating the testing and monitoring program and sample collection procedure. The

staff will evaluate the rationale for choosing particular sampling locations and verify that they are commensurate with the complexity of the saturated zone. The staff will confirm that acceptable procedures were used by the applicant to collect, preserve, and analyze samples. The staff will determine that adequate quality control was used for the collection, preservation, and laboratory analyses of samples. The staff will evaluate the adequacy of non-applicant-constructed monitoring devices used in the characterization (including the characterization of seeps, springs, and private, municipal, or industrial wells in the vicinity of the proposed site).

The staff will evaluate aquifer tests performed by the applicant to ensure that applicable test methods incorporate proper assumptions, analyses, and test procedures. The LLTB staff will assess the accuracy of the transmissivity, storativity, and hydraulic conductivity results derived from testing.

The staff will determine if groundwater will discharge to the surface within the facility (10 CRF 61.50(a)(8)) and if fluctuations in the water table will result in interactions of groundwater with the waste material (10 CRF 61.50(a)(7)). Furthermore, the staff will confirm that the description of major hydrologic parameters, aerial extent of aquifers, recharge-discharge zones, flow rates and directions, and travel times, including seasonal fluctuations and long-term trends.

(2) Unsaturated Zone

The staff will review the applicant's information on the unsaturated zone by evaluating the monitoring program and sample collection procedure. The staff will evaluate the rationale for choosing particular sampling locations and verify that they are commensurate with the complexity of the unsaturated zone.

The staff will confirm that the description of the unsaturated zone incorporates the necessary field and laboratory data, including seasonal fluctuations and long-term trends. The staff will review the applicant's analysis of the likelihood of the development of perched aquifers and perform independent analyses, using accepted methods, to determine the adequacy of the description.

(3) Conceptual Model

The staff will carefully analyze and evaluate the applicant's conceptual model that describes, to the extent practicable, all hydrogeologic processes and features, including the potential for deep percolation, recharge/discharge zones, areas of anomalous physical parameters affecting regional processes, extent of aquifers and confining layers, interactions between aquifers, and movement of groundwater in the saturated and unsaturated zone.

The staff will review this model to determine its defensibility, conservatism, and adequate incorporation of data into a unified conceptual model. Moreover, the staff will verify that the applicant's results

adequately address the pertinent requirements in 10 CFR 61.50(a)(2), (7), and (8).

3.2.2 Numerical Analysis

The staff will evaluate the numerical analyses of groundwater data collected by the applicant for the disposal site and vicinity. This will normally involve analytical or numerical modeling. The staff will verify that the model type chosen for analysis is properly documented, verified, and calibrated and adequately simulates the physical system of the site and vicinity.

The staff's review of the numerical analysis of the saturated zones begins with the modeling strategy used by the applicant. Whether the applicant chooses to perform analytical or numerical techniques, the chosen technique should be explained. The staff will review this modeling strategy and determine whether it is logical and defensible.

The staff will review the adequacy of the model input data generation and reduction techniques. Modifications of input data, required for calibration, will be reviewed to ensure that the new values are realistic and defensible.

Following its review of this information, the staff will determine whether the applicant's conclusions are adequately conservative or realistic so that the applicable requirements of 10 CFR 61.50(a)(2), (7), and (8) are met. However, if the staff considers that the applicant's results are based on inadequate analysis, the staff will communicate its concerns to the applicant. Alternatively, the staff may decide to conduct an independent analysis. If the staff conducts an independent analysis, it will compare the results with those derived by the applicant to determine if the applicant's results are adequately conservative or defensible.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (a), as it relates to the description of the hydrologic features of the disposal site and vicinity

(2) 10 CFR 61.12(j), as it relates to a description of the quality control program for the determination of natural disposal site characteristics

(3) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(2), as it relates to the capability of the disposal site to be monitored characterized, and modeled

(4) 10 CFR 61.50(a)(7), as it relates to a sufficient depth of the water table so that it will not rise into the waste

(5) 10 CFR 61.50(a)(8), as it relates to the onsite discharge of groundwater from the hydrogeologic unit used for disposal

(6) 10 CFR 61.53, "Environmental Monitoring," (a), as it relates to the collection of hydrogeologic information on the disposal site for at least 1 year for those characteristics subject to seasonal variation

4.2 Regulatory Guidance

NUREG-0902, as it relates to characterizing the groundwater flow regime at the disposal site and vicinity, provides information, recommendations, and guidance and in general describes a basis acceptable- to the staff for implementing the requirements of 10 CFR 61. Other useful information is contained in NUREG/CR-2700, NUREG/CR-2917, NUREG/CR-3038, NUREG/CR-3164, and NUREG/CR-4369.

4.3 Regulatory Evaluation Criteria

To adequately evaluate the groundwater characterization section of the SAR, the staff must have at least 1 year of characterization monitoring data for both the saturated and unsaturated zones. Data pertinent to saturated zone evaluation include, but are not limited to, location of all monitor wells (in coordinate system), well drilling and construction information, water quality and water levels, hydrologic test data and results, storativity, transmissivity, and possible surface recharge or discharge features.

Data pertinent to unsaturated zone evaluation include, but are not limited to, sample locations, moisture content measurements, laboratory analyses techniques and results for obtaining the characteristic curves for soil cores, and results of infiltration, percolation, and saturated hydraulic conductivity tests.

Information pertinent to modeling both the saturated and unsaturated zones include, but are not limited to, a description of the conceptual model, equations, and computer code; verification and calibration procedures; descriptions of all data inputs and model outputs; and conclusions pertaining to compliance with relevant sections of 10 CFR 61.50(a)(2), (7), and (8).

To adequately review this section of the SAR, the staff will refer to information supplied in sections of the SAR reviewed under the following SRPs:

(1) SRP 2.2, "Meteorology and Climatology," referring to information on annual precipitation, design-basis rainfall events, and evapotranspiration rates required for the groundwater flow model

(2) SRP 2.3, "Geology and Seismology," referring to the stratigraphy of the affected environment, grain sizes, thicknesses, and regional and local structural features for both aquifers and aquicludes

5. EVALUATION FINDINGS

5.1 Introduction

As part of the review, the staff will document its conclusions and the basis for the conclusions in a Safety Evaluation Report. This report will also contain a description of the site hydrogeology (as background for the reader and justification for the conclusions reached). This report will also contain a description of any model used by the staff to conduct an independent analysis

along with the results and conclusions reached from it. If the groundwater characterization satisfies the review procedures and acceptance criteria specified in Sections 3 and 4 of this SRP, the staff will conclude that the information and description adequately characterize, with reasonable assurance, the hydrogeology of the proposed site and vicinity and indicate this in the Safety Evaluation Report. However, if the staff concludes that the description and characterization are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

5.2 Sample Evaluation Findings

The staff's evaluation must support the following types of concluding statements to be used in its Safety Evaluation Report.

(1) The staff concludes that the quality control program has been adequately described for the collection of hydrogeologic data (10 CFR 61.12(j)).

(2) The staff concludes that the applicant has conducted a preoperational groundwater monitoring program sufficient to provide basic data on the disposal site characteristics (10 CFR 61.53(a)).

(3) The staff concludes that the site is capable of being characterized, modeled, analyzed, and monitored for groundwater flow and transport (10 CFR 61.50(a)(2)).

(4) The staff concludes that the disposal site provides sufficient depth to the water table that groundwater intrusion, perennial or otherwise, into the waste will not occur (10 CFR 61.50(a)(7)).

(5) Alternatively, the staff concludes that when disposal is below the water table, it has been conclusively shown that molecular diffusion is the predominant means of radionuclide movement and the rate of movement results in meeting the performance objectives of Subpart C (10 CFR 61.50(a)(7)).

(6) The staff concludes that waste disposal will not occur in the zone of water table fluctuation (10 CFR 61.50(a)(7)).

(7) The staff concludes that the hydrogeologic unit used for disposal shall not discharge groundwater to the surface within the disposal site (10 CFR 61.50(a)(8)).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection and Characterization," April 1982.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

---, NUREG/CR-2700, "Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, May 1982.

---, NUREG/CR-2917, "Review of Ground-Water Flow and Transport Models in the Unsaturated Zone," C. A. Oster, Battelle Memorial Institute, Pacific Northwest Laboratory, November 1982.

---, NUREG/CR-3038, "Tests for Evaluating Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, December 1982.

---, NUREG/CR-3164, "Subsurface Monitoring Programs at Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, April 1983.

---, NUREG/CR-4369, "Quality Assurance (QA) Plan for Computer Software Supporting the U.S. Nuclear Regulatory Commission's High-Level Waste Management Program," G. F. Wilkinson and G. E. Runkle, Sandia National Laboratories, January 1986.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.5
GEOTECHNICAL CHARACTERISTICS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Geotechnical Engineer

1.2 Secondary - Geohydrologist/Seismologist/Surface Water Hydrologist

1.3 Supporting - Geologist, Hydrologist, and Seismologist

2. AREAS OF REVIEW

The staff will review the geotechnical characteristics and features of the proposed disposal site in accordance with the requirements of 10 CFR 61.12(a) and 10 CFR 61.50(a). The staff will evaluate the information on the disposal site to determine if the site is suitable for a low-level waste disposal facility (LLWDF) and if the LLWDF satisfies the performance objectives of 10 CFR 61, Subpart C. The objectives of the review are to ensure that the (1) geotechnical and geophysical field investigations and laboratory and field testing are adequate; (2) interpretations of the data to develop typical soil and rock layering, typical cross-sections, and design parameters for use in design are reasonable and conservative; and (3) geotechnical characterization of the site meets the guidance and acceptance criteria in this SRP. The staff will review the following items using information in the SAR and information available from other sources: (1) scope and results of the geotechnical and geophysical investigations conducted to characterize the disposal site and proposed borrow areas; (2) scope and results of the field and laboratory tests conducted to determine the engineering properties of various materials at the site and borrow materials; (3) groundwater conditions, including seepage conditions, pertaining to the design of the LLWDF; (4) selection of borrow materials; and (5) interpretation of the site stratigraphy and selection of design parameters based on the data in the SAR.

The staff will review and evaluate the following information in the SAR: geology, seismology, groundwater conditions, and geochemistry. The staff will determine the adequacy of the geologic information cited in support of the applicant's conclusions concerning the geotechnical suitability of the proposed site and the stability of the earth and rock slopes at the site as controlled by mass wasting and erosion phenomena. The staff will also review the seismological and geological investigations carried out to establish the ground motion environment for seismic design of the LLWDF and the procedures and analyses used by the applicant in establishing design-basis seismic events.

The staff will review the groundwater and surface water aspects of the site, information related to annual fluctuation of the groundwater levels, and the adequacy of the flood data provided to assess the erosional environment at the site. The geochemical aspects of the long-term effects of the environment (weather and rain water) on the properties of the soils and rocks at the facility will also be reviewed by the staff.

For those areas of review identified above, the acceptance criteria necessary for the review and their methods of application are contained in SRPs 2.3, 2.4, and 2.6.

The staff will coordinate its safety evaluation of the geotechnical characteristics with other appropriate SRPs, namely, the geotechnical engineering aspects of (1) the description of the disposal facilities and principal design features (SRP 3.1) and principal design criteria (SRP 3.2); (2) site plans, engineering drawings, and construction methods and specifications (SRP 3.3.1); (3) the properties of the borrow materials for backfilling and covering of waste containers (SRP 4.3); (4) the stability considerations for site closure (SRP 5.1.2) and slope stability (SRP 6.3.2); and (5) site characteristics pertinent to long-term settlement/subsidence aspects (SRP 6.3.3).

3. REVIEW PROCEDURES

NRC publications (NUREGs) and other publications that will be used in this review are listed in the reference section of this SRP. In addition to the review of the information provided, site visits are an integral part of the review process.

3.1 Acceptance Review

The staff will review for completeness the information on the geotechnical characteristics of the site in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP both by comparing the applicant's submittal and methods with the regulations and the guides and by checking the applicant's reference to such guides or to proposed alternatives. The staff will verify that the alternatives are either equivalent to or improvements on the methods cited in the referenced regulatory guides. Otherwise, alternatives are likely to be disapproved.

3.2.1 Field Investigations

(1) Geological, Geochemical, and Seismological Investigations

The staff will consider the information for the disposal site and borrow area on these topics in the SAR and the staff's review findings in assessing the following issues:

(a) Have all areas or zones of actual or potential surface or subsurface subsidence, uplift or collapse, deformation, solution cavities or structural weakness, unrelieved stresses in the bedrock, and rocks or soils that may be unstable because of their physical or chemical properties been identified and adequately evaluated?

(b) Does the information on the design-basis seismic event identify the magnitude of the earthquake, the elevation or level at which the design-basis earthquake is defined, the maximum value of the horizontal component of the acceleration, maximum particle velocity, duration of the earthquake, and potential for amplification of ground motion as a result of soil conditions at the site?

The review procedures for the above areas are presented in SRPs 2.3 and 2.6.

(2) Geotechnical and Geophysical Investigations

The staff will review the scope and results of the geotechnical and geophysical investigations at the LLWDF site and the borrow area using Regulatory Guide 1.132 as a general guide and other pertinent references listed at the end of this SRP. Because Regulatory Guide 1.132 was developed for nuclear power plants, it is intended to be used only as a general guide in the site investigations for an LLWDF site. The staff will consider the adequacy of the applicant's information in response to the following questions in its review of field investigations:

(a) Are the exploratory techniques used by the applicant representative of the current accepted engineering practice? Do the samples represent the in situ soil conditions?

(b) Do the investigations provide adequate coverage of the site and borrow areas and in sufficient detail to define the specific subsurface conditions and their physical characteristics with a high degree of confidence?

If the staff finds that the investigations are inappropriate or insufficient to characterize the site with a high degree of confidence, additional investigations will be required. The final conclusion will be based, in part, on professional judgment depending on the complexity of the site subsurface conditions. As a part of its review, the staff will have to ascertain that appropriate equipment and techniques currently used in the geotechnical engineering profession (see Section 7 References) were used in the field investigations for the LLWDF site.

3.2.2 Field and Laboratory Testing and Engineering Properties

The staff will review the scope, methodology, and determination of soil and rock engineering properties from the various field and laboratory tests performed to characterize the site and borrow area. The staff will consider the adequacy of the applicant's information and data in response to the following questions in its review:

(1) Was the sampling program adequate in quantity (numbers) and quality (suitable recovery of disturbed and undisturbed samples, etc.) to ensure

that all materials that are critical for the geotechnical evaluation of the site have been adequately sampled?

(2) Were the investigations (sampling and testing) to determine the properties of various materials underlying the site sufficient? Regulatory Guide 1.138 presents a detailed list of laboratory tests and parameters to be determined in connection with a nuclear power plant. This may be used as a general guide in evaluating the geotechnical testing needed at an LLWDF site, keeping in mind that the scope of investigations should match the design requirements of the facility and complexities of the site.

(3) Were the static and dynamic properties of materials needed for geotechnical analyses and design determined by performing appropriate laboratory and field tests which are conservative and accepted in practice by the geotechnical engineering profession?

The staff will ascertain if the field and laboratory test data have been conservatively interpreted to determine the design parameters recommended for the various materials at the site. The test results should be presented in tabular or graphical form to readily demonstrate the conservativeness of the selected design values.

If the staff finds that the investigations (sampling and testing) are inappropriate or insufficient to establish the design parameters with a high degree of confidence, additional investigations will be required. The final conclusion will be based, in part, on professional judgment depending on the complexity of the subsurface conditions at the site.

3.2.3 Groundwater Conditions

The staff will review the groundwater aspects of the site characterization studies provided in response to SRP 2.4. The staff will evaluate the following items in its review of the geotechnical characterization of the LLWDF site:

(1) location of the groundwater table and the elevation range of seasonal fluctuations in the groundwater level

(2) information on the presence of perched, aquifer, and artesian conditions, groundwater movement, hydraulic conductivity and infiltration characteristics of site and borrow materials, hydraulic gradients, and installation details and monitoring records for piezometers and observation wells

(3) design water level as determined by design-basis hydrologic events such as the probable maximum flood

3.2.4 Borrow Materials

The staff will review the fill borrow material exploration program to determine if an adequate number of borings, probes, test pits, etc., were carried out to establish with reasonable confidence the quantity and type of material available for fill borrow. Results of the tests performed to establish the properties of the borrow material and selection of the recommended design

parameters for the borrow material will be reviewed in order to assess its suitability for its intended use.

3.2.5 Stratigraphy and Design Parameters

The staff will review location plans for completed subsurface investigations, cross-sections, and profiles showing subsurface soil and rock layering at the site and compare them with exploratory records to ascertain that all the data collected, particularly data on zones of soft/loose conditions encountered in the explorations, have been used and that the uncertainties normally associated with the estimation of the thickness and extent of various materials occurring at the site have been conservatively considered in developing the soil and rock layering. The staff will review the soil and rock test data to determine that strength tests have been performed on undisturbed samples and that there are sufficient relevant test data to support the selection of the design parameters. The review will also consider whether soil and rock characteristics derived from the investigations have been completely and conservatively interpreted to develop design parameters. If clearly unconservative soil and rock properties and subsurface stratigraphy have been used, a request will be made for additional data to verify the applicant's recommendations.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (a), which requires a description of the geotechnical characteristics and features of the disposal site and vicinity to help demonstrate that the performance objectives of 10 CFR 61, Subpart C, and the applicable technical requirements of 10 CFR 61, Subpart D, will be met.

(2) 10 CFR 61.13, "Technical Analyses," (a) as it relates to the analyses that must clearly identify and differentiate between the roles performed by the natural disposal site characteristics and design features in isolating and segregating the wastes.

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b),(e), and (f) which require findings that the applicant's proposed disposal site provide protection of the public health and safety and reasonable assurance that the performance objectives in 10 CFR 61, Subpart C, and the applicable technical requirements in Subpart D will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.44 which present the performance objectives of which the geotechnical characteristics of the land disposal facility must contribute toward the achievement

(5) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal, (a)(1), (a)(2), (a)(7) through (a)(10), which lists the site suitability requirements that must be met by a near-surface disposal facility and

which would include the contribution to be made by the geotechnical characteristics

4.2 Regulatory Guidance

There are no regulatory guides that directly apply to the geotechnical engineering aspects for a low-level waste disposal facility. However, the following guides provide recommendations and guidance generally applicable to a geotechnical review of this type, although the required level of detail and the extent of investigation and analyses would vary on a case-by-case basis:

(1) Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," which describes programs of geotechnical engineering site investigations that would normally meet the needs for evaluating the performance of earthworks under anticipated static and dynamic loading conditions and provides general guidance and recommendations for developing site-specific investigation programs as well as specific guidance on conducting subsurface investigations, the spacing and depth of borings, and sampling

(2) Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants," which describes laboratory investigations and testing practices acceptable for determining soil and rock properties and characteristics needed for geotechnical engineering analysis and design

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 2 of this SRP are given in the following sections.

4.3.1 Field Investigations

(1) Geological, Geochemical, and Seismological Investigations

The investigations in these areas should be adequate in scope and technique to provide the following data necessary for the staff's review of the geotechnical characteristics of the site. The section defining geologic features is acceptable if the discussions, geologic maps, profiles of the site stratigraphy, structural geology, geologic history, and engineering geology are complete and are supported by investigations sufficiently detailed to obtain an unambiguous representation of the site geology. The section presenting the geochemical aspects of the site is acceptable if it discusses the geochemical effects of the environment (weather and rain water) on the physical and strength characteristics of the soil and rock at the disposal site (particularly if there is potential for geochemical weathering and leaching of soils and rocks at the disposal site). The section presenting the seismological aspects of the site is acceptable if it includes discussions on the method used to determine the design-basis seismic event. The information on the design-basis seismic event should include the magnitude of the earthquake, the elevation or location at which the design-basis earthquake is defined, the maximum value of the horizontal component of acceleration, maximum velocity,

duration of the earthquake, and the potential for amplification of ground motion caused by the soil conditions at the site.

The staff would refer to SRPs 2.3 and 2.6 for details on the staff's acceptance criteria for information submitted on the above areas of review.

(2) Geotechnical and Geophysical Investigations

A complete field investigation and sampling program should be performed to define the occurrence and properties of the soil and rock materials underlying the proposed site and in borrow areas proposed for an LLWDF. Regulatory Guide 1.132 describes the geotechnical and geophysical investigations required for a nuclear power plant. However, it can be used as a general guide, since the scope of the field investigations depends on the complexity of the LLWDF and subsurface conditions at the site. The scope of the program should be adequate to establish with a high degree of confidence the geotechnical characteristics of the disposal site. The investigation program is acceptable if it includes the following:

(a) plot plan(s) clearly showing the outline of the LLWDF and the locations of all borings, probes, pits, trenches, seismic lines, piezometers, observation wells, and geologic profiles

(b) profiles and an adequate number of cross-sections of the site showing the subsoil and rock layering and illustrating in appropriate detail the relationship of the proposed LLWDF to the subsurface materials

(c) logs of borings, probes, pits, trenches, and geophysical investigations in sufficient detail as described in Regulatory Guide 1.132

4.3.2 Field and Laboratory Testing and Engineering Properties

The applicant should provide a detailed and quantitative discussion of the criteria used to determine that the samples were taken in accordance with Regulatory Guide 1.132 and tested in sufficient number to define all the soil and rock parameters needed for characterizing the site and borrow areas in accordance with the general guidance of Regulatory Guide 1.138.

In keeping with the regulatory positions of Regulatory Guides 1.132 and 1.138, the description of and test results for the properties of materials underlying the site and borrow areas are considered acceptable if the methods and procedures currently accepted in the geotechnical engineering profession are used to determine their engineering properties. Widely accepted index and engineering properties tests for soils are

Soil classification	Freeze-thaw
Water content	Dispersivity
Unit weights	Diffusion characteristics
Void ratio	Permeability (hydraulic conductivity)
Porosity	Consolidation
Saturation	Direct shear test

Atterberg limits	Triaxial compression tests
Specific gravity	Unconfined compression tests
Gradation analysis	Relative density
Compaction	Special tests (cyclic strength, shear
Shrinkage-swelling	modulus, damping, etc.) as required

Acceptable test methods and procedures are described, for example, in the Annual Book of ASTM Standards and special technical publications published by the American Society for Testing and Materials; in Engineering Manual EM 1110-2-1906 published by the U.S. Army Corps of Engineers; in Geotechnique published by the Institution of Civil Engineers; in various research reports prepared by universities such as the University of California, Earthquake Engineering Research Center; and in other publications mentioned in the reference section.

A detailed discussion of field and laboratory sample preparation for testing should be given when applicable. For strength tests conducted in the laboratory, full details should be given; for example, how saturation of the sample was determined and maintained during testing and how the pore pressures changed. For sites that are underlaid by saturated cohesionless soils and sensitive clays, the applicant should show that all zones that could become unstable because of liquefaction or strain-softening phenomena have been sampled and tested to evaluate their liquefaction potential. The applicant should also show that the static and dynamic engineering properties of the soils, such as unconfined compressive strength, shear strength parameters for total and effective stress conditions, dynamic modulus values, and dynamic strength parameters from cyclic triaxial tests, were properly determined and that reasonable and conservative values were used in the design. This demonstration should explain how the developed data were used in design analyses, how the test data were enveloped for design, and why the design envelope is conservative. A table indicating the values of the parameters used in design should be provided and should be supported by field and laboratory test records.

4.3.3 Groundwater Conditions

The acceptance criteria for information on groundwater conditions at the site are given in SRP 2.4. In the review of the geotechnical characteristics of the LLWDF site, the information identified in Section 3.2.3 of this SRP is reviewed for adequacy and acceptability for use as input into the geotechnical engineering evaluation of backfilling of the disposal excavations and for slope stability, settlement/subsidence, and site closure considerations.

4.3.4 Borrow Materials

Information on the proposed fill borrow material is acceptable if it (1) includes a plan showing the limits, grades, and slopes of the area proposed for fill borrow material and the location of borings drilled and test pits dug to determine the quantity and type of material available and (2) shows that the properties of the borrow material are based on adequate testing. The data on the engineering properties of borrow materials should be based on laboratory tests performed on representative samples of borrow material compacted to the same range of density and moisture contents as that to be specified for the construction of the LLWDF.

4.3.5 Stratigraphy and Design Parameters

Information on the stratigraphy of the disposal site is acceptable if it includes plot plans and an adequate number of cross-sections and profiles showing subsurface soil and rock layering at the site in relationship to features of the LLWDF. The cross-sections should show the location of the borings and the data from the boring logs that are used in developing the soil and rock layering. The layering should be developed using all the data collected particularly data on zones of soft/loose conditions encountered in the explorations. The recommended design parameters should be based on a reasonable and conservative interpretation of the soil and rock layering and test data on soil and rock materials encountered at the site. There should be a sufficient number of relevant tests to support the selection of the design parameters. The recommended design parameters may be presented in tabular form and also in graphical form, where appropriate, to demonstrate the conservatism of the recommended design parameters.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the geotechnical characteristics of the [name of facility] low-level waste disposal facility according to Standard Review Plan (SRP) 2.5. The objectives of the review were to ensure that (1) the scope of the geotechnical and geophysical field investigations and laboratory and field testing are adequate; (2) the interpretations of the data to develop typical soil and rock layering, typical cross-sections, and design parameters used in the design are reasonable and conservative; and (3) the geotechnical characterization of the site meets the guidance and acceptance criteria in SRP 2.5.

In its review, the staff determined the following:

(1) The geologic characterization of the site addresses the potential for surface or subsurface subsidence at the site, unrelieved stresses in the bed rock, the instability of rock or soil because of mineralogy, and the history of deposition and erosion of soil deposits.

(2) The design-basis seismic event is adequately defined by parameters such as magnitude, acceleration, velocity, duration, and potential for site amplification.

(3) The geotechnical and geophysical investigations conducted to characterize the site and borrow materials are adequate in scope.

(4) The static and dynamic engineering properties of various materials used in the analysis and design of the facility are based on adequate field and

laboratory testing and a reasonable and conservative interpretation of the test data.

(5) The groundwater conditions such as the position of the groundwater table, the extent of its fluctuation, and the presence of artesian conditions have been defined on the basis of adequate investigation.

(6) The selection of the properties of fill borrow material was based on an adequate exploration and testing program.

(7) Site stratigraphy and design parameters used in the design are a reasonable and conservative interPretation of the data.

The staff concludes that the geotechnical site characterizations in the SAR provide the basic data needed to determine if the disposal facility meets the performance objectives stipulated in the regulations, thereby satisfying the requirements of 10 CFR 61.12(a), 10 CFR 61.13(a), 10 CFR 61.23(b),(c) and (f), 10 CRF 61.41 through 61.44, and 10 CFR 61.50(a)(1), (a)(2), (a)(7), through (a)(10).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

American Society for Testing and Materials, Annual Book of ASTM Standards, Philadelphia, PA, revised annually.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

General

Shannon & Wilson, Inc., and Agbabian-Jacobsen Associates, "Soil Behavior Under Earthquake Loading Conditions - State-of-the-Art Evaluation of Characteristics for Seismic Responses Analyses," U.S. Atomic Energy Commission contract W-7405-eng-26, January 1972.

Terzaghi, K., and R. B. Peck, Soil Mechanics in Engineering Practice, 2nd edition, John Wiley & sons, New York, 1967.

U.S. Army Corps of Engineers, Engineering Manual EM 1110-2-1902, "Engineering and design Stability of Earth and Rock-Fill Dams," Office of the Chief of Engineers, Department of the Army, Washington, DC, November 1970.

---, Engineering Manual EM 1110-2-1906, "Laboratory Soil Testing," Office of the Chief of Engineers, Department of the Army, Washington, DC, November 1970.

---, Engineering Manual EM 1110-2-1907, "Soil Sampling," Office of the Chief of Engineers, Department of the Army, Washington, DC, March 1972.

---, Engineering Manual EM 1110-2-1908, "Instrumentation of Earth and Rockfill Dams," Office of the Chief of Engineers, Department of the Army, Washington, DC, August 1971.

U.S. Department of the Interior, Bureau of Reclamation, Earth Manual, Denver, CO, 1968.

U.S. Department of the Navy, NAVFAC DM 7-1, DM 7-2, and DM 7-3, "Soil Mechanics, Foundations, and Earth Structures," Alexandria, VA, May 1982.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection and Characterization," April 1982.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-2700, "Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, May 1982.

---, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. G. Tucker, U.S. Department of the Army, Army Engineer Waterways Experiment Station, February 1983.

---, NUREG/CR-3356, "Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities," H. V. Johnson, S. J. Spigolon, and R. J. Lutton, U.S. Department of the Army, Army Engineer Waterways Experiment Station, June 1983.

---, Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants."

---, Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants."

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.6
GEOCHEMICAL CHARACTERISTICS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Geochemist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information on geochemical characteristics in the SAR to determine if it is adequate to support the applicant's conclusions on the suitability of the proposed low-level waste disposal facility.

In addition to characterizing the natural site, geochemical information will be used to evaluate other parts of the SAR under the following SRPs: "Determination of Types, Kinds and Quantities of Waste," (SRP 6.1.1), "Radionuclide Transfer to Human Access Location" (SRP 6.1.5), "Intruder Protection" (SRP 6.2), and "Long-Term Stability" (SRP 6.3).

The staff will review the areas of the SAR discussed in the following sections as they relate to the geochemical characteristics of the site.

2.1 Water Chemistry

The staff will review the background water chemistry information for groundwater and surface water systems that may be affected by site construction, waste disposal, and local precipitation, including the sampling, preservation, storage, and analytical procedures and the quality assurance and quality control procedures used during sampling, preservation, storage, and analysis.

2.2 Geochemistry of Soils and Rock Units

The staff will review the information on the classification, mineralogical identification, and chemical characterization of the soils and rock units, including the sampling, preservation, storage, analytical, and experimental procedures and the quality assurance and quality control procedures used during sampling, preservation, storage, analysis, and experimentation. Information obtained from solubility, ion exchange, and sorption experiments will also be reviewed.

2.3 Geochemical Modeling

The staff will review the development of conceptual models for site geochemistry and the selection and capabilities of codes used to develop these conceptual models. Validation exercises, data bases used in codes, input and output data, and interpretation of results will also be reviewed.

3. REVIEW PROCEDURES

NRC and other publications that will be needed in this review are listed in the reference section of this SRP. In addition to the review of the information provided by the applicant in the SAR, site visits are an integral part of the review process.

The staff will obtain and use such information as is necessary to ensure that the review procedure is complete. The staff will use and emphasize material from this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on geochemistry in the SAR in accordance with, but not limited to, NUREG-1199 and this SRP. The review can be completed if the SAR contains sufficient information to allow the staff to make an independent assessment of the applicant's assumptions, analyses, and conclusions; that is, the staff should be led in a logical manner from the data and premises in the SAR to the conclusions that are made, without having to make an extensive, independent literature search and/or perform numerous calculations.

Inadequate information will result in a recommendation that the application be rejected.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations and technical positions referenced in this SRP by comparing the applicant's submittal and methods with the regulations and technical positions and by checking the applicant's references to such positions or to proposed alternatives. The staff will verify that the alternatives are equivalent to or improvements on the

methods cited in the referenced technical positions. Otherwise, alternatives are likely to be disapproved. To aid in evaluating the information in the SAR, the staff will consider information obtained from (1) discussions with individuals knowledgeable about the geochemistry of the site and region, (2) a review of the technical literature, and (3) a site visit, if deemed necessary.

3.2.1 Water Chemistry

The staff will (1) compare the applicant's sampling, preservation, storage, and analytical procedures and the quality assurance and quality control procedures followed during sampling, preservation, storage, and analysis with those in established procedural manuals; (2) ensure that analytical detection levels are adequate and that temperature, pH, Eh, and dissolved oxygen were measured in situ; (3) determine that the applicant has analyzed for an adequate suite of inorganic and organic constituents, dissolved gases, and stable isotopes, as recommended in NUREG-0902; and (4) determine that sampling has occurred at least quarterly for a minimum period of 1 year.

3.2.2 Geochemistry of Soils and Rock Units

The staff will (1) compare the applicant's sampling, preservation, storage, analytical, and experimental procedures and the quality assurance and quality control procedures followed during sampling, preservation, storage, analysis, and experimentation with those in established procedural manuals; (2) determine that all minerals, amorphous solids, mineral coatings, and organic compounds that will influence the concentrations of important elements and contaminants in the waters or affect site stability have been characterized in sufficient detail so that experimentation and modeling can be performed with confidence; and (3) determine that the solubility, ion exchange, and sorption experimental programs have provided an adequate understanding of processes affecting contaminant migration and rock and soil chemical stability and that experimental conditions are appropriate for expected site conditions, as outlined in NUREG-0902 and the NRC technical positions on solubility and sorption determination. The technical positions, although written for high-level waste disposal applications, are applicable to low-level waste disposal.

3.2.3 Geochemical Modeling

The staff will (1) determine that the conceptual models and computer codes used to support site characterization are used appropriately by reviewing documentation for the models and codes and examining published cases in which the codes were used; (2) compare data bases used in codes (e.g., thermodynamic constants for aqueous complexation, mineral solubility, and gas solubility reactions and binding constants or distribution coefficients for sorption models) with established and up-to-date data compilations to ensure acceptable quality and completeness; (3) determine that the input data are consistent and complete with respect to data gathered during site characterization and related laboratory and field experiments; (4) determine that the interpretation of results is consistent

with the data; and (5) ensure that verification and validation of the codes are sufficient as defined in NUREG-0856. The staff will independently model parts of the system if it is determined that such validation is needed.

3.3 Request for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (a), as it relates to a description of the natural disposal site characteristics

(2) 10 CFR 61.13, "Technical Analyses," (a), as it relates to the analysis of pathways to demonstrate protection of the general population from releases of radioactivity

(3) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity," as it relates to the concentrations of radioactive material that may be released to the general environment

(4) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," as it relates to disposal site suitability for near-surface disposal

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the following documents:

(1) "Determination of Radionuclide Solubility in Groundwater for Assessment of High-Level Radioactive Waste Isolation" and "Determination of Radionuclide Sorption for Assessment of High-Level Waste Isolation," which provide guidance on the experimental determination of solubility and sorption; although written for high-level waste isolation applications, the guidance is also appropriate for low-level waste isolation applications

(2) NUREG-0856, "Final Technical Position of Documentation of Computer Codes for High-Level Waste Management," which describes the methods acceptable to the staff for documentation of computer codes used in analyses

(3) NUREG-0902, "Site Suitability, Selection and Characterization," which provides information, recommendations, and guidance and in general

describes a means acceptable to the staff for meeting 10 CFR 61.12(a) and 10 CFR 61.50

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 3.2 of this SRP are given in the following sections.

4.3.1 Water Chemistry

The information on water chemistry is acceptable if discussions of the water chemistry data are complete, compare well with studies conducted by others in the same area, and are supported by detailed investigations performed by the applicant. Procedures for sampling, preservation, and storage and analytical techniques and their associated detection limits should be acceptable to the technical community. Adequate quality assurance and quality control procedures, such as split, spiked, standard, and blank samples and ion balance calculations, should be performed. Data should be collected at least quarterly for a minimum of 1 year to determine seasonal variations. Data interpretations should be reasonable and consistent with geological, chemical, and hydrological data.

4.3.2 Geochemistry of Soils and Rock Units

The information on the geochemistry of soils and rock units is acceptable if discussions of the classification, mineralogical identification, and chemical characterization and chemical stability of the soils and rock units are complete, compare well with studies conducted by others in the same area, and are supported by detailed investigations performed by the applicant. The sampling, preservation, storage, analytical, and experimental techniques should be acceptable to the technical community, and adequate quality assurance and quality control procedures should be performed. Solubility, ion exchange, and sorption experiments should be carried out by methods such as those suggested in NUREG-0902 and should represent a range of chemical and physical conditions in order to bound the results. Presentation of the experimental results should include a discussion of uncertainties and limitations of the procedures. Data interpretations should be reasonable and consistent with geological, chemical, and hydrological data.

4.3.3 Geochemical Modeling

The information on geochemical modeling is acceptable if the discussions of geochemical modeling are complete and consistent with the detailed investigations performed by the applicant. The conceptual chemical models used should be designed to adequately represent the system being studied, and codes used to make predictions based on the conceptual chemical models should be properly verified and validated as defined in NUREG-0856. Any data used in the codes but not collected by the applicant should be consistent with established and up-to-date data compilations. Input data and interpretations of the results should be

consistent with data collected in field and/or laboratory investigations. The applicant should not draw conclusions based on modeling results that exceed the capabilities of the models and codes, and there should be a discussion of model and code uncertainties and limitations.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the geochemical studies submitted by the applicant for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.6. The staff considered in its review information obtained from (1) data gathered from onsite and near-site borings and water wells and from laboratory and field experiments, (2) discussions with individuals knowledgeable about the geochemistry of the site and region, (3) a review of the technical literature, and (4) the prelicensing monitoring program. Geochemical data are required for the characterization of the site (10 CFR 61.12(a) and 10 CFR 61.50) and as input into technical analyses (10 CFR 61.13(a)) to demonstrate protection of the public from radiation (10 CFR 61.41). The basis for the staff's acceptance of the geochemical studies is that, on the basis of the information collected, the public will be protected from releases of radioactivity. The collection and presentation of the data are consistent with the recommendations in NUREG-0902, "Site Suitability, Selection and Characterization."

The fundamental geochemical concerns addressed in this review to confirm the geochemical aspects of site adequacy are (1) chemical composition of groundwater, surface water, and precipitation as it would influence the concentrations of contaminants in the waters and site stability and (2) the ability of the rocks and soils at the site to prevent significant contaminant migration and contribute to site stability.

The applicant has provided information on water chemistry in support of site characterization. The information suggests that the current chemistry of ground and surface waters and any anticipated changes in the chemistry of these waters after emplacement of the proposed shallow land burial site will not increase (or have a detrimental effect on) the dissolved concentrations of radionuclides relative to the maximum concentration limits for radionuclides in the environment as prescribed by NRC guidelines or be detrimental to site stability. [Describe information on groundwater and surface water chemistry.]

The applicant has proR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The material to be reviewed is informational in nature, and no detailed technical analysis is required. The staff will generally cross check the principal review matters with pertinent discussions in other portions of the SAR to determine if the applicant has dealt with the issue in a rigorous manner. Matters of a highly technical nature will be referred to the appropriate technical reviewer to be reviewed in accordance with the applicable SRP. Matters of a more subjective nature will be verified by independent communication with the party(ies) identified by the applicant as the source of the issue. The staff will reserve the right to modify the list of principal review matters on the basis of its detailed review of the entire SAR.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

There are no regulations that apply to this SRP.

4.2 Regulatory Guidance

There are no regulatory guides that apply to this SRP.

4.3 Regulatory Evaluation Criteria

The applicant's discussion of principal review matters should be as frank and comprehensive as is feasible at the time the application is submitted. It should contain (1) documented or documentable evidence of the applicant's efforts to identify major licensing issues during the application preparation process and (2) objective assessments of technical matters based on analyses. It should contain documentation of interactions with government bodies, technical experts, public interest groups, environmental groups, and affected tribes and summaries of their positions on review matters as identified in the application development process.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the applicant's summary of principal review matters for [name of facility] low-level waste disposal facility according to Standard Review Plan 1.7.

On the basis of the information available to the applicant at the time the SAR was submitted, the applicant has adequately identified and presented resolutions of the principal review matters. The applicant has documented its conclusions and provided information sufficient for regulatory bodies to make informed decisions about these matters.

In its review, the staff has identified the following principal review matters not so identified by the applicant [supply].

On the basis of the information available to the applicant at the time of the initial application, the applicant would have been unable to identify these principal review matters.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCE

Essential

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.7
NATURAL RESOURCES

This SRP Consists of the following:

SRP 2.7.1 Geologic Resources
SRP 2.7.2 Water Resources

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.7.1
GEOLOGIC RESOURCES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Geologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the SAR to establish that known geologic resources in the site area and region have been identified and that future exploitation of such resources will not result in a failure to meet the performance objectives of Subpart C, 10 CFR 61.

The staff will review the known geologic resources at a proposed low-level waste disposal site separately from other types of natural resources. The review, however, should be coordinated with the review that will be conducted by the staff under SRP 2.7.2, "Water Resources." Definitions and examples of known resources are cited in NUREG-1199.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will first conduct an acceptance review to determine if the applicant has presented the information requested in NUREG-1199 and this SRP. This acceptance review is intended to take about two staff days. The staff will then consider whether the applicant has assessed the potential failure of the disposal facility's performance objectives resulting from resource exploitation and if that assessment is complete.

An application can be accepted, and the review can proceed, if the SAR contains the information requested in NUREG-1199 and if the staff can make an independent

assessment of the information. Information that is inadequate or poorly presented will result in a staff recommendation that the application be rejected or in requests for amendments or additions, thus delaying acceptance of the application.

3.2 Safety Evaluations

After an application for a site is judged acceptable for review, the application will be docketed and the review will be conducted. Primary concerns about the presence of known geologic resources are the likelihood of inadvertent intrusion and the effects of resource development on the ability of the site to meet the performance objectives after the period of active institutional control. The review will be conducted according to the following plan:

(1) The staff will determine if the applicant has identified known resources through information sources suggested in NUREG-1199. All information on geologic resources should be in general agreement with geologic, hydrologic, and geochemical site characterizations (sections of the SAR reviewed under SRPs 2.3, 2.4, and 2.6). Each resource identified should be described in terms of its geologic occurrence.

(2) The staff will verify that the SAR presents estimates of economic, marginally economic, and subeconomic known resources as defined in U.S. Geological Survey Circular 831. On the basis of these data, the staff will independently evaluate potential future exploitation considering market values and current and projected demand for the resource in question.

(3) On the basis of the resources identified, the staff will examine the potential for site disruption resulting from exploration and exploitation techniques including, but not limited to, augering, drilling, shaft mining, strip mining, bulldozing and other excavation, quarrying, borehole injection and pumping, uprooting of vegetation, blasting, stream diversion, and dam construction. These techniques are considered for the possibility of direct site intrusion as well as indirect effects such as alternation of groundwater tables or increase in erosion.

(4) The staff will utilize literature sources similar to those suggested in NUREG-1199 as well as site visits.

(5) The review will ensure that resource data are accurate and conservative regarding the present and future use of the resources.

(6) The staff will analyze the applicant's prediction of the potential for failure of the performance objectives of the facility resulting from the exploitation of geologic resources.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant modify its submittal to meet the acceptance criteria in Section 4 of this SRP or supply additional information to clarify certain issues.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (h), which requires identification of the known natural resources at the disposal site, the exploitation of which could result in inadvertent intrusion into the low-level wastes after removal of active institutional control

(2) 10 CFR 61.23, "Standards for Issuance of a License," (c), which requires that the applicant's proposed disposal site,...disposal site closure, and postclosure institutional control are adequate to protect the public health and safety in that they will provide reasonable assurance that individual inadvertent intruders are protected in accordance with the performance objective in 10 CFR 61.42

(3) 10 CFR 61, Subpart C, "Performance Objectives," particularly

  (a) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity"

  (b) 10 CFR 61.42, "Protection of Individuals From Inadvertent Intrusion"

  (c) 10 CFR 61.44, "Stability of the Disposal Site After Closure"

(4) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(4), which requires that areas be avoided having known natural resources which, if exploited, would result in failure to meet the performance objectives of Subpart C, 10 CFR 61

(5) Resource recovery must not affect, directly or indirectly, the disposal site and result in failure to meet various technical requirements of Subpart D, 10 CFR 61, including but not restricted to

  (a) 10 CFR 61.52, "Land Disposal Facility Operations and Disposal Site Closure," (a)(7), as it relates to maintenance of boundary and land survey markers

  (b) 10 CFR 61.52(a)(8), as it relates to maintenance of a buffer zone around and beneath the waste

  (c) 10 CFR 61.53, "Environmental Monitoring," (d), as it relates to maintenance of a postclosure environmental monitoring system

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the following documents:

(1) NUREG-0902, "Site Suitability, Selection and Characterization"

(2) NUREG/CR-2700, "Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste"

(3) NUREG/CR-3038, "Tests for Evaluating Sites for Disposal of Low-Level Radioactive Waste"

4.3 Regulatory Evaluation Criteria

The applicant must identify all known geologic resources and their types, location, and extent as requested in NUREG-1199, to satisfy 10 CFR 61.12(h).

Pursuant to 10 CRF 61.50(a)(4), the applicant must also analayze the potential for resource exploitation. The applicant should base the analysis on market values and current and projected demand for the resources in question. Together with this analysis, the location of the resources, and the methods of extraction, the applicant must provide reasonable assurance that the performance objectives of 10 CFR Part 61 will be met for the proposed facility.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

The staff should report in a Safety Evaluation Report (SER) its findings and discuss the extent to which the acceptance criteria of the SRP have been met and the reasons for the acceptance or rejection of the application when an acceptance criterion has not been met. The SET should contain a description of the review and include topics such as (1) aspects of the review that were emphasized, modified by the applicant, require additional information, will be resolved in the future, or remain unresolved; (2) aspects of the applicant's programs that deviate from the criteria in the SRP; and (3) basis for any deviations from the SRP or exemptions from regulations.

5.2 Sample Evaluation Findings

Geologic resource data are likely to be very site specific for a proposed low-

level waste disposal facility. Therefore, the staff's findings should be resource specific, taking into account different types of resources and the potential for different types of effects on the performance objectives of the proposed facility. For example, the staff may find that exploitation of one particular resource does not create a concern regarding 10 CFR 61 performance objectives, and find that exploitation of another resource does threaten the performance objectives of the proposed facility.

The staff's review, for example, must support the following types of concluding statements:

(1) The staff concludes that the identification of known geologic resources in the SAR for a low-level waste facility license is adequate and appropriate. The applicant has shown, and the staff agrees, that no known geologic resources occur in the proposed disposal area or region and attempts at future resource exploitation are unlikely.

(2) The staff concludes that the applicant has correctly and adequately identified known occurrences of hydrocarbon reserves near the proposed waste disposal facility. The applicant has shown that the reserves are at a location and depth so that future exploitation of those reserves is unlikely to result in the failure of the proposed facility's performance objectives, under 10 CFR 61.

or

(3) The staff concludes that the applicant has correctly and adequately identified abundant gravel deposits in the region of the proposed waste disposal facility. The applicant has shown through conservative estimates that present and future exploitation of the resources is unlikely to result in any direct or indirect effect on the proposed waste disposal facility. Therefore, the consequences of future exploitation of the gravel are unlikely to include failure of the facility's performance objectives.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

The staff will use the method described unless an applicant proposes an acceptable alternative method for complying with the Commission's regulations.

7. REFERENCES

ESSENTIAL

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Geological Survey and U.S. Bureau of Mines, Circular 831, "Principles of a Resource/Reserve Classification for Minerals," Washington, DC, 1980.

U.S. Nuclear Regulatory Commission, NUREG-0902, "Site Suitability, Selection and Characterization," April 1982.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-2700, "Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, May 1982.

---, NUREG/CR-3038, "Tests for Evaluating Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, December 1982.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.7.2
WATER RESOURCES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the areas of the SAR outlined in Sections 2.1 and 2.2 of this SRP as they relate to the description of water resources and uses and the effect of the exploitation of water resources on the health and environment.

The conclusions and findings from this review will be used by the LLTB staff to evaluate the information and analyses under SRP 6.5.1, "Transfer Mechanism - Groundwater." Moreover, information and data presented here are required input in the section of the SAR reviewed under SRP 6.1.5.1. Specifically, this information may include results of a transient simulation showing future direction, velocity, and travel time of groundwater flow; input data matrices for subsequent solute transport analyses; and locations of potential groundwater wells.

2.1 Description of Water Resources

The staff will review the description of water resources including the following:

(1) the description of the present and potential use of local and regional groundwater, including locations of wells both spatially and stratigraphically, and the potential rates of withdrawal from significant aquifer systems, including perched aquifer systems capable of yielding significant quantities of water

(2) the description of the present and potential use of surface water resources, including withdrawal for human or livestock consumption, industrial use, and/or any recreational activities

(3) the description of water resources related to the requirements of 10 CFR 61.12(h)

2.2 Effect of Exploitation

The staff will review the description of the effect of exploitation of water resources including the following:

(1) results of analyses associated with changes occurring to the flow regime as a result of exploitation, including groundwater travel time, flow velocity, and directions

(2) results of conservative scenarios and analyses illustrating the possible effects of exploitation with respect to the performance objectives of Subpart C of 10 CFR 61.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on water resources in the SAR in accordance with NUREG-1199, and this SRP. If the information presented by the applicant is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending submittal of additional information.

3.2 Safety Evaluation

The staff will confirm the local and regional ground and surface water uses (volume and type) by a site visit and discussions with local government officials and water users and by comparing the applicant's data with that in the technical literature. The staff also will compare the applicant's description of projected local and regional use, considering usable groundwater stored in perched aquifer systems, perennial or otherwise.

Following the site visit and review of the description of ground and surface water resources and use, the staff will verify if the information is sufficient to meet the requirements of 10 CFR 61.12(h) and adequate to perform analyses pertaining to the effects of exploitation. Data deficiencies will be addressed through the comment process between the staff and the applicant. The staff will confirm that the applicant's response satisfactorily addresses the inadequacies. If the additional information is still insufficient, the staff will indicate this in the Safety Evaluation Report and assess the ramifications of using the applicant's information in further analyses.

The staff will verify that the numerical techniques used in the analysis are well documented, verified, and calibrated and that input and results are consistent with those presented in the sections of the SAR reviewed under SRPs 2.4.1 and 2.4.2. The staff will verify that the applicant has performed a numerical analysis, if needed, to analyze the effect of present and potential water use on the long-term condition of the hydrologic system. The staff will confirm that the applicant has incorporated the results from characterization

into the model, using present and projected future use of ground and surface water, evaluated under SRP 2.1, "Geography, Demography, and Future Developments." Projected ground and surface water withdrawal scenarios should be analyzed with respect to location and rate of withdrawal of projected pumping schemes.

The staff will review and confirm that the applicant's analyses and conclusions regarding the effect of the exploitation of ground and surface water on the performance objectives in 10 CFR 61, Subpart C, are adequately conservative or defensible. The staff should anticipate that the analyses might be located in other sections of the SAR. In this case, relevant findings and conclusions derived from these sections should be referenced as part of the review process.

If the staff concludes that the applicant's results are inadequate, it will communicate its concerns to the applicant. Alternatively, if it is decided that an independent analysis needs to be performed by the NRC staff, the analysis may include, but not be limited to, an analytical or numerical simulation of the flow system. The model results will be incorporated into dose calculations performed by a health physicist at NRC. The staff then will determine whether the applicant's results were adequately conservative or defensible and whether the performance objectives were met with reasonable assurance.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (h), as it relates to the description of known water resources at the disposal site that, if exploited, would affect waste isolation

(2) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(4), as it relates to avoiding disposal areas with known water resources that, if exploited, would result in failure to meet the performance objectives of Subpart C

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in NUREG-0902, "Site Suitability, Selection and Characterization," as it relates to the identification of water resources.

4.3 Regulatory Evaluation Criteria

To adequately evaluate the assessment of water resources presented in the SAR and perform independent analyses if necessary, the staff will review information pertaining to

(1) the description of the current uses of water resources (including locations of discharge points and withdrawal rates), which include

residential, industrial, and municipal withdrawal for drinking purposes, irrigation, livestock watering, and recreational uses

(2) the description of conceptual and numerical models used in the applicant's evaluation, including documentation, verification, calibration, and results

The staff will also review information reviewed under the following SRPs:

(1) SRP 2.1, "Geography, Demography, and Future Development," referring to the projected use of all water resources in the vicinity of the proposed facility

(2) SRP 2.4.1, "Surface Water Hydrology," referring to the description of surface water features, including location, volumes of water, and hydrologic characteristics of the features

(3) SRP 2.4.2, "Groundwater Characterization," referred to the description of the groundwater flow regime, including the extent, thickness, and physical parameters of all potential aquifer systems, and data and results of the numerical simulation used to calibrate the physical system

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows. As part of the review, the staff will document its conclusions and the basis for the conclusions in a Safety Evaluation Report. The report will also contain a description of water resources and justification for the conclusions reached along with a description of any model used by the staff to conduct an independent analysis and the results and conclusions reached from it. However, if the staff concludes that the description and analyses of water use are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

5.2 Samples Evaluation Findings

The staff has reviewed the water resources for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.7.2. The staff concludes that no water resources exist at the site that, if exploited, would result in failure to meet the performance objectives of Subpart C of 10 CFR 61.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Committion, NUREG-0902, "Site Suitability, Selection and Characterization," April 1982.

..., NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.8
BIOTIC FEATURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Biologist

1.2 Secondary - Technical Branch (LLTB)

1.3 Support - Office of Regulatory Research (RES)

2. AREAS OF REVIEW

The staff will review site maps, flora and fauna inventories, descriptions, and relationships provided by the applicant in both the SAR and the Environmental Report (ER). The review will focus on terrestrial and aquatic species, and the habitats thereof, that may affect facility performance at some point after the commencement of operations or that may represent a direct pathway to man either as part of the food chain or through incidental contact. The review will include an independent assessment of the probable effect of these species on the basis of data provided by the applicant in the SAR and ER and will consider the presence of the species at the present time and the likelihood of intrusion or emigration during various phases of facility life either because of facility activities or anticipated activities in nearby environs.

The staff will review the areas in the SAR given in the following sections that are pertinent to biotic characterization.

2.1 Site and Vicinity

(1) a map of the site and vicinity showing the boundaries of major plant communities, the locations of minor communities, special habitats (e.g., spring seeps, bogs, sink holes, and cliff faces), any habitats used by species that affect facility performance, the site boundary, the construction zone, other areas to be cleared, and the buffer zone; a map showing habitats used by "important" species in the vicinity of the site that are expected to be affected by facility construction and operation; and recent aerial photographs showing the site and adjacent land areas (from the ER) to supplement the maps when possible

(2) U.S. Geological Survey topographic maps of the site (7-1/2-minute scale, when available)

(3) onsite data on the botanical species and the composition and relative abundance of the major vegetation layers (e.g. overstory and understory) in enough detail so that the communities can be identified as to dominant species (from the ER)

(4) summary of onsite natural and man-induced effects (e.g., farming, fishing logging, grazing, and burning) and the successional stage (i.e., weed, brush, pole, and mature stages) (from the ER)

(5) lists of vertebrate species important to facility performance known to occur (from the ER and consultation with local, State, and Federal agencies)

(6) lists of invertebrate species of local importance or concern as disease vectors or pests (from the ER and consultation with local, State, and Federal agencies); detailed field surveys of all insect populations are not needed

(7) estimates of the relative abundance of both commercially and recreationally important game and nongame vertebrates (from the ER and consultation with local, State, and Federal agencies)

2.2 Offsite Areas

(1) major vegetation types hydraulically or geolically downgradient (from the ER, site visit, and consultation with local, State, and Federal agencies)

(2) lists of commercially or recreationally important vertebrate animals known to occur eolically and hydraulically downgradient of the facility to a distance of 5 km

(3) lists of other vertebrate species important to facility performance known to occur within 25 km or migratory distance, whichever is less, from the facility

(4) lists of invertebrate species of local importance or concern as disease vectors or pests (from the ER and consultation with local, State, and Federal agencies); detailed field surveys of insect populations are not needed

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness of information on biotic features in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

In reviewing the applicant's description of the biotic resources of the site and offsite areas likely to be affected by construction, operation, and closure of the proposed project, the staff independently will (1) describe the terrestrial and aquatic communities and their interactions with their environment, (2) describe the existing habitat types, and (3) identify species

important to the performance of the facility. The reviews of this and other sections dealing with terrestrial and aquatic ecology will be closely coordinated with the review of the applicant's ER and the staff's environmental assessment, so that appropriate feedback to establish the extent and relevance of information contained in this section is provided.

The staff will develop a description of the terrestrial and aquatic communities and habitat types based on information provided by the applicant, a review of the literature, information acquired during the site visit, and consultation with appropriate local, State, and Federal agencies, including the U.S. Fish and Wildlife Service and the director of the State fish and wildlife agency.

The staff will identify species in the site vicinity and offsite areas that are important to site performance. This identification will begin with a review of the previously identified communities and habitats of these areas. The categories and methods of identification will be the following:

(1) Regarding commercially or recreationally valuable species, the staff will consider wildlife and plants that could be adversely affected by the proposed action and could subsequently have an adverse effect on humans. In addition to using the applicant's ER, the staff will consult with State or local agencies or organizations that maintain records of harvest levels of these species.

(2) The staff will identify any species in the site and vicinity whose behavior or characteristics could have an adverse effect on facility performance.

3.3 Input to Environmental Statement and Reviews Under Other SRPs

The staff will prepare as input to the Environmental Statement (ES) descriptions of the site and offsite areas potentially affected by the proposed project. The input should be brief and will include the following information:

(1) The principal terrestrial ecological features of the site and vicinity and offsite areas should be described with emphasis on the communities that will be potentially affected by or affect the construction, operation, maintenance, and closure of the proposed project.

(2) Species lists, if included, will be prepared as an appendix to the ES and should be limited to those "important" species whose presence may characterize community structure and function or that are central to the analysis.

The staff will provide terrestrial ecology data to the staff performing reviews under other SRPs, including a description of the food webs leading to man and a description of the potential effect of selected species on the construction, operation, maintenance, and closure of the facility.

4.0 ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is

> 10 CFR 61.12, "Specific Technical Information," (a), as it relates to a description of the biotic features of the disposal site and vicinity

4.2 Regulatory Guidance

There are no regulatory guides that apply to biotic resources for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The applicant's description of biotic resources at or in the vicinity of the proposed facility should be presented in adequate detail so that the staff can assess the effects on safety.

Descriptions should contain quantified information in sufficient detail to allow for independent manipulation of data during confirmatory analysis.

The applicant should have considered and analyzed the relationships between all biotic species that are important to facility performance and safety.

The applicant should have considered and analyzed the effects of man-induced and, if appropriate, natural changes in the site vicinity and must have analyzed the changes that would affect the abundance and behavior of species important to facility performance and safety.

The applicant should have presented evidence supporting the conclusion that its analyses were exhaustive with respect to species that are likely to affect facility performance and safety.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the biotic features for [name of facility] low-level waste disposal facility according to Standard Review Plan 2.8.

The applicant has described and characterized the biotic features of the disposal site and vicinity in a manner that is consistent with the intent of 10 CFR 61.12(a).

The biotic description is sufficiently detailed to establish compliance with 10 CFR 61.41, 61.44, 61.50(a)(2), 61.51(a)(1), (a)(2), (a)(3), and (a)(4), and 61.52(a)(2).

The information on biotic characteristics provided by the applicant is complete and comprehensive.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 2.9
PREOPERATIONAL ENVIRONMENTAL MONITORING

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrogeologist/Meteorologist/Geochemist/Health Physicist

1.2 Secondary - Operations Branch (LLOB)

1.3 Supporting - None

2. AREAS OF REVIEW

The staff* will review the preoperational environmental monitoring program at the proposed disposal site in accordance with the requirements of 10 CFR 61.12(l) and 10 CFR 61.53(a). The staff will evaluate how well the applicant's preoperational environmental monitoring program meets the following objectives: to obtain baseline data in order to radiologically characterize the site before construction and operation; to determine existing levels of selected nonradiological constituents**; to identify a statistical method to relate baseline data to data collected during the operational and postoperational phases; and, in accordance with 10 CFR 61.53(a), to provide the basic environmental data on the disposal-site characteristics.

The staff will review the following items using information given in Section 2.9 of the SAR and information available from other sources as they relate to the preoperational phase of the environmental monitoring program: (1) description of the preoperational environmental monitoring program; (2) equipment, instrumentation, and facilities; (3) data recording and statistical

*Although the primary review responsibility resides with the LLTB staff, the term "the staff" as used in this SRP will generally refer (unless stated otherwise) to the NRC staff as a whole. Special aspects of the review conducted by the LLOB staff are explicitly identified in this SRP.

**In this SRP, the term "selected nonradiological constituents" refers to the water quality parameters identified in Environmental Standard Review Plan (ESRP) 3.4.2.2, "Groundwater Quality" (NUREG-1300). These include parameters such as concentrations of major inorganic and organic constituents, as well as pH, total dissolved solids, turbidity, and temperature. For the balance of this SRP these constituents are simply referred to as nonradiological or other (meaning other than radiological).

analysis; (4) organization; and (5) quality assurance* and quality control. The LLTB staff will review Items (1), (2), (3) and (5, technical aspects only), and the LLOB staff will review Items (4) and (5, administrative aspects only).

The staff will be aware of and use results of the reviews required by other SRPs that could influence the environmental monitoring aspects, such as the reviews of site characterization (SRPs 2.1.2, 2.2, 2.4.1, 2.4.2, 2.7.2, and 2.8), facility operations (SRP 4.3), and safety assessment (SRPs 6.1.1 through 6.1.6)

3. REVIEW PROCEDURES

The staff will obtain and use such information as is necessary to ensure that the review is complete. The staff will use and emphasize material from this SRP, the NRC technical position paper on environmental monitoring (NRC, 1988), and the recommendations to the NRC for environmental monitoring review criteria (NUREG/CR-5054), as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on the preoperational environmental monitoring program in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP by comparing the applicant's submittal and methods with the regulations and guides and by verifying the applicant's references to such guides or to proposed alternatives. The staff will verify that the alternatives are equivalent to or improvements on the methods cited in the referenced regulatory guides. Otherwise, alternatives are likely to be disapproved.

3.2.1 Description of the Preoperational Environmental Monitoring Program

The staff will evaluate the overall acceptability of the monitoring program with respect to the necessary finding that there is reasonable assurance that the program will yield data sufficient to compare future site performance with regulatory requirements and acceptance criteria. This will include evaluating the adequacy of the applicant's information in response to the following concerns:

(1) Is the program based on the requirements of 10 CFR 61.53(a)?

(2) Does the information provided include a description of the environmental monitoring program and the plan for taking corrective measures as required by 10 CFR 61.12(l)?

(3) Are the proper components (media and analyses) included in the monitoring program?

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*See footnote page 9.1-5.

(4) Are the sampling/monitoring procedures appropriate?

(5) Are there sufficient sampling/monitoring locations for each medium?

(6) Is there at least one background/control monitoring location for each medium?

(7) Do the monitoring procedures ensure representative samples/measurements?

(8) Is the frequency of sampling/monitoring/analysis adequate to establish environmental trends?

(9) Were the monitoring data provided by the applicant collected over a sufficiently long period (at least 1 year) to adequately evaluate environmental variability for that area?

(10) Does the program include provisions for special samples or analyses based on site-specific conditions (e.g., high natural background area, other nearby facilities, and previously contaminated groundwater)?

3.2.2 Equipment, Instrumentation, and Facilities

The staff will determine whether the equipment for measuring radiation levels and for sampling radioactive and nonradioactive constituents is consistent with the measurement and sampling requirements of the monitoring program; whether the facilities used for instrument calibration and laboratory analyses are adequate to ensure the availability of appropriate methods and sensitivities; and whether the methods and frequency of calibration are adequate to ensure that the instrument performance requirements will be met. This staff review will include the evaluation of the number, type, range, accuracy, sensitivity, and planned uses of laboratory and field monitoring instruments; the evaluation of the capabilities of the instrument calibration and analytical laboratory facilities; and for selected samples, a detailed review of the processing and radiochemical analyses of each type of field sample (e.g., air, water, soil, and biota).

3.2.3 Data Recording and Statistical Analysis

The staff will review the data handling and recording and statistical analysis procedures for appropriateness in response to the following questions:

(1) Are the data handling and recording and statistical analysis procedures based on standard techniques, such as those provided in Report 58 published by the National Council on Radiation Protection and Measurements or EPA-520/1-80-012 published by the U.S. Environmental Protection Agency (EPA)?

(2) Is the choice of units consistent with those given in Table II, Appendix B of 10 CFR 20 and do the number of significant figures truly reflect the precision of the measured or calculated values?

(3) Is there a clear distinction between measured and calculated values?

(4) Is the overall uncertainty of the data stated, and is it at least at the 95% confidence level?

(5) Are the sources of data variability clearly discussed?

(6) Have the data been appropriately evaluated by grouping, such as spatial and temporal comparisons?

(7) Have data sets containing more than 10 data points been subjected to normality tests?

(8) Did the applicant include a discussion of any other data that was omitted from the preoperational environmental monitoring data summary?

(9) Was an appropriate method used to evaluate less-than-detectable values in the preoperational environmental monitoring data set?

(10) Were appropriate sets of data (e.g., direct radiation and air particulates) subjected to trend analyses?

3.2.4 Organization

The staff will review the organizational position, functional responsibilities, experience, and qualifications of persons responsible for the environmental monitoring program. It will verify that the administrative practices are in accordance with 10 CfR 61.11(b) and consistent with Regulatory Guide (RG) 8.2 and that appropriate personnel are being trained in the use of monitoring equipment and sampling procedures. In its review the staff will also consider the applicant's qualifications in response to the following question:

Does the person responsible for radiation safety and environmental protection have a minimum of a bachelors degree in science or mathematics and 5 years of professional health physics experience?

3.2.5 Quality Assurance* and Quality Control

The staff will evaluate the quality assurance aspects of the environmental monitoring program. In its review, the staff will consider the adequacy of the applicant's quality assurance (QA) program in response to the following questions:

(1) Is the applicant's QA program based on appropriate parameters, such as those identified in RG 4.15 and NUREG-1293?

(2) Are the applicant's organization, authorities, and personnel qualifications adequately discussed in the QA plan?

(3) Were preapproved written procedures used for all sampling and analyses?

*See footnote page 9.1-5.

(4) Was appropriate supporting documentation provided for testing, maintenance, and calibration of instruments; checks on sampling procedures and analytical analysis; and sample control?

(5) Did the analytical laboratory use standards certified by the National Bureau of Standards (NBS) or standards provided by suppliers who participate in measurement assurance programs with NBS?

(6) Did the applicant or the applicant's designated analytical laboratory incorporate replicate analyses of the same sample, including a comparison of those results, and the analysis of blanks and spiked pseudosamples, including a comparison of those results with known concentrations, as part of the quality control program?

(7) Did the analytical laboratory participate in an interlaboratory cross-check program?

(8) Did the analytical laboratory include routine performance checks (e.g., determination of background and individual detector response to appropriate check sources)?

(9) Did the applicant include review and analysis of sample and quality control data for reasonableness and consistency, and provide for independent verification of a substantial fraction of computations?

(10) Did the applicant include planned, periodic audits to verify implementation of the QA program by qualified individuals who did not have direct responsibilities for the areas being audited?

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify its submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are:

(1) 10 CFR 61.12, "Specific Technical Information," (1), which requires that the applicant provide a description of the environmental monitoring program and of a plan for taking corrective measures

(2) 10 CFR 61.53, "Environmental Monitoring," (a), which requires that, at the time a license application is submitted, the applicant shall have conducted a preoperational environmental monitoring program to provide basic environmental data on the disposal site characteristics

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the NRC documents and other supporting references

(e.g., industry standards and general guidance documents) identified below. Most of these documents provide general methods for environmental monitoring that can be used in the preoperational as well as operational and post-operational periods. A supplemental bibliography is provided in Appendix A for additional, more in-depth guidance on specific environmental monitoring topics.

NRC Documents

(1) NUREG-1293, "Quality Assurance Guidance for Low-Level Radioactive Waste Disposal Facilities," as it relates to the overall quality assurance of low-level radioactive waste disposal facility operations

(2) Regulatory Guide 4.5, "Measurements of Radionuclides in the Environment - Sampling and Analysis of Plutonium in Soil," as it relates to techniques of soil sampling and soil sample preparation

(3) Regulatory Guide 4.13, "Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications," as it relates to the application of thermoluminescent dosimeters for environmental monitoring

(4) Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment," as it relates to quality control of all phases of the program (e.g., organizational structure, responsibility of personnel, records, operating procedures, sampling, and radioanalytical analyses)

(5) Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring," as it relates to guidance on administrative practices associated with radiation monitoring programs

(6) Regulatory Guide 8.21, "Health Physics Surveys for Byproduct Material at NRC-Licensed Processing and Manufacturing Plants," as it relates to general methods and procedures for measurements of radioactive material in air, radiological surveys of external radiation levels, and radiological surveys of surface contamination

(7) Regulatory Guide 8.25, "Calibration and Error Limits of Air Sampling Instruments for Total Volume of Air Sampled," as it relates to air sampling, frequency, and documentation of calibration, and error limits for volume measurements

(8) NUREG-1388, "Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility," as it relates to the staff technical position on elements appropriate to an environmental monitoring program at low-level waste disposal facilities

Industry Standards

(9) American National Standards Institute, ANSI N323-1969, "Radiation Protection Instrumentation Test and Calibration," as it relates to guidance on the calibration of instruments

(10) American Public Health Association (APHA), Standard Methods for the Examination of Water and Wastewaters, as it relates to the examination of water samples

(11) American Public Health Association (APHA), Intersociety Committee, Methods of Air Sampling and Analysis, as it relates to standard methods of air sampling and analysis

General Program Guidance

(12) U.S. Department of Energy, "Low-Level Radioactive Waste Management Handbook Series: Environmental Monitoring for Low-Level Waste Disposal Sites," DOE/LLW-13Tg, as it relates program design and implementation for environmental monitoring at low-level radioactive waste disposal sites

(13) U.S. Nuclear Regulatory Commission, NUREG/CR-5054, "Recommendations to the NRC for Review Criteria for Alternative Methods of Low-Level Radioactive Waste Disposal - Environmental Monitoring and Surveillance Programs," as it relates to environmental monitoring program objectives, regulations, and implementation criteria for alternative methods of low-level radioactive waste disposal

Guidance on Equipment, Instrumentation, and Facilities

(14) National Council on Radiation Protection and Measurements, "Environmental Radiation Measurements," Report 50, as it relates to requirements for monitoring and surveillance programs, in situ measurements, sample collection and sample preparation for laboratory analysis, and laboratory measurements

(15) National Council on Radiation Protection and Measurements, "A Handbook of Radioactivity Measurements Procedures," Report 58, as it relates to methods for measuring radioactivity, including techniques for the preparation of samples, statistical treatment of data, and quality assurance of measurement accuracy and precision

(16) U.S. Environmental Protection Agency, "Handbook of Radiochemical Analytical Methods," EPA-680/4-75-001, as it relates to radiochemistry procedures for the analysis of samples

(17) U.S. Environmental Protection Agency, "Manual of Ground-Water Sampling Procedures," as it relates to methods for installing groundwater sampling stations and groundwater sampling procedures

Guidance on Data Recording and Statistical Analysis

(18) U.S. Environmental Protection Agency, "Upgrading Environmental Radiation Data," EPA-520/1-80-012, as it relates to statistical methods for radiation data interpretation, reporting of radiation measurement data, and quality assurance for environmental monitoring programs

Specific Guidance on Quality Assurance/Quality Control

(19) U.S. Environmental Protection Agency, "Handbook for Analytical Quality Control in Radioanalytical Laboratories," EPA Report 600/7-77-088, as it relates to quality controls in radioanalytical analyses of environmental samples

4.3 Regulatory Evaluation Criteria

Evaluation criteria necessary to meet the relevant requirements of the regulations for the areas of review described in Sections 2 and 3.2 of this SRP are discussed in the following sections.

4.3.1 Description of the Preoperational Environmental Monitoring Program

The description of the monitoring program is acceptable if the applicant has demonstrated that the proposed preoperational environmental monitoring program for planned waste disposal operations is consistent with NUREG-1388, "Environmental Monitoring of Low-Level Radioactive Waste Disposal Facility," and NUREG/ CR-5054, which provides recommendations for NRC review criteria. The description should include a justification for the selection of specific media to be monitored; the choice of sampling locations (onsite as well as offsite); depth and elevation of sample points; the type, number, and methods of collection; the collection frequency; preanalysis treatment; analytical instrumentation and analyses; and minimum sensitivities.

Components of the described preoperational environmental monitoring program should normally include both quality (e.g., concentrations or levels) and quantity (e.g., flow rates, volumes, and directions) for meteorological (e.g., air and precipitation), hydrological (e.g., of saturated zone, vadose zone, and surface waters), geological (e.g., soil and sediment), and biological (e.g., vegetation and other biota) parameters as well as for direct radiation monitoring. The description of the monitoring program should also show that special program features have been considered, such as analyses for specific radionuclides or other contaminants, because of pre-existing site-specific parameters or conditions. The reviews of the meteorological, hydrological, and geological characteristics that are conducted according to SRPs 2.2, 2.4.1, 2.4.2, and 2.5 are beyond the scope of this SRP. The LLTB staff will use the results of these reviews as they relate to or could influence the preoperational environmental monitoring program.

Environmental information that the staff's review will usually include is as follows:

(1) site-specific radiation measurements and radionuclide concentrations including such radiological parameters as

   (a) ambient radiation levels (taken at 1 m above the ground surface) at a number of locations within 10 km of the site as well as in the nearest residential community or city of 10,000 or more population within 50 km of the site

   (b) concentrations of the major naturally occurring radionuclides (e.g., uranium, thorium, and potassium) in applicable environmental media (e.g., air, water, soil, and biota)

(c) concentrations of the major fallout radionuclides (e.g., strontium, cesium, and plutonium) or appropriate radionuclides that could be included as emissions from other nearby (within 50 km) nuclear installations in applicable environmental media (e.g., air, water, soil, and biota)

(d) concentrations of the radionuclides expected to be included in disposed waste, especially those that could be considered mobile in the environment (e.g., tritium, technetium, and ruthenium)

(2) site-specific nonradiological parameters that might influence radionuclide transport, including parameters such as

(a) concentrations of major inorganic constituents (including important trace elements) and dissolved gases

(b) concentrations of major organic constituents, dissolved organic carbon, total organic carbon, total organic halogens, and water quality indicator organisms (e.g., fecal coliforms and fecal streptococci)

(c) pH, oxidation/reduction conditions, total dissolved solids, specific conductance, alkalinity, ionic strength, and density

(d) turbidity, and the nature of colloidal-sized materials

(e) temperature

(3) regional data, whether acquired through a literature search conducted by the applicant or, if necessary, collected by the applicant, to be used to describe the radiological and nonradiological characteristics of the region and vicinity

(4) descriptions of the preexisting (i.e., contaminated) site environment and sources of that contamination that may affect local air, soil, or water quality or site construction, operations, or monitoring programs

4.3.2 Equipment, Instrumentation, and Facilities

The determination of acceptability is based on the survey requirements of 10 CFR 20.201 and on a comparison of the applicant's implementation of the guidance in RGs 8.6, 8.21, and 8.25; ANSI N323-1969 and N545-1975; Items 10, 11, 14, 15, and 16 in Section 4.2 of this SRP; and the following guidelines.

The analytical laboratory should be equipped to perform the routine analyses required on environmental samples for both radiological and nonradiological constituents. Instruments and monitoring devices for field surveys and field sampling should have appropriate range, accuracy, and sensitivity to adequately measure direct radiation and to monitor relevant radiological and nonradiological constituents to be encountered during routine disposal operations. The analytical capabilities should be adequate to detect specific radiological and nonradiological indicators (e.g, tritium, radioiodine, trace metals, total organic carbon, and pH).

In accordance with the requirements of 10 CFR 20.201, instruments and equipment for measuring levels of radiation (or concentrations of radioactivity) present normally should include the following:

(1) Direct radiation monitoring - Geiger-Müller meters, micro-R meters, gamma spectrometers, a high-pressure ionization chamber, and thermoluminescent dosimeters

(2) Radiochemical analyses - multichannel gamma pulse height analyzer, low-background alpha-beta proportional counter, gamma and alpha-beta scintillation counter, and end-window Geiger-Müller counter

The information provided by the applicant should address inspection, maintenance, and repair of the monitoring equipment. The environmental monitoring program support facilities should include, as a minimum, controlled storage areas for instruments and equipment, a controlled area for the calibration of instruments, and facilities to clean, repair, and decontaminate monitoring equipment and instrumentation.

Field sampling equipment and the instruments for measuring nonradiological parameters should normally include the following, in addition to sample containers, labels, and chain-of-custody and data recording forms:

(1) Air sampling - air samplers with particulate filters and charcoal canisters

(2) Water sampling - lysimeters; tensiometers; specific ion probes; various types of pumps (e.g., submersible or air powered); flow-through measurement cells; flow-through filters; pH, Eh, and specific conductivity meters; water level indicators; sounding devices; and equipment for field measurements

(3) Soil and sediment sampling - top soil cutters, augers, knives, and rubber mallets

(4) Vegetation and other biota sampling - cutters, knives, and devices for capturing animals

4.3.3 Data Recording and Statistical Analysis

Data should be recorded in appropriate units (mrem, mrad, pCi) and expressed with an appropriate number of significant figures. Unambiguous overall estimates of the uncertainties associated with the measurements of radioactivity and radioactive concentrations should be provided. The applicant should implement the guidance in RG 8.25 and in Items 15 and 18 in Section 4.2 of this SRP (or the provisions of acceptable alternatives) and the following guidance.

Reported measurement results should include descriptive statistics (i.e., measured or calculated values, sample size, mean, standard deviation, overall uncertainty, confidence interval for the mean, etc.). The applicant should adequately estimate the statistical validity of the sampling program. Statistical consideration should be given to the number and distribution of sampling locations, the frequency and number of sample collections, the number

of analyses per sample, and the frequency of sample analyses. Descriptions and rationales should be compared against those in the U.S. Department of Energy handbook, NUREG/CR-5054, and the EPA collection of techniques for upgrading environmental data (Items 12, 13, and 18, respectively, Section 4.2), and the list of questions provided in Section 3.2.3 of this SRP.

4.3.4 Organization

The administrative organization for the monitoring program is acceptable if the information submitted by the applicant includes the lines of authority, the qualifications of the technical personnel, and a description of the staff training program as required by 10 CFR 61.11(b) and if the staff specifics are in accordance with RG 8.2.

4.3.5 Quality Assurance* and Quality Control

The quality assurance (QA) measures and quality control (QC) procedures should be adequate to ensure the accuracy and validity of the monitoring program. Components of a QA/QC program should include the following: recordkeeping, audits, quality control on field and laboratory measurements (e.g., source checks, calibration standards, instrument calibration procedures, written operational procedures for the use of instruments, sample collection, sample processing, and radioanlytical analyses), and quality control on the maintenance and calibration of instruments. The staff's determination of acceptability is based primarily on a comparison with the criteria in RG 4.15, guidance in NUREG-1293, SRP 9.1, and the questions noted previously in Section 3.2.5 of this SRP.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the preoperational environmental monitoring program of the [name of facility] low-level waste disposal facility for adherence to the requirements of 10 CFR 20 and 10 CFR 61 according to Standard Review Plan 2.9. The objectives of the review were to ensure that the applicant's preoperational environmental monitoring program was adequate to characterize the site before construction and operation (i.e., to determine existing levels of radiological and selected nonradiological constituents), in accordance with 10 CFR 61.53(a).

In its review, the staff determined the following:

*See footnote page 9.1-5.

(1) The applicant provided a description of the preoperational environmental monitoring program and of a plan for taking corrective measures as required by 10 CFR 61.12(1). The staff further noted that the program covered at least a 12-month period and included the basic environmental data (e.g., monitoring direct radiation exposures, airborne constituents, groundwater in the saturated and vadose zones, surface water, soil and sediment, and vegetation and biota) in accordance with the requirements of 10 CFR 61.53(a). The applicant's program description is therefore considered acceptable.

(2) The applicant's methods, techniques, and procedures for monitoring radiation and for sampling environmental media are consistent with Regulatory Guides (RGs) 4.5, 8.21, and 8.25; American National Standards Institute Standard ANSI N545-1975; NUREG/CR-5054; and "Technical Position on Environmental Monitoring of Low-Level Radioactive Waste Disposal Facilities," (NRC, 1988) and are adequate for determining radiation exposure levels and for obtaining representative samples.

(3) Field and laboratory data are recorded in appropriate units (according to the requirements of 10 CFR 20.401) and include appropriate descriptive statistics, statistical analysis, reporting levels, action levels, and regulatory limits. Maps were provided that clearly show all sampling locations and their direction, distances, and elevations with respect to the disposal units.

(4) The environmental monitoring program organization, lines of authority, staff qualifications, and training of personnel are in accordance with the requirements of 10 CFR 61.11(b) and the implementation guidelines of RG 8.2.

(5) The quality assurance (QA) measures and quality control (QC) procedures include quality controls on the organizational structure, selection and training programs, equipment, instrument testing, and calibration procedures for field monitoring and sampling, sample handling, sample analysis, data reporting, administrative reviews, audits, and general environmental monitoring procedures. The QA/QC program with respect to environmental monitoring is adequate, meets the guidelines of RG 4.15 and NUREG-1293, and provides reasonable assurance that the applicant's preoperational environmental monitoring program was maintained according to acceptable standards.

The location of the sampling points, the type of samples obtained, and the sampling frequencies have been adequately justified by the applicant on the basis of site-specific data with regard to locations of critical pathways and their measured variability. Therefore, the staff concludes that the applicant's preoperational environmental monitoring program meets the review criteria noted, thereby satisfying the requirements of 10 CFR 61.12(1) and 10 CFR 61.53(a).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility, including alternative disposal facilities relative to shallow-land burial. In addition,

it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

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American National Standards Institute, ANSI N323-1969, "Radiation Protection Instrumentation Test and Calibration," New York.

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STANDARD REVIEW PLAN 2.9 - APPENDIX A SUPPLEMENTAL BIBLIOGRAPHY

This appendix is based on the collections of books, reports, documents, and other publications reviewed by the Pacific Northwest Laboratory (PNL) team in preparing NUREG/CR-5054, "Recommendations for NRC Review Criteria for Alternative Methods of Low-Level Radioactive Waste Disposal - Environmental Monitoring and Surveillance Programs," 1987. It contains approximately 50 additional references beyond those provided in the body of this SRP. The references cited are those judged by the authors to be most current and useful in designing and implementing environmental monitoring and surveillance programs for shallow-land burial as well as for the three alternative methods of low-level radioactive waste disposal currently considered to be acceptable to the NRC.

This appendix is arranged within four (i.e., program design; equipment, instrumentation, and facilities; data recording and statistical analyses; and quality assurance/quality control) of the five major review categories of this SRP.

PROGRAM DESIGN

General Guidance

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3
DESIGN AND CONSTRUCTION - INTRODUCTION

The standard review plans (SRPs) that make up SRP 3 are directed at identifying and describing the technical information on design and construction of a low-level waste disposal facility (LLWDF) that is needed to demonstrate that the performance objectives of Subpart C and the applicable technical requirements of Subpart D of 10 CFR 61 will be met. In the staff's development of the various SRPs, the need to have a clear understanding of the intent and meaning of certain terms essential to design is clearly evident. For this reason the following definitions are provided:

Principal Design Feature - an important or prominent part of a land disposal facility requiring deliberate and purposive planning to ensure safe construction, operation, and closure of the waste disposal facility.

Principal Design Criteria - the criteria that establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components to provide reasonable assurance that a land disposal facility can be operated and closed without undue risk to the health and safety of the public. Principal design criteria may be in the form of an important distinguishable standard on which a technical judgment or decision related to design adequacy or acceptability may be based. Principal design criteria are to be established by an applicant to ensure and demonstrate that 10 CFR 61 performance objectives and technical requirements will be met.

Design Bases - the information that identifies the specific functions to be performed by a structure, system, or component of a land disposal facility and the specific values or ranges of values chosen for controlling parameters as reference bounds for design.

Design Limit - a selected parameter that is not to be exceeded and that has been established to ensure that principal design criteria and design bases will be met.

Design-Basis Natural Event - In design, certain severe natural events are estimated and assumed to occur to permit their impact (or loading) to be imposed on a facility in order to safely design the facility's structures. The establishment of the severity of the events is called the design-basis event. A naturally occurring event that may be tectonic (seismic, volcanic, ground rupture), hydrologic, or meteorologic (storms, floods, hurricanes, tsunamis, seiches). Natural events are typically assumed to occur in design for both normal (short-term) operating conditions and abnormal (long-term) postclosure conditions, with the severity of the event established on the basis of its

likelihood of occurrence during the period of design being considered.

The following SRPs present the NRC staff's review approach and procedures for evaluating the acceptability of technical information on design and construction.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.1
PRINCIPLE DESIGN FEATURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer, Hydrologist, Hydrogeologist

1.2 Secondary - None

1.3 Supporting - Health Physicist

2. AREAS OF REVIEW

The staff will review the principal design features of the proposed low-level waste disposal facility (LLWDF) that are designed to provide long-term isolation of disposed waste, to minimize the need for continuing active maintenance after site closure, and to improve the site's natural characteristics in order to protect public health and safety in accordance with the requirements of 10 CFR 61.12(b) through (e), 61.13 (a), (b) and (d), 10 CFR 61.23(b) through (f), 10 CFR 61.41 through 61.44, 61.50 (7) (8), 61.51(a) (1) through (6) and 61.52 (a) (1) through (10).

The staff will evaluate the applicant's description of the principal design features of the disposal facility and disposal units that are related to the following functional requirements: (1) minimizing infiltration of water into disposal units; (2) ensuring the integrity of disposal unit covers; (3) providing the structural stability of backfill, wastes, and covers; (4) minimizing contact of waste with standing water; (5) providing adequate site drainage during operations and after closure; (6) facilitating site closure and stabilization; (7) minimizing the need for long-term maintenance; (8) providing a barrier against inadvertent intrusion; (9) maintaining occupational exposures as low as is reasonably achievable; (10) providing adequate monitoring of the disposal site; and (11) providing an adequate buffer zone for monitoring and potential mitigative action, in accordance with 10 CFR 61.12(b).

The staff will assess the adequacy of the description of the principal design features, determine their compatability on the basis of conformance with the principal design criteria and design bases reviewed under SRP 3.2, and verify that each of the minimum technical requirements of 10 CFR 61.51(a) has been addressed.

3. REVIEW PROCEDURES

The staff will evaluate the description of the 11 related principal design features separately using the acceptance criteria in Section 4.3 of this SRP. The staff will obtain and use such information as is necessary to ensure the review procedure is complete. The staff will use and emphasize material from this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the descriptions and analyses of the principal design features and their performance in accordance with NUREG-1199 and this SRP

3.2 Safety Evaluation

The staff will determine whether the applicant has followed the guidance in this SRP both by comparing the applicant's submittal and methods with the information in this SRP and by verifying the applicant's references to industry standards or proposed alternative methods. The staff will evaluate any proposed alternative methods against methods cited in this SRP. Alternative methods that are neither equivalent to nor improvements on the methods in this SRP are not likely to be approved.

The staff will review the principal design features in Section 4.3 of this SRP to ensure that the important features have been properly identified and described.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations pertinent to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) through (e), which require descriptions of design features, principal design criteria, and design-basis natural events and their relationship to the performance objectives and to each other and a description of codes and standards that the applicant has applied to design and will apply to construction

(2) 10 CFR 61.13, "Technical Analyses," (a), (b) and (d) as they relate to clearly identifying the role performed by the design features in isolating and segregating the wastes, and to the analyses for protection of individuals from inadvertent intrusion and for long-term stability.

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b) through (f), which require that the applicant's proposed design provide adequate protection of the public health and safety and reasonable assurance that the performance objectives of 10 CFR 61, Subpart C, and the technical requirements of 10 CFR 61.51, Subpart D, will be met

(4) 10 CRF 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.44 which present the performance objectives of which the designed disposal facility must contribute toward the achievement

(5) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a), (7) and (8) as they related to the designed disposal facility to ensuring sufficient depth to the water table and its placement in hydrogeologic unit that shall not discharge ground water to the surface within the disposal site

(6) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a), which presents the minimum technical requirements for near-surface disposal site design

(7) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(1) through (10) which present the minimum technical requirements for facility operation and site closure.

4.2 Regulatory Guidance

There are no NRC regulatory guides that directly apply to the principal design features. Guidance related to some of the principal design features can be found in the following sections.

4.3 Regulatory Evaluation Criteria

Design details and principal design criteria for the 11 principal design features that are described in Section 2 of this SRP are covered in greater depth in other SRPs. As an example, the principal design feature requiring the minimization of infiltration of water into a disposal unit, after initially being addressed in SRP 2.4.2 with respect to site characteristics, has principal design criteria and design-basis considerations addressed in SRP 3.2. The information required for a safety assessment of water infiltration into the waste cover system is covered in SRP 6.1.2.

The major reason that the principal design features are addressed in this SRP is to ensure that the applicant provides a clear description in one section of all the principal design features with regard to their relationship to each other and to demonstrate that all of the principal design features have been carefully considered in a coherent LLWDF plan. The staff's acceptance of the required detailed information for a specific principal design feature and the staff's evaluation conclusions on the design completeness (validity of assumptions, methods employed, results of studies and calculations, etc.) will be made under the appropriate SRPs, where the specific and detailed information is provided in a license application.

4.3.1 Water Infiltration

The applicant's discussion of the feature of the land disposal facility and disposal units designed to minimize the infiltration of water into the disposal units is acceptable if the design feature is clearly described and the feature is shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature should include: (1) the covers over the waste that are designed to direct onsite precipitation away from the disposal units in accordance with 10 CFR 61.51(a)(4); and (2) onsite drainage systems that direct onsite precipitation, flow of offsite precipitation onto the site, and groundwater away from the disposal units in accordance with 10 CFR 61.51(a)(5).

Details on other aspects of this design feature are covered in SPRs 3.2, 3.3.1, 4.3, 5.1.2, and 6.1.2.

4.3.2 Disposal Unit Cover Integrity

The discussion of the feature designed to ensure the integrity of disposal unit covers is acceptable if the design feature is clearly described and shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature that is designed to ensure cover integrity should describe measures so that (1) performance for the required period of time and avoidance of the need for continuing active maintenance is in accordance with 10 CFR 61.51(a)(1), and (2) resistance to degradation by surface geologic processes and biotic activity is in accordance with 10 CFR 61.51(a)(4).

Details on other aspects of this design feature are covered in SRPs 3.2, 3.3.1, 4.3, 5.1.2, and 6.3.3.

4.3.3 Structural Stability

The discussion of the feature designed to ensure the structural stability of the backfill, wastes, and covers is acceptable if the design feature is clearly described and shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature that is designed to ensure the structural stability of the backfill, wastes, and covers should address how long-term isolation of the waste and avoidance of the need for active maintenance in accordance with 10 CFR 61.51(a)(1) has been considered.

Details on other aspects of this design feature are presented in SRPs 3.2, 3.3.1, 4.3, 5.1.2, and 6.3.3.

4.3.4 Contact With Standing Water

The discussion of the feature designed to minimize contact of waste with standing water is acceptable if the design feature is clearly described and shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature that is designed to minimize contact of waste with standing water should address measures to minimize, to the extent practicable, contact of water with waste during storage and disposal operations and after disposal operations in accordance with 10 CFR 61.51(a)(6).

Details on other aspects of this design feature are presented in SRPs 3.2, 3.3.1, 5.1.2, and 6.3.3.

4.3.5 Site Drainage

The discussion of the feature designed to provide site drainage during construction and disposal operations and after closure is acceptable if the design feature is clearly described and shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature that is designed to provide site drainage should address measures that will direct (1) surface water away from the disposed waste in accordance with 10 CFR 61.51(a)(4), and (2) surface water drainage away from the disposal units at velocities and gradients that will not result in erosion in accordance with 10 CFR 61.51(a)(5).

Details on other aspects of this design feature are presented in SRPs 3.2, 3.3.1, 3.4.4, 5.1.1, 5.1.2, 6.3.1, and 6.3.3.

4.3.6 Site Closure and Stabilization

The discussion of the feature designed to facilitate site closure and stabilization and for avoiding the need for active maintenance is acceptable if the design feature is clearly described and shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature that is designed to facilitate site closure and stabilization should address the provisions needed to (1) provide long-term isolation of the waste and for avoiding the need for active maintenance in accordance with 10 CFR 61.51(a)(1); (2) provide compatibility with the disposal site closure and stabilization plan in accordance with 10 CFR 61.51(a)(2); and (3) complement, where appropriate, the site's natural characteristics in accordance with 10 CFR 61.51(a)(3).

Details on other aspects of this design feature are presented in SRPs 3.Z, 3.3.1, 4.3, 5.1.1, 5.1.2, 5.2, and 6.3.3.

4.3.7 Long-Term Maintenance

The discussion of the feature designed for avoiding the need for long-term maintenance is acceptable if the design feature is clearly described and shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature should address the provisions for avoiding the need for long-term maintenance after site closure in accordance with 10 CFR 61.51(a)(1).

Details on other aspects of this design feature are presented in SRPs 3.2, 5.1.2, and 6.3.2.

4.3.8 Inadvertent Intruder Barrier

The discussion of the feature designed to provide a barrier against inadvertent intrusion is acceptable if the design feature is clearly described and the feature is shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature should include the provisions for the required protection from inadvertent intrusion in accordance with 10 CFR 61.42.

Details on other aspects of this design feature are presented in SRPs 3.2, 3.3.1, and 6.2.

4.3.9 Occupational Exposure

The discussion of the feature designed to maintain occupational exposures as low as is reasonably achievable is acceptable if the design feature is clearly described and the feature is shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature designed to reduce occupational exposures should address the information identified in 10 CFR 61.12(k) and the provisions in 10 CFR 61.43.

Other aspects of this design feature are presented in SRPs 3.2, 6.1, 7.1, and 7.3.

4.3.10 Site Monitoring

The discussion of the feature designed to provide adequate monitoring of the disposal site is acceptable if the design feature is clearly described and the feature is shown to be coordinated iin the overall LLWDF plan.

At a minimum, the description of the feature should include the information identified in 10 CFR 61.12(k) and (l) and should fulfill the provisions in 10 CFR 61.53.

Details on other aspects of this design feature are presented in SRPs 3.2, 4.4, 5.3, and 6.3.3.

4.3.11 Buffer Zone

The discussion of the feature designed to provide an adequate buffer zone between any buried waste and the disposal site boundary and beneath the buried waste is adequate if the design feature is clearly described and the feature is shown to be coordinated in the overall LLWDF plan.

At a minimum, the description of the feature should fulfill the provisions in 10 CFR 61.52(a)(8).

Details on other aspects of this design feature are presented in SRPs 3.2 and 4.3.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the principal design features for [name of facility] low-level waste disposal facility in accordance with Standard Review Plan 3.1. The objective of the review was to verify that the applicant has presented sufficient descriptive information in an overall disposal facility plan on the principal design features to: (1) minimize infiltration of water into disposal units; (2) ensure the integrity of disposal unit covers; (3) ensure the structural stability of backfill, wastes, and covers; (4) minimize contact of waste with standing water; (5) provide adequate site drainage during operations and after closure; (6) facilitate site closure and stabilization; (7) minimize the need for long-term maintenance; (8) provide a barrier against inadvertent intrusion; (9) maintain occupational exposures as low as is reasonably achievable; (10) provide adequate monitoring of the disposal site; and (11) provide an adequate buffer zone for monitoring and potential mitigative action.

On the basis of its review, the staff concludes that the descriptions of the principal design features have been clearly presented in a coherent disposal facility plan and the descriptions of the principal design features are acceptable. Specific designs and details on the principal design features are addressed and evaluated under other pertinent SRPs.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC staff's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

17. REFERENCES

Essential

Code of Federal Regulation, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.2
DESIGN CONSIDERATIONS FOR NORMAL AND ABNORMAL/ACCIDENT CONDITIONS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - Surface Water Hydrologist

1.3 Supporting - Health Physicist and Hydrogeologist

2. AREAS OF REVIEW

The staff will review the principal design criteria for the proposed low-level waste disposal facility (LLWDF) that have been established by the applicant to reasonably ensure that the principal design features under normal conditions and abnormal/accident conditions are designed to provide long-term isolation of the disposed waste, to minimize the need for continuing active maintenance after site closure, and to improve the site's natural characteristics in order to protect the public health and safety in accordance with the requirements of 10 CFR 61.12(b) through (g), 10 CFR 61.13(a) through (d), 10 CFR 61.23(a) through (f), 10 CFR 61.40 through 61.44, 10 CFR 61.51(a), and 10 CFR 61.52(a).

The staff will evaluate the applicant's description of the principal design criteria related to normal conditions, abnormal conditions, and accident scenarios and the criteria's relationships to 10 CFR 61 performance objectives and technical requirements for each of the following functional requirements related to the principal design features: (1) minimizing infiltration of water into disposal units; (2) ensuring the integrity of disposal unit covers; (3) providing the structural stability of backfill, wastes, and covers; (4) minimizing contact of waste with standing water; (5) providing adequate site surface drainage during operations and after closure; (6) facilitating site closure and stabilization; (7) minimizing need for long-term maintenance; (8) providing a barrier against inadvertent intrusion; (9) maintaining occupational exposures as low as is reasonably achievable; (10) providing adequate monitoring of the disposal site; and (11) providing an adequate buffer zone for monitoring and potential mitigative action.

The staff will (1) assess, in accordance with 10 CFR 61.12(c) through (d), the adequacy of the description of the principal design criteria and their relationship to the performance objectives in 10 CFR 61, Subpart C,

considering normal operating conditions, abnormal conditions (meteorologic, tectonic, and hydrologic site characteristics are discussed in SRPs 2.2, 2.3, and 2.4, respectively), and accident scenarios; (2) verify the analyses and assessments described in SRP 6 for their consistency and contribution to the design of the principal design features and for their meeting 10 CFR 61.41 performance objective and 10 CFR 61.13 information requirements; and (3) verify the applicant's assessment that reasonable assurance exists that abnormal events or accident scenarios will not cause exposures greater than the levels permitted by the provisions of 10 CFR 61.

3. REVIEW PROCEDURES

The staff will evaluate the principal design criteria for the principal design features using the acceptance criteria in Section 4.3 of this SRP. The evaluation will be based on the functional requirements for each structure, system, and component and the contribution that each makes toward meeting the performance objectives of 10 CFR 61, Subpart C.

3.1 Acceptance Review

The staff will review for completeness (1) the descriptions of the principal design criteria for normal conditions, abnormal conditions, and accident scenarios; (2) the functional requirements for each of the design features; and (3) the analysis of each design feature's contribution toward meeting the performance objectives in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the descriptions of the principal design criteria for each principal design feature listed in Section 4.3 of this SRP to ensure that the principal design criteria meet the functional requirements of each structure, system, and component and contribute to the fulfillment of the performance objectives, as claimed by the applicant, under normal operating conditions and abnormal/accident conditions. Other relevant information on design bases, design limits, and design details (assumptions, methods, calculations, and results) may either be reviewed under this SRP or subsequent SRPs, depending on which section of the SAR the applicant chooses to provide the required design information.

The staff will compare the design-basis events and accident scenarios used by the applicant to develop the principal design criteria.

As appropriate, the short- and long-term stability of the principal design features should be analyzed for both static and dynamic loading conditions. For long-term stability considerations, the design-basis abnormal events would include (1) the maximum earthquake (SRP 2.3.2), (2) the probable maximum flood (PMF) and the probable maximum precipitation (PMP) (SRP 6.3.1), and (3) the extreme meteorological conditions (SRP 2.2). For short-term normal operational stability considerations, the loading from the above events would meet with staff approval; however, less severe natural events would be considered acceptable by the staff provided there is documentation on a case-by-case basis that supports the use of the less severe event and conclusively

demonstrates that the 10 CFR 61 performance objectives and technical requirements will be fully achieved.

The staff will review the applicant's evaluation of the effects of the abnormal events or accidents on exposures from releases of radioactivity in unrestricted areas and on the performance assessment analyses and models. The staff will determine if each principal design criterion provides reasonable assurance that the associated abnormal event or accident will not present an unacceptable challenge to the required functions of a principal design feature. The challenge will be assessed as unacceptable if it would result in failure to meet the performance objectives of 10 CFR 61, Subpart C, or in an inability to successfully model the performance of the disposal facility.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) through (g), which require descriptions of design features, principal design criteria, and the relationship of the aforementioned with each other and the 10 CFR 61 performance objectives

(2) 10 CFR 61.13, "Technical Analyses," (a) through (d), which require (a) analyses to demonstrate that the performance objectives of 10 CFR 61, Subpart C, will be met and (b) that the role performed by design features in isolating and segregating the wastes be clearly differentiated from the role performed by natural site characteristics

(3) 10 CFR 61.23, "Standards for Issuance of a License," (a) through (f), which require findings that the applicant's design provides protection of the public health and safety and reasonable assurance that the performance objectives in 10 CFR 61, Subpart C, and the technical requirements in Subpart D will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.40 through 10 CFR 61.44, which present the performance objectives toward the achievement of which the facility design must contribute

(5) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a), which presents the minimum technical requirements for near-surface disposal site design

(6) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a), which presents the minimum technical requirements for disposal facility operation and closure

4.2 Regulatory Guidance

There are no regulatory guides that apply to principal design criteria. The applicant should use the following sections as guidance.

4.3 Regulatory Evaluation Criteria

Principal design features are reviewed under SRP 3.1, and auxiliary systems are reviewed under SRP 3.4. The actual design of the principal design features may not be addressed under this SRP if the applicant chooses to provide the required design details in sections reviewed under subsequent SRPs. However, this section of the SAR should provide the principal design criteria for all the principal design features of the proposed LLWDF reviewed under SRP 3.1. The regulatory evaluation criteria in this SRP are to ensure that the applicant's principal design criteria establish the design, testing, and performance requirements for structures, systems, or components that are necessary to provide reasonable assurance that the LLWDF can be designed, constructed, and operated to meet the performance objectives of 10 CFR 61, Subpart C, under normal conditions, abnormal conditions, and accident scenarios. The staff will verify that that the design information provided in response to the guidance in this SRP has been appropriately and correctly applied in the analyses of performance assessment which are reviewed under SRP 6. The staff will evaluate the applicant's principal design criteria as discussed in the following sections.

4.3.1 Water Infiltration

The applicant's principal design criteria to minimize water infiltration are acceptable if they support the design-related portions of the infiltration analysis reviewed under SRP 6.1.2 and are consistent with the information reviewed under SRPs 3.1, 3.2A, 3.3A, 3.3.1, 4.3, 5.1A, and 5.1.2 for minimizing water infiltration.

At a minimum, the principal design criteria should (1) be clearly stated, (2) be consistent with the design feature description reviewed under SRP 3.1, (3) be presented for the design of all site subsurface drainage systems and disposal unit covers, and (4) identify the fraction of precipitation allowed to infiltrate.

The hydrologic event to be used in the design of subsurface and surface water drainage systems should be the event producing the severest conditions resulting from either a snowmelt, where applicable because of locality, or the probable maximum precipitation (PMP).

Guidance for establishing the amount of infiltration to be considered in performance assessment studies will be provided in the staff's Branch Technical Position on Performance Assessment. The amount of infiltration to be considered in performance assessment would need to be established after assessing long-term precipitation records to determine severe and sustained

infiltration rates. Analyses of increased infiltration resulting from accidents on the cover surface are not required, but changes in infiltration rates through the covers from potential degradation caused by site climatological conditions should be identified and evaluated in performance assessment studies. The description of possible remedial measures (such as maintenance or regrading) to be performed in the event of increased infiltration during years of operation, closure, and active institutional control should be provided to demonstrate that the intended function of this design feature will be maintained.

Principal design criteria for directing and controlling onsite precipitation or seasonally perched groundwater away from disposal units should identify the flow rates and groundwater levels that subsurface drainage systems are expected to handle. These flow rates or groundwater levels at a minimum should be based on (1) the worst conditions resulting from maximum snowmelt or the PMP; and (2) accidental blockage of single subsurface drainage components as an accident condition.

4.3.2 Disposal Unit Cover Integrity

The applicant's principal design criteria to ensure the integrity of disposal unit covers are acceptable if they are consistent with and support the analyses of percolation, subsurface and surface water drainage and erosion protection reviewed under SRPs 3.4.4, 4.3, 5.1.1, 5.1.2, 6.1.2 and 6.3.1, and the settlement and/or subsidence evaluations reviewed under SRP 6.3.3. Appendix A includes additional review guidance for the placement, compaction, and testing of soil cover systems over wastes.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the principal design feature reviewed under SRP 3.1.

Principal design criteria for erosion protection of disposal unit covers should at a minimum identify (1) surface water and wind velocities used for normal operating conditions and (2) abnormal surface water and wind velocities and water levels used for long-term stability considerations. Analyses of increased cover erosion resulting from accidents are not required.

Principal design criteria to ensure that settlement and/or subsidence do not affect disposal unit cover integrity should at a minimum identify (1) estimated total and differential settlements and anticipated densification of waste and fill material, (2) anticipated strength and durability of cover materials for the period the buried waste would be hazardous, and (3) abnormal ground motion associated with the maximum earthquake. Analyses of increased settlement/ subsidence resulting from accidents are not required.

4.3.3 Structural Stability

Principal design criteria to ensure the structural stability of the fill, wastes, and waste covering are acceptable if they are consistent with and support the analysis of settlement and/or subsidence reviewed under SRP 6.3.3. Design considerations for the stability of slopes are reviewed under SRP 6.3.2. Design considerations for the structural stability of engineered structures such as below-ground vaults and earth-mounded concrete bunkers are reviewed under SRP 3.2A.

At a minimum, the principal design criteria should (1) be clearly stated; (2) be consistent with the description of the design feature reviewed under SRP 3.1; and (3) be consistent with the information reviewed under SRPs 3.2A, 3.3A, 3.3.1, 4.3, 5.1A and 5.1.2.

Principal design criteria to ensure the structural stability of the fill, wastes, and waste covering should at a minimum identify (1) the volume of anticipated voids within waste containers and within the fill around the containers; (2) the effect of voids that might result from operational occurrences; (3) the effects of the design-basis abnormal events on structural stability; and (4) the anticipated degradation of fill, waste forms, and waste cover materials for the period that the waste remains hazardous and in recognition of the geochemical environment. Analyses of reduced structural stability associated with accidents are not required.

4.3.4 Contact With Standing Water

Principal design criteria to prevent contact of waste with standing water are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 3.3.1, 4.2, 5.1.1, 5.1.2, 6.1, 6.3.1, and 6.3.3.

At a minimum, the principal design criteria should (1) be clearly stated; (2) address waste in storage, open disposal units, and closed disposal units; (3) be consistent with the description of the design features reviewed under SRP 3.1; (4) cover subsurface and surface water drainage away from disposal units and temporary storage areas; (5) describe the relative permeability of the disposal unit floor natural materials to the placed drain materials and drainage collection features on the disposal unit floors; and (6) describe temporary platforms and covers to be employed for stored waste exposed to the atmosphere.

The design-basis hydrologic and meteorologic events for preventing contact of waste with standing water are identical to those in Section 4.3.1 of this SRP for subsurface drainage systems. Design criteria to cover accidental failure of active drainage system components during operations and accidental failure of any passive drainage system component after closure would need to be provided.

4.3.5 Site Surface Drainage

Principal design criteria related to site drainage for safely handling surface water runoff are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 3.3.1, 3.4.4, 5.1.1, 5.1.2, 6.3.1, and 6.3.3.

At a minimum, the principal design criteria should (1) be clearly stated; (2) address site surface drainage under operating (short-term) and post-closure (long-term) conditions; (3) be consistent with the description of the design feature in Section 4.3.5 of SRP 3.1; and (4) cover site surface drainage features, diversionary structures, and surface drainage slopes.

The design-basis hydrologic and meteorologic events for ensuring site surface drainage are identical to those in Section 4.3.1 of this SRP for subsurface drainage systems for normal and abnormal conditions. Design criteria for

the possible effects of upstream dam failures or downstream drainage blockages are needed for analyses of accident conditions.

4.3.6 Site Closure and Stabilization

Principal design criteria related to site closure and stabilization are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 3.3.1, 4.3, 5.1.1, 5.1.2, 5.2, 6.3.2, and 6.3.3.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the design feature reviewed under SRP 3.1.

Principal design criteria related to site closure and stabilization should identify (1) items in the final site closure plan requiring contribution from design and (2) the effects of design-basis abnormal events on closure and potential active maintenance requirements. Analyses of the effect of accidents after site closure are not required.

4.3.7 Long-Term Maintenance

Principal design criteria related to avoiding the need for long-term maintenance are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 5.1A, 5.1.2, 6.3.1, and 6.3.2.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the design feature reviewed under SRP 3.1.

Principal design criteria should identify and discuss the provisions to be incorporated that will permit the need for long-term maintenance to be avoided by addressing (1) anticipated material durability, (2) anticipated erosional effects, (3) the effects of anticipated drainage system degradation, (4) anticipated monitoring system degradation, and (5) the potential effects of design-basis abnormal events on long-term maintenance requirements. Analyses of the effects of accidents on long-term maintenance are not required.

4.3.8 Inadvertent Intruder Barrier

Principal design criteria related to inadvertent intruder barriers are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 3.3.1, 4.3, and 6.2.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the design feature reviewed under SRP 3.1.

Principal design criteria for inadvertent intruder barriers should identify the potential range of degradation rates for markers, engineered barriers, and the materials separating the stable and unstable wastes. Analyses of accidental effects on intruder barriers may be required at sites where the top of Class C wastes is placed at depths less than 5 meters below the top surface of the disposal unit cover.

4.3.9 Occupational Exposure

Principal design criteria related to occupational exposure are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 4.1, 4.2, 6.1, 7.1, and 7.3.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the design feature reviewed under SRP 3.1.

Principal design criteria to limit occupational exposure should identify, on the basis of the information reviewed under SRP 7.3 (1) ALARA requirements for receiving, inspection, handling, storage, and disposal excavation areas; (2) required shielding for anticipated higher activity wastes; and (3) provisions for handling the accidental rupture of nonstable waste containers.

4.3.10 Site Monitoring

Principal design criteria related to site environmental monitoring and surveillance are acceptable if they are consistent with the information and support the analyses reviewed under SRPs 2.9, 4.4, 5.1A, 5.3, 6.1, and 6.3.3.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the design feature reviewed under SRP 3.1.

Principal design criteria for site monitoring systems should identify the (1) anticipated life of monitoring system equipment and components, (2) potential rate of degradation and actions to be taken in the event of loss of the various types of monitoring equipment, and (3) the effects of design-basis abnormal events on site monitoring systems. Analyses of accidental effects on the monitoring system are not required.

4.3.11 Buffer Zone

Principal design criteria related to the buffer zone are acceptable if they are consistent with the information and support the analyses reviewed under Appendix A to SRP 2.4.1 and SRPs 4.3 and 4.4.

At a minimum, the principal design criteria should (1) be clearly stated and (2) be consistent with the description of the design feature reviewed under SRP 3.1.

Principal design criteria for the buffer zone should identify (1) dimensional requirements to be available for monitoring and (2) dimensional requirements for taking corrective measures if unacceptable migration of radionuclides is indicated. Analyses of accidental effects on the buffer zone are not required.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of the submitted information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the principal design criteria for [name of facility] low-level waste disposal facility under normal operating and abnormal/accident conditions according to Standard Review Plan (SRP) 3.2. The objectives of the review were (1) to verify that the principal design criteria are consistent with the information in other sections and will support the design analyses and results performed for the principal design features, (2) to ensure that abnormal events or accident conditions will not invalidate performance assessment assumptions or result in unacceptable disposal facility performance, and (3) to verify that the design bases and design-basis natural events used for the principal design features of the proposed facility were correct.

The staff concludes that the objectives of the review have been met because the applicant (1) has clearly described the principal design criteria, (2) has adequately described the relationship between the functional requirements of the principal design features reviewed under SRP 3.1 for normal and abnormal/accident conditions, (3) has verified that the principal design criteria ensure that performance will not be invalidated by abnormal events or accidents, and (4) has verified that the principal design criteria are sufficient to support the contribution of the principal design features used for performance analyses in the SAR.

The information provided by the applicant on principal design criteria related to normal conditions, abnormal conditions, and accident scenarios is adequate to satisfy the objectives of the staff review. On the basis of its review, the staff concludes that the information provided gives reasonable assurance that the disposal facility is properly designed and will be acceptably constructed and will satisfy the applicable portions of the regulatory objectives and requirements of 10 CFR 61.12(b) through (g), 10 CFR 61.13(a) through (d), 10 CFR 61.23(a) through (f), 10 CFR 61.40 through 61.44, 10 CFR 61.51(a), and 10 CFR 61.52(a).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC staff's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 1, January 1988.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.2A
STRUCTURAL DESIGN FOR
BELOW-GROUND VAULTS AND EARTH-MOUNDED CONCRETE BUNKERS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information on the structural design of below-ground vaults (BGVs) and earth-mounded concrete bunkers (EMCBs) to ensure that the performance objectives in Subpart C and the applicable technical requirements in Subpart D of 10 CFR 61 are met. The staff will review the following aspects of the structural design: (1) the loads and load combinations to be imposed in the design (2) the appropriateness of the industrial building codes and standards used in the design, (3) the analytical procedures used in the design with supporting bases, (4) the principal design criteria and the bases for their acceptance by the applicant and (5) the impact from site factors (e.g., geology, hydrology, and geotechnical characteristics) on the design and performance of the engineered BGV and EMCB structures and components. The information to be provided by the applicant for the structural design of the BGV and EMCB will need to be coordinated with other portions of NUREG-1200 (the information on site characteristics, facility operations, site closure plan and institutional controls, safety assessment, occupational radiation protection, etc.).

The guidance provided in this SRP is based on the assumption that site suitability requirements of 10 CFR 61 are met, particularly 61.50(a)(7), and the actual location of a BGV or EMCB selected by an applicant provides sufficient depth to the water table that groundwater intrusion, perennial or otherwise, into the waste will not occur. If the proposed disposal facility were to be located where this siting requirement on groundwater intrusion would not be met, the applicant would need to show conclusively that molecular diffusion was the predominant means of radionuclide movement and that the rate of movement would still permit the performance objectives of Subpart C to be met.

3. REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that this review procedure is complete and will use and emphasize material from this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on structural design in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review and determine whether the applicant has followed the guidance in this SRP by comparing the applicant's submittals and plans with the information in this SRP and verify the applicant's reference to and proper use of industrial codes, standards, specifications and guides or review proposed alternative plans. The staff will evaluate the proposed alternative plans against the methods cited in this SRP. Alternative plans would need to be equivalent to or improvements on the methods in this SRP to be approved.

The staff will evaluate the information provided by the applicant in the following areas of review.

3.2.1 Loads and Load Combinations

The staff will review the information on loads and load combinations that were used in the structural design of the BGV or EMCB. The applicable loads are defined in NUREG/CR-5041, Section 2.1, and include dead (D) and live (L) loads, loads due to lateral and vertical pressures of incidental liquids (F), loads due to lateral earth pressures (H), thermal loads resulting from temperature differences (T), loads generated by design wind pressure (W), and loads generated by the design-basis earthquake (E). The incidental liquid pressure load (F) is included to provide for engineering conservatism in the design but it is anticipated that liquid pressures will not develop because of the 10 CFR 61.50(a)(7) requirement that groundwater intrusion not occur.

For the design of concrete structures the following load combinations are considered applicable:

(1) $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7E$

(2) $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W$

(3) $U = D + F + L + T + E + H$

(4) $U = D + F + L + T + W + H$

The required strength U should be at least equal to the greatest of the above load combinations. The strength design method should be used in the design of BGV and EMCB reinforced concrete structures.

For the design of steel members, it is recommended that the elastic working stress method be used. The following load combinations are considered applicable:

(1) S = D + L

(2) S = D + L + E

(3) S = D + L + W

(4) S = D + L + T + E

(5) S = D + L + T + W

The required strength S should be at least equal to the greatest of the above load combinations.

Guidance on determining the proper loading coefficient to be used in cases where any load reduces the effects of other loads or in considering the effects of differential settlement, creep, or shrinkage can be found in NUREG/CR-5041 and the applicable codes and standards listed in the following section.

3.2.2 Applicable Codes, Standards and Regulatory Guidance

The following codes, standards, and regulatory guidance document, in their entirety or portions thereof, are considered applicable for the structural design of BGVs and EMCBs.

ACI 349	"Code Requirements for Nuclear Safety Related Concrete Structures," American Concrete Institute (ACI, 1985)
AISC	"Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," American Institute of Steel Construction (AISC, 1981)
ANSI A58.1	"Minimum Design Loads for Buildings and Other Structures," American National Standards Institute, (ANSI, 1982)
ATC3-06	"Tentative Provisions for the Development of Seismic Regulations for Buildings," Applied Technology Council (ATC, 1978)
NUREG/CR-5041	"Recommendations to the NRC for Review Criteria for Alternative Methods of Low-Level Radioactive Waste Disposal," Volumes 1 and 2, U.S. Nuclear Regulatory Commission, November 1987

The use of ACI 349 for concrete design is recommended because its use provides a level of conservatism in structural design that is greater than that provided by the use of ACI 318, the building code commonly used for conventional reinforced concrete structures. This conservatism is desirable because of 10 CFR 61.44, which requires stability that is significantly longer than that expected for conventional buildings. In this SRP it is recognized that there are inherent differences in the level of hazard between a LLW disposal facility and a nuclear power plant facility. Accordingly, the requirements in ACI 349 that are not considered appropriate for a LLW disposal facility have been

modified or eliminated. Examples include the modification of the loading requirements in ACI 349 (e.g., the deletion of tornado generated or general aircraft missiles) which is evident in the description of loads and load combinations in Section 3.2.1 above and the elimination of the quality assurance program requirement of ACI 349. The staff will provide specific quality assurance guidance in a separate document for a LLW disposal facility that will replace the quality assurance program requirement of ACI 349.

3.2.3 Design and Analytical Procedures

The staff will review the information on the design and analysis of structures, and structural systems and components to determine if accepted engineering practice has been followed and if there is reasonable assurance of long-term stability without the need for active maintenance after site closure. The information to be provided by an applicant should include (1) a description of each structure and its foundation, whose failure would result in radiological risks to site personnel or to the public, along with a supporting plan and sectional views of the structures; (2) design assumptions including boundary conditions and the basis for the assumptions; (3) a description of the analytical procedures used in the design including computer programs and the applicant's method for validating the programs; (4) a description of the method used to calculate forces resulting from the design-basis earthquake; and (5) a description of the results and the methods used to verify the design including the calculations.

NRC staff experience has shown that in reviewing the designs of structures and components for a nuclear facility, the information provided in a SAR is often not adequate. This inadequacy results in the raising of regulatory concerns and questions that are best resolved by a structural audit. The staff, therefore recommends that the applicant maintain a design report separate from the SAR that would contain all design assumptions and calculations. The applicant would not have to include this design report in a license application but would have to make it available to the regulatory staff for a structural audit only if the staff concluded that the design information in the SAR was insufficient or questionable. Maintaining a separate design report requires an applicant to keep orderly records on design assumptions and computations, but it does not result in additional design efforts or calculations.

3.2.4 Principal Design Criteria

The staff will review the principal design criteria and their bases that have been established by the applicant to reasonably ensure that the proposed design of the BGV and EMCB will provide long-term isolation of the disposed waste and will minimize the need for continuing active maintenance after site closure. The applicant may choose to establish principal design criteria by demonstrating compliance with the applicable codes, standards, and regulatory guidance identified in Section 3.2.2 of this SRP. Deviations from cited codes, standards, and regulatory guidance should be described by the applicant and evaluated by the NRC staff.

The principal design criteria to be reviewed under this SRP refer only to the structural design aspects of the BGV and EMCB. Principal design criteria for aspects other than the structural design of the LLW disposal facility are reviewed under SRP 3.2.

3.2.5 Impacts of Site Factors

Important technical requirements in 10 CFR Part 61 covering such features as site suitability, site design, facility operation and site closure, environmental monitoring, waste classification, and waste characteristics remain regulatory requirements that must be addressed in a license application. Under this SRP, the applicant should provide a description of how site factors (i.e., geology, seismology, meteorology, climatology, hydrology, and geotechnical and geochemical characteristics) have been considered and addressed in the structural design of the BGV and EMCB. The applicant may choose to address the impacts of the site factors under other SRPs, where the siting features are initially discussed, but should provide references under this SRP to the sections where the impacts are discussed.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) through (e), which require descriptions of design features, principal design criteria, codes and standards applied in the design, and the relationship of the aforementioned with each other and the performance objectives of 10 CFR 61

(2) 10 CFR 61.13, "Technical Analyses," (a) through (d) as they relate to clearly identifying the roles performed by the design features in isolating and segregating the wastes and to the analyses for protection of individuals from inadvertent intrusion and during ooperations, and for long-term stability.

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b) through (f), which require findings that the applicant's design provides protection of the public health and safety and reasonable assurance that the performance objectives of 10 CFR 61, Subpart C, and the technical requirements of Subpart D will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 10 CFR 61.44, which present the performance objectives toward the achievement of which the facility design must contribute

(5) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(7) as it relates to the designed structures to ensuring sufficient depth to the water table

(6) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a), which presents the minimum technical requirements for near-surface disposal site design

(7) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(1) through (a)(10), which present the minimum technical requirements for disposal facility operation and closure

4.2 Regulatory Guidance

Guidance on structural design criteria are provided in NUREG/CR-5041, Volumes 1 and 2, Sections 2.1 and 2.2.

4.3 Regulatory Evaluation Criteria

Regulatory evaluation criteria pertaining to the areas of review in Section 2 of this SRP are given in the following sections.

4.3.1 Loads and Load Combinations

The information on loads and load combinations is acceptable if the loads and load combinations were conservatively established and are generally consistent with the General Design Criteria and Specific Design Review Criteria in Sections 2.1.1, 2.1.2.3, and 2.2.2.3 of NUREG/CR-5041. The staff will use as the basis for acceptance the allowable limit, U, identified in Section 3.2.1 of this SRP for the load combinations in the design of concrete structures. For the design of steel members, the staff will use the allowable limit, S, as the basis for acceptance.

4.3.2 Applicable Codes, Standards and Regulatory Guidance

The staff will compare the codes, standards and specifications used by the applicant in the structural design with the codes, standards, and regulatory guidance document listed in Section 3.2.2 of this SRP. Conservative and proper interpretation and use of the listed codes and standards are acceptable. The applicant should describe any deviations from the listed codes and standards and justify the bases for their adoption. The staff will identify inadequately justified deviations as unacceptable and provide the reasons for this determination to the applicant.

4.3.3 Design and Analytical Procedures

The information on the design and analysis of structures and structural systems and components is acceptable if the design, analytical method used and described by the applicant, and the results are conservative and representative of good engineering practice and are generally consistent with the General Design Criteria and Specific Design Review Criteria in Sections 2.2.1 and 2.2.2 of NUREG/CR-5041.

4.3.4 Principal Design Criteria

The information on the principal design criteria is acceptable if the criteria meet the intent of the General Design Criteria in Section 2.2.1 of NUREG/CR-

5041 and if they are clearly identified and demonstrated to result in long-term safe isolation of the disposed waste and to eliminate to the extent practicable the need for continuing active maintenance after site closure.

Criteria that are generally consistent with the codes, standards, and regulatory guidance document listed in Section 3.2.2 of this SRP would be found acceptable.

4.3.5 Impacts of Site Factors

The information on the impacts of site factors is acceptable if the applicant has clearly defined and assessed the potential impacts and has shown that the site factors will not have any adverse effects on the proposed design and operation of the BGV and EMCB in meeting the performance objectives in Subpart C of 10 CFR 61.

5. EVALUATION FINDINGS

5.1. Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows:

5.2. Sample Evaluation Findings

The staff has reviewed the structural design aspects for the below-ground vault [or earth-mound concrete bunker] for [name of facility] according to Standard Review Plan 3.2A. The objectives of the review were to ensure that (1) the loads and load combinations imposed on the engineered structure in the design were conservative and were consistent with established criteria; (2) the codes and standards used in the design were properly interpreted and any deviation including justification for its acceptance was adequately documented; (3) the design and analytical procedures that were followed are reasonable and representative of good engineering practice; (4) the principal design criteria established by the applicant provide reasonable assurance of safe long-term isolation of the disposed waste and elimination to the extent practicable of the need for active maintenance after site closure; and (5) the impact from site factors such as geologic, seismic, hydrologic, and geotechnical features were properly assessed and the site factors did not have any adverse effects on the design and operation of the engineered structures.

The staff concludes that the objectives of the review have been met.

On the basis of its review, the staff concludes that the information provided by the applicant gives reasonable assurance that the BGV [or EMCB] is properly designed, will be acceptably constructed, and will satisfy the applicable portions of 10 CFR 61.12(b) through (e), 10 CFR 61.13(a) through (d), 10 CFR 61.23(b) through (f), 10 CFR 61.41 through 61.44, 10 CFR 61.50(a)(7), 10 CFR 61.51(a) and 10 CFR 61.52(a)(1) through (a)(10).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of a SAR for an engineered structure at a low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC staff's plans for performing such a technical review.

Except when an applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

American Concrete Institute, ACI 318, "Building Code Requirements for Reinforced Concrete," Detroit, MI, 1983.

---, ACI 349, "Code Requirements for Nuclear Safety Related Concrete Structures," Detroit, MI, 1985.

American Institute of Steel Construction, "Specification for Design, Fabrication, and Erection of Structural Steel for Buildings," Chicago, IL, eighth edition, 1981.

American National Standards Institute, ANSI A58.1, "Minimum Design Loads for Buildings and Other Structures," New York, 1982.

Applied Technology Council, ATC 3-06, "Tentative Provisions for the Development of Seismic Regulations for Buildings," Palo Alto, CA, 1978.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-5041, "Recommendations to the NRC for Review Criteria for Alternative Methods of Low-Level Radioactive Waste Disposal," Vols. 1 and 2, R.H. Denson, R.D. Bennett, R.M. Wamsley, D.L. Bean, and D.L. Ainsworth, U.S. Army Engineer Waterways Experiment Station, November 1987 (Vol. 1) and January 1988 Vol. 2).

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.3A
CONSTRUCTION AND OPERATION CONSIDERATIONS FOR BELOW-GROUND VAULTS AND EARTH-MOUNDED CONCRETE BUNKERS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information on construction materials, including their quality and durability, and the construction methods and disposal operations for low-level waste to be placed in below-ground vaults (BGVs) or earth-mounded concrete bunkers (EMCBs) to provide reasonable assurance that the construction and operation of the engineered BGV or EMCB structures will result in meeting the performance objectives in Subpart C and the applicable technical requirements in Subpart D of 10 CFR 61.

The staff will review the information on construction materials to determine if the proposed construction materials possess characteristics that are suitable in regard to their composition, quality, and durability. This information should be supported by data and test results from qualified testing laboratories based on accepted and recognized testing codes and standards. The staff will review the following with regards to construction methods and waste disposal operations: (1) construction and operational procedures and techniques that are to be used to ensure a safe disposal facility, (2) provisions unique to LLW disposal in an engineered structure to provide for worker safety, and (3) the operations to be followed to avoid long-term adverse impacts on adjacent filled and closed disposal vaults.

Construction methods and operational features that are unique to BGVs and EMCBs will be reviewed under this SRP. For example, the construction of reinforced concrete disposal vaults that require top loading of waste containers will be reviewed. Features of an overall disposal facility with aspects that are common to shallow land trench-type burial (e.g., security measures, general site drainage, buffer zone, utilities, and roadways) are not addressed in this

SRP but should be adequately covered in the SAR as described in other sections of NUREG-1199 and other SRPs. Some areas related to the construction and operational features addressed in other SRPs are discussed in greater detail in this SRP. Examples include the installation of foundation drains beneath the concrete vaults and the placing and compacting of fill adjacent to and above the vaults. This extended discussion of certain features unique to engineered structures provides additional guidance to the NRC staff and to an applicant on the staff's technical review

3. REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that this review procedure is complete and will use and emphasize material from this SRP as may be appropriate for a specific case. The staff may visit the site after a license has been issued to ensure a satisfactory transition from the design phase through the construction and operational stages.

3.1 Acceptance Review

The staff will review for completeness the information on construction materials and methods and operational procedures in the SAR in accordance with NUREG-1199 and this SRP

3.2 Safety Evaluation

The staff will review the information provided by the applicant in the SAR and determine whether the construction materials proposed for the engineered structures will acceptably perform for the long term in the waste disposal environment that is expected to exist and whether the major construction methods and operational procedures have been adequately described and considered in a systematic and workable plan that will provide reasonable assurance that the health and safety of the workers and the public will be protected.

The staff will evaluate the information identified in Section 2 of this SRP using the procedures as described in the following sections.

3.2.1 Construction Materials Quality and Durability

The staff will evaluate the types of materials the applicant proposes to use in the construction of a BGV or EMCB to determine if they are acceptable with regard to their properties, quality, and durability. The information provided by an applicant should include supporting data and test results on the proposed materials based on inservice performance records, where applicable, and testing using accepted and recognized codes and standards. Testing and supporting data should address the quality and durability of the materials including their resistance to (1) freezing and thawing; (2) humidity; (3) aging; (4) fatigue; (S) sulfate; chloride and acid attack; (6) toxic material attack; (7) abrasion; (8) temperature changes; (9) wetting and drying; (10) radiation; (11) biodegradation; (12) electrolysis; and (13) cracking. The following sections cover the types of materials likely to be used in the construction of a BGV or EMCB and offer guidance on the information that should be provided in an SAR.

3.2.1.1 Portland Cement Concrete

The information on Portland cement concrete should include the type of cement, mixing water, coarse and fine aggregates, and admixtures. The concrete to be used in construction should be a dense, low permeability material that can safely support the imposed loads and resist the adverse waste disposal environment. Guidance in NUREG/CR-5041 indicates that a concrete mixture consisting of air-entrained Type V cement with water-reducing admixtures should be used . A minimum unconfined compressive strength, f'_c, of 4000 psi at 28 days of age is also recommended. The staff supports the recommendations of the U.S. Army Corps of Engineers (COE) for the above concrete mixture and the minimum unconfined compressive strength and agrees with the basis for each recommendation. An applicant may propose an alternative concrete mixture, such as Type II cement with pozzolan replacement or silica fume to provide comparable sulfate protection. The staff will review and evaluate alternative concrete mixtures on a case-by-case basis to ensure long-term protection of the engineered structure that is comparable to that provided by the COE recommendation.

The addition of synthetic fibers to a concrete mixture to improve durability (resistance to cracking, lower permeability, etc.) is acceptable to the staff provided performance records and laboratory test results for conditions that are representative of a LLW disposal environment clearly show that the addition of fibers improves long-term stability .

NUREG/CR-5041 provides guidance on (1) the recommended slump range for the concrete mixture with and without water-reducing admixtures, (2) durable aggregates, (3) mixing water, and (4) admixtures. It also lists relevant codes, tests, and standards for concrete that should prove useful in addressing issues pertaining to material quality and durability.

3.2.1.2 Steel

Reinforcing steel and possibly structural steel are likely to be used in the construction of a BGV or EMCB. To increase the long-term performance of structures that use steel in an LLW disposal environment, the staff and its consultant recommend that the steel be epoxy coated or acceptably protected against oxidation, corrosion or chemical attack by some means. The staff will use the guidance in NUREG/CR-5041 in its review of appropriate codes and specifications for reinforcing and structural steel.

3.2.1.3 Moisture Barriers

Moisture barriers may consist of a wide variety of materials with the purpose of retarding liquid migration through the concrete and protecting the engineered structure against deleterious attack. NUREG/CR-5041 does not recommend a specific moisture barrier material. It does recognize the material selection should be made by an applicant based on site conditions and design, construction, and long-term stability objectives. It also provides guidance on the types of coatings and sealers, elastomeric sheet membranes, waterstop and joint sealants, bentonite clay, and shotcrete that are available. The type of material selected as the barrier will determine which specification or standard

listed in NUREG/CR-5041 should be applied to establish satisfactory quality and durability characteristics.

3.2.1.4 Geosynthetics

The staff will review the information on geosynthetic products proposed by the applicant. The types of geosynthetics may consist of low permeability membranes (geomembranes) or permeable fiber textile products (geotextiles) that are used as filters. Because the inservice performance records for geosynthetics are limited and the demonstrated performance may be questionable for the long-term periods needed for the safe disposal of LLW, the use of geosynthetics alone will not be acceptable. Therefore, geomembranes or geotextiles should be used in combination with naturally occurring and durable soils such as clays and coarse-grained quartz soil particles.

NUREG/CR-5041 identifies the types of geosynthetic products that are available, and their advantages and disadvantages, and lists the standards related to controls on the quality and durability of materials.

3.2.1.5 Soils

Both cohesive and cohesionless soils are likely to be used as fill and backfill in the construction of a BGV or EMCB. Because of their importance to long-term stability, soil materials are addressed separately in SRP 5.1A.

3.2.2 Construction Methods and Disposal Operations

The staff will review the applicant's description of the major construction methods and operational procedures for the BGV or EMCB. The description should cover (1) site preparation for the structure (surveying, clearing, draining, excavation, and foundation surface preparation at the location of the proposed engineered structure); (2) permanent drainage system (drainage blanket, perimeter drains and pipes, and collector sumps); (3) wells for monitoring the sump drainage; (4) vault construction (formwork; steer reinforcement placement; formation of joints in concrete; concrete mixture proportioning; batching, mixing, and casting operations; form removal; and placement of moisture barriers); (5) waste disposal operations (placement of waste packages, filling voids around waste packages, closing of vault openings, placing and compacting fill and measures to protect workers); and (6) closure of individual disposal units.

The construction methods and operational procedures discussed in the following sections are based on concepts of structures that are illustrated in Figure 1.1 of NUREG/CR-5041. It is not intended that the concepts shown in Figure 1.1 limit or control design and construction flexibility. It is recognized that specific or unique site and design conditions will result in variations to be made on the features shown in Figure 1.1. Variations that will still permit the performance objectives of 10 CFR 61 to be met will be acceptable to the staff. The applicant should describe the construction features that differ from the concepts described in this SRP in sufficient detail to demonstrate that the alternative construction methods and operational procedures meet the regulatory requirements in Section 4.1 of this SRP.

3.2.2.1 Site Preparation for Structures

The staff will review the applicant's discussion on site preparation for structures to determine if the planned construction activities (surveying, clearing, draining, excavation and structure foundation surface preparation) are adequate for the construction of the engineered structures. This section differs from SRP 3.3.1 in that this section addresses specific activities related to site preparation for the construction of the engineered BGV or EMCB structures, whereas SRP 3.3.1 addresses the overall disposal site facility and the locations for trench-type waste burial. Section 2.4 of NUREG-5041 discusses site preparation procedures in more detail. Of special importance are the discussions in NUREG/CR-5041 on the preparation of foundation surfaces (removal of loose or weak soils and debris, proof-rolling, verification of foundation materials and elevations, and protection of foundation surfaces against freezing and ponding of water).

3.2.2.2 Permanent Drainage System

The staff will review the information provided by the applicant on the construction of the drainage system intended to safely control surface and subsurface waters that could drain toward the engineered structures. In NUREG/CR-5041, Figures 2.4.1, 2.7.1, 2.7.2, and 2.7.3 show the necessary drainage provisions for a BGV, and Figures 1.1, 2.7.1, 2.7.2, and 2.8.1 show those for an EMCB. The drainage provisions indicated on these figures include (1) a drainage blanket on a sloped foundation surface, (2) foundation drain trenches and pipes, (3) monitored collector sumps, (4) vault interior drainage channels and drain pipes, (S) free draining fill, (6) filter materials, and (7) filter cloth (geotextiles). The applicant should describe the construction aspects of the drainage system to be installed under this SRP. There may be some overlapping of discussions on drainage provisions with those under SRP 5.1A, where the design and material considerations for some of these features are to be described. The applicant is not required to provide all identical drainage provisions; however, the proposed provisions should address the safe conveyance of surface water in regard to infiltration and percolation that could reasonably and conservatively be assumed to occur.

3.2.2.3 Monitoring Wells

The staff will review the applicant's description of and plans for installing monitoring wells with riser pipes that will extend from the collector sumps along the foundation drains and vault drains to the top surface. Sections 2.4 and 2.6 of NUREG/CR-5041 discuss information to be provided (well size, method of construction, well casing, well seals, and screens) and provide comprehensive references on this topic.

3.2.2.4 Vault Construction

The staff will review the information provided by the applicant on constructing the reinforced concrete vault for the safe, permanent retention of the LLW. The information on construction activities to be described should include (1)the

plant for installing the forms and formwork (for structure walls, roof, etc.) including tolerances; sequence for the erection of the forms; verification efforts on the number, correct alignment, and finish of the forms; (2)steel reinforcement placement (quality verification, size, cleanliness, location, spacing and embedment depth); (3)formation of joints in concrete (the type, number, location, material quality, and joint details); (4)concrete mixture proportioning (logical sequence for establishing maximum water-cement ratio, minimum cement content,air content, slump, maximum size of aggregate, strength, and admixture proportions); (5)batching, mixing, and casting operations (the producing, hauling and placement of concrete into its final place in the forms, vibration or consolidation, finishing, and curing); (6)form removal (basis for time of removal, protection, and maintenance of forms to be reused; and (7) placement of moisture barriers (type, extent, method, time of application, compliance with manufacturer's recommendations, and measures to protect applied surfaces).

NUREG/CR-5041 provides guidance and recommendations for properly completing the above vault construction activities and identifies pertinent and appropriate industrial standards

3.2.2.5 Waste Disposal Operations

The staff will review the information on the operations to (1) receive and inspect the waste containers; (2) handle, properly segregate according to waste classification, and temporarily store the waste, if required; and (3) permanently dispose of the waste. The information to be provided for these operations is essentially identified in SRPs 4.1, 4.2, and 4.3. This section of the SRP identifies the information to be provided on the operations unique to the placement of waste into the engineered structures. This information includes a description of (1) the type and method of loading (e.g., top or side loading) of the waste containers, (2) the type of.fill to be placed in voids around and above the containers within the structure and the manner of the fill placement, (3) the procedures for compacting the fill above the waste, and (4) the type of fill and the procedures for placing and compacting the freedraining fill adjacent to and above the vaults. NUREG/CR-5041, Section 2.4, provides guidance for properly completing these operations.

3.2.2.6 Closure of Individual Disposal Units

The staff will review the information on the construction activities to close individual disposal units and ensure minimization of water infiltration and acceptable long-term performance after closure. The applicant should provide information on the construction activities unique to the closure of the engineered structures under this SRP and information on the closure activities that are similar to those for shallow-land and trench-type burial under SRPs 3.3.1 and 4.3. The information to be provided under this SRP should include description of (1) the procedures to be followed to prevent damage or disturbance of completed disposal units; (2) the method for sealing access openings in the vaults, including the notification of responsible regulatory agency to permit onsite inspection, if elected; (3) the method for placing the materials over the completed vaults; and (4) the maximum time period that would be permitted before the closed unit was covered sufficiently and properly drained. Section

2.4 of NUREG/CR-5041 provides guidance for completing the above activities.

Most of the discussions in the preceding sections address the construction of a below-ground vault and related construction activities (e.g., fill placement around the vault). Information on the placement of waste containers above the vaults in the tumulus portion of the EMCB is not discussed. The staff anticipates, however, that an applicant proposing to construct an EMCB would provide in the SAR the information on the tumulus portion that is now identified in other SRPs. For example, the information needed with regard to waste emplacement, filling of void spaces, placement of fill adjacent to waste packages, waste covering, disposal unit closure and stabilization and buffer zone provisions for the tumulus portion of an EMCB would be similar to those described in SPRs 3.3.1 and 4.3. Therefore, these information requirements are not discussed herein for an EMCB.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (e) and (f), which require a description of the codes and standards the applicant has applied to the design and will apply to the construction of the land disposal facility and a description of the construction of the disposal facility, which should include, as a minimum, the methods of, construction of disposal units and of waste emplacement and the methods to control surface water and groundwater access to the wastes

(2) 10 CFR 61.12(j) as it relates to the description of the quality control program for the design and construction of the disposal facility

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b) through (f) which require findings that the applicant's proposed land disposal facility operations provide protection of the public health and safety and reasonable assurance that the performance objectives in 10 CFR 61, Subpart C, and the technical requirements in Subpart D will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.44 which present the performance objectives of which the land disposal facility operations must contribute toward the achievement

(5) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(2), which requires that the disposal site design and operation be compatible with the disposal site closure and stabilization plan and lead to disposal site closure that will provide reasonable assurance that the performance objectives of Subpart C of 10 CFR 61 will be met

(6) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(4), which requires that wastes be emplaced in a manner that will maintain package integrity during emplacement, minimize the void spaces between packages, and permit the void spaces to be filled

(7) 10 CFR 61.52(a)(5), which requires that void spaces between waste packages be filled with earth or other material to reduce subsidence within the fill

(8) 10 CFR 61.52(a)(6), which requires that waste be placed and covered in a manner that will limit the radiation dose rate at the surface of the cover to levels that, at a minimum, will permit the licensee to comply with all provisions of 10 CFR 20.105 at the time the license is transferred pursuant to 10 CFR 61.30

4.2 Regulatory Guidance

Guidance on the construction and operation of a BGV or EMCB are provided in NUREG/CR-5041, Sections 2.3 and 2.4. Many useful, comprehensive, and acceptable industrial standards related to construction materials and methods are identified in NUREG/CR-5041. An applicant may choose to significantly reduce the extent of information to be submitted in an SAR by providing a commitment to comply with certain accepted standards. In cases where commitments to standards are given, the applicant should identify the specific chapters or sections of the standard that will be fully complied with and identify where deviations are to be made along with the bases for accepting the substitute procedures.

4.3 Regulatory Evaluation Criteria

Regulatory evaluation criteria pertaining to the areas of review in Section 2 of this SRP are given in the following sections.

4.3.1 Construction Materials Quality and Durability

The information on the quality and durability of construction materials is acceptable if the materials to be used in construction are generally consistent with the General Design Criteria and Specific Design Review Criteria in Sections 2.3.2 and 2.3.3 of NUREG/CR-5041. The staff will evaluate alternative construction materials proposed by an applicant on a case-by-case basis to determine if the supporting test results and data demonstrate that the quality and durability characteristics ensure that the material will be able to resist the adverse forces identified in Section 3.2.1 of this SRP. Materials that are proposed without sufficient supporting data are unacceptable, and the staff will provide the reasons for this determination to the applicant.

4.3.2 Construction Methods and Disposal Operations

The information on construction methods and disposal operations is acceptable if it reflects an organized and logical plan of activities for BGV or EMCB construction and operation and is generally consistent with the General Design and Specific Design Review Criteria in Sections 2.4.1 and 2.4.2 of NUREG/CR-5041. Deviations from the construction methods and operational procedures described in Section 3.2.2 of this SRP are anticipated to allow the greatest flexibility to the constructor of the engineered structures. However, the applicant should identify those deviations in the license application to permit staff review and evaluation and verification that regulatory requirements will be met.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has evaluated the quality and durability of the construction materials and the construction methods and disposal operations for the below-ground vault [or earth-mounded concrete bunker] for [name of facility] according to Standard Review Plan 3.3A.

The applicant has adequately described the construction materials to be used with supporting test data and inservice performance records to permit the staff to conclude that the engineered structures will acceptably perform for the long term in the waste disposal environment that is expected to exist.

The applicant's description of the major construction methods and operational procedures to be followed reflects an organized and logical plan of activities that should result in the safe construction and operation of the BGV [or EMCB] and fulfillment of the pertinent regulatory requirements. The staff plans a site visit during the initial construction and operation activities to verify the satisfactory implementation of the applicant's methods and procedures.

On the basis of the findings, the staff concludes that the construction materials proposed for construction and the construction methods and operational procedures to be followed by the applicant are acceptable and there is reasonable assurance that the applicable regulatory requirements of 10 CFR 61.12(e), (f), and (j), 10 CFR 61.23 (b) through (f), 10 CFR 61.41 THROUGH 61.44, 10 CFR 61.51(a)(2), and 10 CFR 61.52(a)(4) through (a)(6) will be met.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR

for an engineered structure at a low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.5. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-5041, "Recommendations to the NRC for Review Criteria for Alternative Methods of Low-Level Radioactive Waste Disposal," Vols. 1 and 2, R. H. Denson, R. D. Bennett, R. M. Wamsley, D. L. Bean, D. L. Ainsworth, U.S. Army Engineer Waterways Experiment Station, November 1987 (Vol. 1) and January 1988 (Vol. 2).

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.3
CONSTRUCTION CONSIDERATIONS

This SRP Consists of the following:

SRP 3.3.1 Construction Methods and Features
SRP 3.3.2 Construction Equipment

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.3.1
CONSTRUCTION METHODS AND FEATURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the major construction methods and features that should be considered and described for the land disposal of low-level radioactive waste to ensure a safe and efficient disposal facility that will meet the performance objectives and technical requirements of 10 CFR 61, Subparts C and D.

Design and construction information and drawings pertaining to site plans, such as site location, topography, groundwater contours, site boundary, buffer zone, security area, onsite rail and roadways, utility lines, buildings, general layout of disposal units, and engineering drawings should be provided by the applicant for staff review. Construction specifications that clearly and adequately describe the scope and extent of the various construction features would be an acceptable way for presenting the required information.

The staff recognizes that construction methods and features will vary with specific site conditions and selected construction equipment. The guidance in this SRP is not intended to limit the applicant's flexibility in the selection of construction methods, procedures, or equipment; but it is intended to identify the type and scope of information that should be presented for a conceptual and clear presentation of the applicant's planned construction operations that will be performed to meet the pertinent provisions of 10 CFR 61.

The construction features to be covered include those related to site preparation, control and diversion of water, construction of disposal units, concrete and steel construction, backfilling, and closure. Relevant information from other sections of the SAR related to these features may either be referenced or directly included in this section.

The following example illustrates the type of information that the staff expects would be covered in this section of the SAR as it extends the discussion of related items in other sections.

In the sections of the SAR reviewed under SRPs 4.3 and 5.1.2, the applicant should describe the engineering properties of the backfill materials to be placed around the waste containers. In the section reviewed under SRP 3. 3.1, however, the applicant should describe the construction methods planned for the actual placement of the backfill materials around the waste containers. The information should include: (1) the planned stacking arrangement of the containers; (2) the provisions requiring minimization in use of decomposable wooden pallets to avoid future subsidence; (3) the construction controls to be used to ensure the proper moisture condition of the backfill materials at the time of placement; and (4) the sequence that is planned for the placement of waste and backfill to ensure the filling of all the interstitial spaces between the containers, thereby complying with the 10 CFR 61 requirement to reduce future subsidence within the fill.

3. REVIEW PROCEDURES

The staff will evaluate the major methods and features to be used by the applicant in constructing and operating the low-level waste disposal facility using the procedures in the following sections and in accordance with the acceptance criteria in Section 4 of this SRP. The staff may make site visits following issuance of a license to ensure a satisfactory transition from the design phase through the construction and operation stages.

3.1 Acceptance Review

The staff will review for completeness the information on construction methods and features in the SAR in accordance with NUREG-1199 and this SRP. The intent of the staff's acceptance review is to determine if there are any obvious safety issues and if the information in the SAR is sufficiently complete so that it can be accepted for a more detailed review.

3.2 Safety Evaluation

The staff will evaluate the SAR including pertinent references, engineering drawings, and specifications to ensure that the major design and construction features have been carefully coordinated into a systematic and workable construction plan and to identify safety-related issues that result from inconsistencies in information from other sections of the SAR or from inadequate discussions on construction methods and features.

The staff will perform its review using the procedures described in the following sections.

3.2.1 Site Preparation

The staff will review the applicant's discussion of construction operations to prepare the site for the disposal of low-level radioactive waste to determine if adequate measures have been established to protect the public's health and safety and land and water resources and to control erosion and sedimentation. The review will encompass the areal extent and depth of land to be cleared and

stripped, the configuration and extent of planned stockpile areas, and the construction of fencing to define the restricted area. The staff also will review the description of features unique to a specific site such as the procedures for backfilling existing wells or open boreholes. The applicant's description of the site preparation procedures should be closely coordinated and referenced with the appropriate engineering drawings and construction specifications.

3.2.2 Control and Diversion of Water

The staff will review the applicant's plans for controlling surface water and groundwater in the proposed excavations and fill areas. Where appropriate, the applicant should discuss the methods used in constructing control and diversion features (temporary or permanent dikes, diversion ditches, etc.) and the time schedule for completing this work. The staff review will consider the requirements for water control both during the construction stage of individual disposal units, as identified in the applicant's planned construction sequence, and at the time of site closure.

3.2.3 Construction of Disposal Units

The staff will review the applicant's description of the construction methods for individual disposal units and the sequence for closure of these units. The description should cover construction operations up to the actual placement of waste into the individual disposal unit and should include information on: (1) excavations (types of soil and rock materials to be removed; limits, slopes, and depths or bottom elevations shown in plan and sectional views; requirements on final surface preparation, including identification of any unsuitable materials, and on excavated surfaces where concrete is to be placed; disposition of excavated materials); (2) fill areas (limits, slopes, and heights or top elevations; requirements on surfaces that will receive fill, such as no placement over frozen ground and scarifying to promote bonding and proof rolling; types of fill materials; requirements for spreading and moisture conditioning of fill layers, removal of oversize particles, and field procedures to obtain the required degree of compaction); (3) preplacement details for directing and controlling precipitation and surface water runoff in excavations (thickness of permeable base layer, slopes for drainage, sump locations, etc.); and (4) quality control testing (e.g., testing to determine field density, fill moisture, laboratory compaction, gradation, and plasticity), including identification of test standard and testing frequency.

3.2.4 Concrete and Steel Construction

The staff will evaluate the applicant's information on disposal facility construction that involves the use of concrete and structural steel materials. For concrete, this information should include the design, manufacture, mixing, reinforcement, forming, transporting, placing, finishing, and curing of concrete. For structural steel, this information should include the design, fabrication, and erection of buildings and components.

3.2.5 Backfilling

The staff will review the information on backfilling, which should address the technical requirements for emplacement of the waste packages in the land

disposal facilities, as well as the requirement that void spaces between the waste packages be filled in order to reduce future subsidence within the excavations. Staff guidance on backfilling with a cohesionless soil is contained in Appendix A to SRP 4.3, "NRC Staff Recommendations for Filling Void Spaces Around Waste Containers Emplaced in Low-Level Waste Land Disposal Excavations." The staff will check backfilling operations of land disposal excavations to determine if they are at least equivalent to those in the above recommendations in order to ensure long-term stability of backfilled excavations.

The information on backfilling should include: (1) the planned stacking arrangement of the waste containers; (2) the provisions that restrict the placement of decomposable materials in the excavation in order to minimize future long-term subsidence; (3) the construction controls required to ensure proper gradation and moisture condition of the cohesionless backfill materials that are placed around the containers so as to avoid bridging and clumping of the backfill soils and the resulting creation of voids; and (4) the construction operations, and their sequence, that are planned for the actual placement of the waste containers and the fill materials (e.g., the placement of fill after each successive layer of waste is placed to ensure the filling of interstitial spaces rather than delaying the placement of fill until the full height of waste has been placed).

3.2.6 Closure of Individual Disposal Units

The staff will review the information on closure, which should include the construction features of the materials to be placed in the cover above the backfilled waste to ensure minimization of water infiltration and acceptable performance of the disposal facility both during construction and after site closure. These materials may include an uppermost layer to promote vegetative growth and to resist surface cracking and other layers such as an intruder barrier, permeable drainage and impermeable layers, and possibly geotechnical fabrics.

For many of the types of material to be placed in the excavation cover over the waste, the applicant should provide information that is similar to that identified for fill areas and quality control testing in Section 3.2.3 of this SRP, "Construction of Disposal Units." The applicant should discuss any unique consideration of these materials, such as the use of construction methods that will prevent undesirable mixing or contamination of the different materials in the excavation cover. The applicant should identify and discuss special manufacturer or handling or placement requirements for the intruder barrier or geotechnical fabric materials.

The staff will review documentation provided by the applicant on the overall construction plans and sequence of operations covering development activities (access ramps, separation of disposal units according to waste classification, phased backfilling, etc.) and closing activities that demonstrate a safe and effective disposal facility operation that will meet the requirements of 10 CFR 61.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply

additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are:

(1) 10 CFR 61.12(e) as it relates to the codes and standards that the applicant has applied to the design and that will apply to the construction of the land disposal facility

(2) 10 CFR 61.12(f) as it relates to the description of the construction of the disposal facility, which should include, as a minimum, the methods of construction of disposal units and of waste emplacement and the methods to control surface water and groundwater access to the wastes

(3) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.44 which present the performance objectives of which the construction methods and features of the land disposal facility must contribute toward the achievement

4.2 Regulatory Guidance

There are no regulatory guides that provide staff guidance on all aspects of construction for land disposal of low-level radioactive waste. The following regulatory guides and NUREG reports do, however, provide information and recommendations on construction methods and features and, in general, describe a basis acceptable to the staff for implementing the requirements of 10 CFR 61.12(b), (e), and (f):

(1) NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," which provides information on trench design and construction techniques used in the disposal of low-level waste by shallow land burial and recommends overall construction techniques for the ultimate success of the disposal facility

(2) NUREG/CR-3356, "Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities," which provides information and recommendations on geotechnical quality control criteria applicable to the construction of a low-level waste disposal facility

(3) NUREG/CR-5432, "Recommendations to the NRC for Soil Cover Systems Over Uranium Mill Tailings and Low-Level Radioactive Wastes," Volume 3, which provides guidance on proper construction methods for soil cover systems

4.3 Regulatory Evaluation Criteria

The NUREG reports in Section 4.2 of this SRP provide information, recommendations, and guidance and, in general, describe a partial basis acceptable to the staff that may be used to implement the requirements of 10 CFR 61.12 (e) and (f). The construction aspects of earthwork in land disposal operations are standardized. This lack of standardization and readily

established regulatory criteria on construction features results, in part, from the recognition that flexibility in earthwork construction must be maintained to permit adjustments to actual field conditions during construction. For this reason the regulatory evaluation criteria in this section will be based on the adequacy and acceptability of information provided and on engineering judgment as to whether the applicant has developed a systematic and workable construction plan that will ensure long-term safety of the disposal facility.

4.3.1 Construction Methods and Procedures

The staff will review the information on the construction methods and procedures for site preparation, control and diversion of water, construction of disposal units, concrete and steel construction, backfilling, and closure to establish that sufficient information is provided and is acceptable and to ascertain that the applicant's construction methods and procedures are consistent with the relevant acceptance criteria in the following SRPs:

(1) 3.1, "Principal Design Features"
(2) 3.2, "Design Considerations for Normal and Abnormal/Accident Conditions"
(3) 3.4.1, "Utility Systems"
(4) 3.4.2, "Auxiliary Facilities"
(5) 3.4.3, "Fire Protection System"
(6) 4.3, "Waste Disposal Operations"
(7) 5.1, "Site Stabilization"
(8) 6.2, "Intruder Protection"
(9) 6.3, "Long-Term Stability"

4.3.2 Applicable Codes, Standards, and Specifications

The staff will review the information on the design and construction codes, standards, and specifications that were applied in the design and that will be applied in the construction of the disposal facility and will ensure that appropriate codes or standards are used. The following codes and standards on concrete and structural steel materials are acceptable to the NRC staff:

(1) American Concrete Institute, ACI 349, "Code Requirements for Nuclear Safety-Related Concrete Structures," 1980

(2) American Institute of Steel Construction, "Specification for Design, Fabrication, and Erection of Structural Steel for Buildings," eighth edition, 1981

(3) American National Standards Institute, ANSI N45.2.5, "Supplementary Quality Assurance Requirements for Installation, Inspection and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants," 1974

(4) State and local building, electrical, and fire codes

4.3.3 Construction Materials and Quality Assurance

The staff will review the information on the materials that will be used in the construction of the disposal facility. The major materials of construction include the excavation and fill materials, the concrete and grouting

ingredients, reinforcing bars, and structural steel. If any material not used previously in NRC-licensed facilities is proposed, the applicant should provide sufficient testing and user data to establish the acceptability of the material. The staff also will evaluate the applicant's quality control procedures and construction techniques to ensure that there will be no degradation of the construction quality that might affect the stability and structural integrity of the disposal facility.

4.3.4 Site Plans, Engineering Drawings, and Construction Specifications

The staff will review the completeness and adequacy of the site plans and engineering drawings for conveying the design features. The engineering drawings should show dimensions, sections, and relative locations of the various facilities within the disposal site boundary. All plans and drawings should be drawn to a scale large enough to convey the design information adequately and should be signed by a licensed engineer. As-built condition should ultimately be documented by the applicant as a permanent record for the constructed disposal facility. Construction specifications should be compatible and consistent with the design and operation requirements. The contents and procedures specified in the specifications should conform to the applicable industry codes and standards.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the construction methods and features for the [name of facility] low-level waste disposal facility according to Standard Review Plan (SRP) 3.3.1 to ensure that the construction methods used by the applicant will result in the long-term stability of the disposal site and that the required construction procedures and methods will ensure that the construction of the waste disposal facility will meet 10 CFR 61.41, 61.42, 61.43, and 61.44.

The construction procedures and methods that will be used by the applicant are applicable to the construction features of the disposal site and are related to site preparation, control and diversion of water, construction of disposal units, concrete and steel construction, backfilling, and disposal unit closure. The procedures and methods to be used will ensure that the functional requirements of the principal design features will be met.

The site plans have clearly shown the site boundary, restricted zone, security area, buffer zone, operational area, and general layout of the disposal facility. The engineering drawings have provided the necessary information for the construction of the waste disposal facility at [name of site]. Construction specifications provided by the applicant are based on the function and design requirements of the land disposal facility. Compliance with the

construction, drawings, and specifications will provide assurance that the land disposal facility will be properly constructed and will perform its intended safety function. The applicant has provided the information identified in SRP 3.3.1 and in 10 CFR 61.12(e) and (f). The construction procedures and methods that will be used by the applicant conform with established criteria, codes, standards, specifications, and good engineering judgment and are acceptable to the NRC staff. The use of these criteria, as defined by good engineering judgment and practice, and the applicable codes, standards, guides, and specifications (as noted below) provides reasonable assurance that, in the event of an occurrence of a design-basis event or of a postulated accident during construction and operation, the constructed facilities will withstand the specific design imposed loading conditions without impairment of structural integrity and stability.

The criteria and standards used by the applicant for the construction of the disposal facility meet Regulatory Guide 1.94, American Concrete Institute Code ACI 349, "Code Requirements for Nuclear Safety Related Concrete Structures," and American Institute of Steel Construction, "Specification for Design, Fabrication and Erection of Structural Steel for Buildings."

The applicant has provided detailed descriptions of the construction methods and procedures for the disposal facility that are acceptable. Because these procedures and methods have been proven to be adequate, they provide assurance that the construction of the waste disposal facility will meet the design requirements.

The site plans provided by the applicant have clearly shown the location and boundary of the disposal site. General layout of the facilities and disposal units are also indicated on the plans.

Engineering drawings provided by the applicant have conveyed the design information correctly and adequately. The drawings have provided the necessary information for the construction of the disposal facility including the location, type, and details of the structures, systems, and components of the land disposal facility. The engineering drawings provided by the applicant ensure that the designed land disposal facility will be properly constructed and will conform to the required design standards. The engineering drawings are acceptable and have met the technical information requirements of 10 CFR 61.12(e) and (f).

Construction specifications provided by the applicant are compatible and consistent with well-established industry codes, standards, and specifications and are acceptable to the staff. Provisions of the construction specifications provide reasonable assurance that the constructed disposal facility will conform to the specified design requirements.

On the basis of the findings, the staff concludes that there is reasonable assurance that the procedures and methods proposed by the applicant for the construction of the waste disposal facility are acceptable and meet the applicable provisions of 10 CFR 61.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR

for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commissions regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

American Concrete Institute, ACI 349, "Code Requirements for Nuclear Safety Related Concrete Structures", Detroit, MI, 1980.

American Institute of Steel Construction, "Specification for Design, Fabrication, and Erection of Structural Steel for Buildings", Chicago,IL, eighth edition 1981.

American National Standards Institute, ANSI N45.2, "Quality Assurance Program Requirements for Nuclear Facilities." New York. 1977.

---, ANSI N45.2.5, "Supplementary Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants", New York, 1974.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

---, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. G. Tucker, U.S. Department of the Army, Army Engineers Waterways Experiment Station, February 1983.

---, NUREG/CR-3356, "Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities," H. V. Johnson, S. J. Spigolon, and R. J. Lutton, U.S. Department of the Army, Army Engineer Waterways Experiment Station, June 1983.

---, NUREG/CR-5432, "Recommendations to the NRC for Soil Cover Systems Over Uranium Mill Tailings and Low-Level radioactive Wastes," Volume 3, R.D. Bennett and A.F. Kimbrell, U.S. Army Waterways Experiment Station, February 1991.

---, Regulatory Guide 1.28, "Quality Assurance Program Requirements (Design and Construction)."

---, Regulatory Guide 1.94, "Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants."

---, Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants."

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.3.2
CONSTRUCTION EQUIPMENT

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - Health Physicist

2. AREAS OF REVIEW

The staff will review the equipment that will be used in the construction of the low-level waste disposal facility to ensure that the equipment is adequate and will result in a safe and efficient disposal facility that will meet the performance objectives and technical requirements of 10 CFR 61. The staff's evaluation will include a review of the following:

(1) types of equipment
(2) equipment specifications and capabilities
(3) storage, maintenance, replacement, and inspection of equipment

3. REVIEW PROCEDURES

The staff will evaluate the equipment proposed by the applicant for the construction of the facility using the procedures in the following sections and in accordance with the acceptance criteria in Section 4 of this SRP. In addition to the review of the information provided, site visits to assess equipment capabilities to safely perform their intended functions may be made after a license has been issued.

3.1 Acceptance Review

The staff will review for completeness the information on construction equipment in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine whether the applicant has provided adequate and acceptable information on the equipment that will be used for the construction

of the disposal facility. The staff will evaluate the areas of review using the procedures discussed in the following sections.

3.2.1 Types of Equipment

The staff will review the information in the SAR to determine if the types of equipment (cranes, draglines, crawler dozers, compacters, etc.) and the pieces of equipment that will be used are adequate to safely construct and operate the disposal facility. In its evaluation the staff will consider site-specific features and requirements and the ability of the equipment to fulfill design objectives and safety goals.

3.2.2 Equipment Specifications and Capabilities

The staff will review the manufacturer's specifications provided for each piece of equipment pertinent to its intended function and usage. For example, the staff will review the capabilities of the equipment to safely handle the waste containers from the ground surface and to place them in the planned stacking arrangement in the excavated disposal unit and to properly place backfill between containers in order to fill voids and reduce future subsidence.

3.2.3 Storage, Maintenance, Replacement, and Inspection of Equipment

The staff will evaluate the information provided by the applicant that ensures that reasonable equipment for storage, maintenance, replacement, and inspection facilities, including backup equipment, are available to support a safe disposal operation. The staff will determine if the provisions and procedures proposed by the applicant will provide reasonable assurance that there will be no unsafe interruption or delay of the construction and operation activities and that safe handling or disposition of contaminated equipment has been adequately addressed.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (e), as it relates to the codes and standards that the applicant has applied to the design and that will apply to the construction of the disposal facility

(2) 10 CFR 61.12(f), as it relates to the description of the construction and operation of the disposal facility, which should include as a minimum, the methods of construction and the equipment to be used for the construction and operation of the disposal units and for waste emplacement

(3) 10 CFR 61.12(k), as it relates to the description of the radiation safety program for controlling and monitoring radioactive effluents to ensure compliance with the performance objective of 10 CFR 61.41 and the occupational radiation exposure requirements of 10 CFR 20 and to control contamination of personnel, vehicles, equipment, buildings, and the disposal site

(4) 10 CFR 61.43, "Protection of Individuals During Operations," which presents the performance objective of which the operational equipment would contribute towards the achievement of

4.2 Regulatory Guidance

There are no regulatory guides that apply to construction or operational equipment for low-level waste disposal facilities. However, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," discusses heavy construction equipment specifications and capabilities and offers guidance on the proper selection of equipment for use at low-level waste disposal facilities.

4.3 Regulatory Evaluation Criteria

Because there are no regulatory guides that directly cover construction and operational equipment to be used at low-level waste disposal facilities, the staff's evaluation will be based primarily on engineering judgment. On the basis of this judgment, the staff will conclude whether or not the information provided by the applicant acceptably fulfills the requirements of 10 CFR 61.12(e), (f), and (k). The type and scope of information to be provided have been identified in Section 3 of this SRP, and acceptance considerations are discussed in the following sections.

4.3.1 Types of Equipment

The information on construction equipment in the SAR will be acceptable to the staff if the subject matter addressed in Section 3.3.2 of NUREG-1199 and in this SRP is covered in sufficient detail with regard to the types of equipment and their functions. The applicant should provide information on the following categories of equipment:

(1) equipment for site preparation and safe control of surface water and groundwater
(2) equipment for excavation of disposal units
(3) equipment for hauling materials
(4) equipment for fill placement and compaction
(5) equipment for transporting, handling, and placing of low-level waste
(6) equipment for backfilling disposal units
(7) equipment for concrete and steel construction
(8) equipment for closure of individual disposal units and site closure

4.3.2 Equipment Specifications and Capabilities

Staff acceptance of the information provided on equipment manufacturer's specifications will be based on the capabilities of the construction equipment to safely perform the intended functions and fulfill design objectives.

4.3.3 Storage, Maintenance, Replacement, and Inspection of Equipment

Staff acceptance will be based on the adequacy of the procedures and measures pertinent to the storage, maintenance, replacement, and inspection of equipment. The staff will determine whether reasonable assurance is provided that construction and operation activities will not be interrupted and that unsafe conditions will not be permitted to develop because of the breakdown or scarcity of important and required equipment.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the types of equipment, and their capabilities, that are to be used in the construction and operation of the [name of facility] low-level waste disposal facility according to Standard Review Plan (SRP) 3.3.2 to ensure that the equipment will meet the construction requirements and will safely perform its intended functions. Selection and use of the designated construction and operational equipment are based on the required function and capability of the equipment. The applicant has ensured that, with the use of the designated equipment, the construction and operation of the disposal facility can be safely performed.

The staff has reviewed the information on the construction and operational equipment provided by the applicant and has concluded that the equipment is acceptable because reasonable assurance has been provided that it: (1) will perform its intended function; (2) is in conformance with the construction requirements; and (3) will permit safe construction and operation of the disposal facility.

The applicant has met SRP 3.3.2 and 10 CFR 61.12(e), (f), and (k) and has provided adequate information on the types of equipment and on equipment specifications and capabilities that will provide assurance of the safe performance of the equipment.

The applicant's procedures for the purchase, replacement, maintenance, and inspection of equipment are adequate, and the use of these procedures will ensure that there will be no unacceptable breakdown, interruption, or delay in the construction and operation of the land disposal facility.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

---, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. G. Tucker, U.S. Department of the Army, Army Engineers Waterways Experiment Station, February 1983.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.4
DESIGN OF AUXILIARY SYSTEMS AND FACILITIES

This SRP consists of the following:

SRP 3.4.1 Utility Systems
SRP 3.4.2 Auxiliary Facilities
SRP 3.4.3 Fire Protection System
SRP 3.4.4 Erosion and Flood Control System

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.4.1
UTILITY SYSTEMS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Electrical Engineer

1.2 Secondary - None

1.3 Supporting - Civil Engineer

2. AREAS OF REVIEW

The staff will review the utility systems of the proposed low-level waste disposal facility that would be designed to support the operational needs of the proposed facility and which directly contribute to worker safety.

The staff will evaluate the applicant's description of the utility systems that would include communication, electric, water, lighting, sanitary waste disposal, and fuel delivery systems to ensure that: (1) the design bases and design criteria for each utility system are adequate for the proposed facility; (2) each system will perform as predicted under design-basis events for the operational life of the facility; (3) the potential adverse effects of each utility system on the principal design features have been identified; and (4) the potentially adverse effects of each utility system will not significantly degrade or impair the safe performance of the facility.

3. REVIEW PROCEDURES

The staff will evaluate each of the utility system categories using the acceptance criteria in Section 4.3 of this SRP. The level of detail to be provided for review of each utility system should be commensurate with the importance of that system to the safe operation and performance of the waste disposal facility.

3.1 Acceptance Review

The staff will review for completeness the descriptions and analyses of the utility systems and their performance in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the design criteria and design bases for each utility system presented in the SAR and will assess the adequacy of this information with regard to its compatibility and effect on the principal design features. The staff will evaluate the applicant's identification and assessment of any potential adverse effects on the design and safe operation of the facility because of a malfunction or failure of a utility system.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) and (e), which require descriptions of design features, design criteria, design bases, codes, and standards related to design and the relationship of the aforementioned with each other and the performance objectives.

(2) 10 CFR 61.13, "Technical Analyses," (c) as it relates to the analyses for protection of individuals during operations in handling, storing and disposing of the waste.

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b) through (f), which require that the applicant's proposed design and other systems provide reasonable assurance that the performance objectives of 10 CFR 61 Subpart C, and the technical requirements will be met.

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.43 which present the performance objectives of which the utility systems must contribute toward the achievement

4.2 Regulatory Guidance

There are no regulatory guides or general design criteria that apply directly to the safety-related performance of the utility systems. The applicant should use the following section as guidance.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review of this SRP are given in the following sections.
SRP 3.4.1

4.3.1 Communication System

The communication system is acceptable if it is designed and installed so that it: (1) will provide clear communication, either visual or sound, between plant personnel at all times during waste receipt, handling, and disposal operations; (2) will provide a reliable link with offsite officials, particularly during a period of emergency response; (3) will be constructed according to common and accepted practice; and (4) will not interfere with the design or operation of the facility.

4.3.2 Electric System

The electric system is acceptable if it is designed and installed so that it: (1) will provide onsite power as required to safely operate the disposal facility; and (2) will be constructed according to common and accepted practice.

4.3.3 Water System

The water system is acceptable if it is designed and constructed so that it: (1) will provide adequate volumes of water for construction, operation, and fire fighting as required to safely operate the disposal facility; (2) will be installed according to common and accepted practice; (3) will provide potable water for workers; and (4) will provide warm water for the decontamination of workers as discussed in SRP 7.

4.3.4 Lighting System

The lighting system is acceptable if it is designed and installed so that it: (1) will provide adequate lighting during periods of construction and operation as required to safely operate the disposal facility; (2) will provide emergency lighting as required for anticipated accident scenarios; and (3) will be constructed according to common and accepted practice.

4.3.5 Sanitary Waste Disposal System

The sanitary waste disposal system is acceptable if it is designed and constructed so that it: (1) will be adequately sized for its anticipated usage; (2) meets applicable State and local codes and standards; and (3) will not interfere with the design and safe operation of the facility.

4.3.6 Fuel Delivery System

The fuel delivery system is acceptable if it is designed and constructed so that it: (1) will provide adequate fuel for the onsite building equipment and disposal activities; (2) would result in isolation of accidental fires, if they were to occur; (3) will meet or exceed the standards of common and accepted practice; and (4) will not interfere with the design or operation of the facility.

4.3.7 Other Utility Systems

Any other utility system that may be required for the safe operation of the proposed facility is acceptable if the system is designed and installed so that

it: (1) will be adequately sized for the proposed design; (2) will be constructed according to common and accepted practice; and (3) will not interfere with the design or operation of the facility.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the utility systems for [name of facility] low-level waste disposal facility according to Standard Review Plan (SRP) 3.4.1 to verify that sufficient information has been provided for each utility system that is required by the facility design; that each utility system has been designed and will be constructed to provide the support functions required by the principal design features, construction, and safe operation of the facility; and that the design and construction of the utility system will not adversely affect facility performance.

The applicant has accurately described the required functions of the [specify] system, including all the materials and components that are necessary so that it will function as required and at the capacity required. The staff has evaluated the adequacy of the applicant's proposed design criteria and bases for the [specify] system and the requirements for facility operations. The staff has determined that the applicant's proposed design of the [specify] system is consistent with the principal design criteria and bases. The system's design does not interfere with the design of the principal design features or the safe operation of the facility. Therefore, there is reasonable assurance that the [specify] system, which the staff has found acceptable, meets 10 CFR 61.12(b) and (e), 10 CFR 61.13(c), 10 CFR 61.23(b) through (f), and 10 CFR 61.41 through 61.43.

On the basis of its review, the staff concludes that the design of the [specify] system conforms to all applicable regulations and industry standards and is acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of a SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review. Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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STANDARD REVIEW PLAN 3.4.2
AUXILIARY FACILITIES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the auxiliary facilities of the proposed low-level waste disposal facility, including buildings and roadways, that have been designed to: (1) support the operational needs of the proposed facility by directly contributing to worker safety in accordance with 10 CFR 61.43; (2) support the construction requirements in accordance with 10 CFR 61.41, 61.42, and 61.44; and (3) not adversely affect completed closure measures.

The staff will evaluate the applicant's description of the auxiliary buildings, pursuant to 10 CfR 61.12(b), (e), and (f), to ensure that: (1) the design bases and design criteria for each building are adequate for the proposed facility's design, construction, and operations; (2) appropriate building codes and industry standards have been applied; (3) each building will safely perform under the conditions anticipated for the operational life of the facility; and (4) the buildings do not pose any potential adverse effects on the principal design features or construction and operational procedures of the proposed disposal facility.

The staff will evaluate the applicant's description of traffic systems with respect to the following:

(1) overall traffic system design, including the layout and purpose of roadways, materials to be used in their construction, traffic controls, and the appurtenant drainage features for the roadways to control surface water

(2) traffic movement of equipment and vehicles as they would affect overall safe operation of the disposal facility

(3) roadway design as it would affect closure and stabilization measures to be

completed at the facility

(4) roadway design as it would relate to the buffer zone and any adverse effect on the taking of mitigative measures, if required

3. REVIEW PROCEDURES

The staff will evaluate each of the auxiliary facilities using the acceptance criteria in Section 4.3 of this SRP.

3.1 Acceptance Review

The staff will review for completeness the description and analyses of auxiliary facilities and their performance in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the design bases and design criteria for each auxiliary facility reviewed under this SRP and will assess the adequacy of these bases and criteria with regard to the safe operation of the disposal facility. Using the applicant's design criteria, the staff will evaluate the applicant's description of each auxiliary facility and coordinate this information with facility layout, engineering drawings, and construction specifications reviewed under SRP 3.3.1. The staff will examine the applicant's discussion including references to the appropriate building codes and industry standards. The staff will evaluate the applicant's identification and assessment of any potential adverse effects on the design, construction, and operation of the facility. The staff will use the evaluation of the buffer zone to determine the effect, if any, of the auxiliary facilities on the buffer zone. The staff will use the evaluation of the closure and stabilization plan performed under SRP 5.1 to determine any effect the auxiliary facilities may have on the closure and stabilization measures.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b), (e), and (f), which require descriptions of design features, design criteria, design bases, codes, and standards related to design and the relationship of the aforementioned with each other and the performance objectives in 10 CFR 61, Subpart C, and a description of the construction and operation of the land disposal facility that includes onsite traffic systems

(2) 10 CFR 61.13, "Technical Analyses," (c) as it relates to the analyses

for protection of individuals during operations and would include assessment of expected exposures due to accidents during handling, storage, and disposal of waste

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b) through (f), which require that the applicant's proposed design and other systems provide reasonable assurance that the performance objectives of 10 CFR 61, Subpart C, and the technical requirements of 10 CFR 61, Subpart D, will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.43 which present the performance objectives of which the auxiliary facilities must contribute toward the achievement

4.2 Regulatory Guidance

There are no regulatory guides or general design criteria that apply directly to the safety-related performance of the auxiliary facilities. Staff guidance on roadways is provided in Section 3.1 of "Technical Position Paper on Near-Surface Disposal Facility Design and Operation," specifically in the section entitled "Access Roads."

4.3 Regulatory Evaluation Criteria

The staff will evaluate the information on each auxiliary facility according to the criteria given in the following sections.

4.3.1 Auxiliary Buildings

Auxiliary buildings are acceptable if they have been designed so that they: (1) will support operations at the facility in a manner consistent with 10 CFR regulations; (2) are constructed in accordance with applicable and appropriate Federal, State, and local building codes and industry standards; (3) will perform safely under loading imposed by normal design-basis events anticipated during the operational life of the facility; and (4) will not interfere with operations at the facility, including planned closure and stabilization activities.

4.3.2 Roadway Layout and Traffic Controls

The information on the roadway layout and traffic controls is acceptable if the proposed traffic system will support and not adversely affect safe operation of the facility, will not interfere with closure measures completed on disposal units during operations, and will not interfere with the buffer zone proposed for the facility. The roadway system is acceptable if it is compatible with the closure and stabilization plan proposed for the facility. The traffic controls should follow applicable industry standards, and the roadways should be of sufficient dimensions to allow for safe movement of facility equipment and vehicles. The layout should be designed so that environmental and site monitoring and remedial actions that may have to be undertaken in the buffer zone will not be affected.

4.3.3 Roadway Characteristics

The information on roadway characteristics is acceptable if the proposed roadways will support and not adversely affect safe operation of the facility and are compatible with the closure and stabilization plan proposed for the facility. The roadway materials should be sufficiently durable to handle traffic loads expected during operations without deterioration and should follow applicable and accepted industry standards. The roadway materials and characteristics including appurtenant drainage features should be consistent with the final plans for closure and stabilization proposed for the facility.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the auxiliary facilities for [name of facility] low - level waste disposal facility according to Standard Review Plan (SRP) 3.4.2 to verify that sufficient information has been provided by the applicant for each auxiliary facility that is required by the facility design; that each auxiliary facility has been designed to provide the supporting functions required by the principal design features, construction, and safe operation of the facility; and that the design and construction of the auxiliary facilities will not adversely affect the disposal facility performance.

The staff concludes that the objectives of the review have been met and that the review supports the following conclusions for the auxiliary facilities.

The applicant has accurately described the required functions of each auxiliary facility, including all buildings and roadways necessary to function as required by the disposal facility design, construction, and operation. The staff has determined the adequacy of the applicant's proposed design criteria and bases for each auxiliary facility. The staff has determined that each auxiliary facility conforms to the design criteria and bases and that the design does not interfere with the design of the principal design features, construction, or operation of the disposal facility. Therefore, there is reasonable assurance that the auxiliary facilities which the staff has found acceptable meet 10 CFR 61.12(b), (e), and (f), 10 CFR 61.13(c), 10 CFR 61.23(b) through (f) and 10 CFR 61.41 thru 61.43.

On the basis of its review, the staff concludes that the design of each auxiliary facility conforms to applicable regulations and industry standards and is acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of a SAR

for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

--- "Technical Position Paper on Near Surface Disposal Facility Design and Operation," November 1982.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.4.3
FIRE PROTECTION SYSTEM

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Fire Protection Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information on the fire protection system to ensure that the system can adequately respond to the accidental fires that could occur at the facility. Fire protection measures unique to a facility that handles radioactive materials have to be satisfactorily addressed by the applicant. The fire protection system includes the equipment, procedures, training, management, and emergency planning designed to provide fire protection at the facility. The review will include the following areas:

(1) the postulated accidental fires that could possibly occur in all important areas of the facility, which would include, as a minimum, the waste receipt area, the waste handling area, the waste storage area, and the disposal unit areas

(2) the equipment to be used for responding to a fire emergency

(3) the emergency response plan with established procedures to be implemented in case of a fire emergency

3. REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that the review procedure is complete and will use and emphasize the material from this SRP that may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on the fire protection system in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the information on the fire protection system in the SAR to determine if the applicant has followed the regulations and the guidance of applicable references and industry standards and has demonstrated that the methods used will provide reasonable and acceptable protection in the event of an accidental fire. The areas discussed in the following sections will be reviewed.

3.2.1 Accidental Fire Analysis

The staff will review the information on the accidental fires postulated to occur at the facility. In its postulation of accidental fires, the applicant should consider the initiation of fires under normal operating conditions as covered in SRP 3.2 for the waste receipt area, the waste handling area, the waste storage area, and the waste disposal area. The applicant also should consider and describe the anticipated chemical environment at the disposal facility and demonstrate with supporting information how the proposed fire protection system in the anticipated environment will safely control accidental fires and protect the health of facility personnel and the public.

3.2.2 Fire Protection System

The staff will review the information on the fire protection system for the disposal facility giving special attention to the management plan on response to a fire emergency; the procedures, materials, and equipment to be available for responding to a fire emergency; the procedures and equipment for providing offsite alarms in response to a fire emergency; and the training provided to facility personnel related to the prevention of fire and to protection during a fire emergency. The staff will review these aspects of the fire protection system and will determine if they are consistent with the specified methods recommended in NFPA 901-1981, "Uniform Coding for Fire Protection," of the National Fire Protection Association and other applicable guidance and are adequate to safely handle all types of fires and scenarios that could result from the postulated accidental fires.

3.2.3 Emergency Response

The staff will review the information on the response to a fire emergency to ensure that adequate measures are in place to evacuate facility personnel effectively and to provide sufficient public notification of potential radiological hazard, should this contingency be necessary. The results of the review conducted by the staff under SRP 8.4 will be used as input into the staff's conclusions in this area.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.11, "General Information," (b)(3) and (4), which require that information submitted by the applicant include a description of the applicant's personnel training program and a plan to maintain an adequate complement of trained personnel to carry out waste receipt, handling, land disposal in a safe manner

(2) 10 CFR 61.12, "Specific Technical Information," (b) and (e) which require descriptions of design features related to occupational exposures that would include fire protection measures and the applicable codes and standards the applicant will apply in the construction and operation of the land disposal facility

(3) 10 CFR 61.12, "Specific Technical Information," (k), which requires that information submitted by the applicant include a description of the radiation safety program for control and monitoring of radioactive effluents to ensure compliance with the performance objective in 10 CFR 61.4] and occupational radiation exposure to ensure compliance with the requirements of 10 CFR 20 and to control contamination of personnel, vehicles, equipment, buildings, and the disposal site; both routine operations and accidents must be addressed, and the program description must include procedures, instrumentation, facilities, and equipment

(4) 10 CFR 61.13, " Technical Analyses," (c) as it relates to the analyses for protection of individuals during operations and would include assessment of expected exposures due to accidents that would include postulated accidental fires

(5) 10 CFR 61.23, "Standards for Issuance of a License," (b), (c), (d), and (f), which require that the applicant's proposed design and facility operations provide reasonable assurance that the performance objectives of 10 CFR 61, Subpart C, and the technical requirements of 10 CFR 61, Subpart D, will be met

(6) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.43 which present the performance objectives of which the fire protection system must contribute toward the achievement

(7) 10 CFR 61.56, " Waste Characteristics," (a)(4) and (6) which require all classes of waste to be non-explosive and not be pyrophoric

4.2 Regulatory Guidance

Guidance is provided in the following national fire codes published by the National Fire Protection Association:

(1) NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials"

(2) NFPA 901-1981, "Uniform Coding for Fire Protection"

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 2 of this SRP are given in the following sections.

4.3.1 Accidental Fire Analysis

The information on the accidental fire analysis is acceptable if fires and their effects in the presence of radioactive substances are postulated for the waste receipt area, the waste storage area, and the waste disposal area, at a minimum. The analysis should consider the location where the most severe fire could occur, the materials likely to be consumed, the construction arrangement of any buildings or areas likely to be consumed, and the harmful effects of smoke and heat associated with the fire.

4.3.2 Fire Protection System

The information on the fire protection system is acceptable if (1) the procedures, materials, equipment, and systems for fire protection will protect workers and the public from radiation and fire hazards, (2) there is a suitable program for the prevention of hazards from radiation and fire, and (3) there is a program to adequately train facility personnel to respond to fire emergencies and to prevent fires. The methods proposed to provide this system should meet the prescribed recommendations of NFPA 801-1986 and NFPA 901-1981, including the referenced recommended practices, especially in regard to the equipment for the detection of fires; equipment for the prevention of fire hazards (sprinklers, etc.); onsite and offsite alarm systems; wet, dry, and chemical fire extinguishers; foam-extinguishing systems; personnel training; building materials; and facilities handling radioactive wastes. Buildings on site should meet the requirements of the Uniform Fire Code for their intended purposes, especially the waste receipt and storage areas, the vehicle washdown facility, and the waste repackaging areas.

4.3.3 Emergency Response

The information on the emergency response in the event of a fire is acceptable if the accidental fire analysis does not indicate any conditions that may adversely affect the results of the review and conclusions drawn under SRP 8.4. The emergency response plan reviewed under SRP 8.4 should contain adequate measures for the notification and evacuation of workers and nearby residents if a fire should occur.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the fire protection system for the [name of facility] low-level waste disposal facility according to Standard Review Plan 3.4.3. The staff concludes that the fire protection system has been designed (1) to maintain occupational exposures as low as is reasonably achievable if an accidental fire should occur and (2) to be compatible with the facility's radiation safety and emergency planning programs. The applicant has provided provisions for an adequate training program for personnel in fire prevention and protection. The fire protection system, therefore, meets 10 CFR 61.11(b)(3) and (b)(4), 10 CFR 61.12(b)(e), and (k), 10 CFR 61.13(c), (d), and (f), 10 CFR 61.41 through 10 CFR 61.43, and 10 CFR 61.56(a), (e), and (a), (b) as they relate to fire protection.

In meeting these requirements, the applicant has used the recommended methods in the following national fire codes published by the National Fire Protection Association (NFPA):

(1) NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials"

(2) NFPA 901-1981, "Uniform Coding for Fire Protection

On the basis of its review, the staff concludes that the proposed fire protection system is reasonable and acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

National Fire Protection Association, NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials," Quincy, MA.

---, NFPA 901-1981, "Uniform Coding for Fire Protection," Quincy, MA.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.4.4
EROSION AND FLOOD CONTROL SYSTEM

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Surface Water Hydrologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review those hydrologic analyses and design details that document that designs have been provided to adequately prevent erosion and surface flooding during the operation of the facility in accordance with the requirements of 10 CFR 61.51(a). The major review areas related to this aspect of the site design are identical to those described in SRP 6.3.1. Particular emphasis is placed on the review of information and analyses that document that flooding and surface runoff will not adversely affect the site, as required by 10 CFR 61.51(a)(5) and (a)(6).

Geomorphic instability and rock durability, however, are not reviewed under this plan because of the short operational period normally expected at a typical facility; they are reviewed only for long-term implications in accordance with SRP 6.3.1.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on the erosion and flood control system in the SAR in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply more information or an explanation. The staff, at this time, may recommend that the application be rejected or accepted for docu~entation, pending the submittal of the requested information.

If the staff finds that the information furnished by the applicant is adequate, the technical analyses will begin.

3.2 Safety Evaluation

The general review procedures that will be used by the staff in its evaluation

are identical to those described in SRP 6.3.1. However, geomorphological aspects and rock durability are not reviewed under this plan.

4. ACCEPTANCE CRIIERIA

4.1 Regulatory Requirements

Requirements related to the adequacy of information and technical evaluations are found in 10 CFR 61. 11(c) and 10 CFR 61.12. The basic acceptance criteria pertinent to the flooding aspects of these reviews are provided in 10 CFR 61.51(a)(5) and (a)(6), which generally require that the site design be capable of preventing erosion and flooding of disposal units.

4.2 Regulatory Guidance

Acceptable methods for estimating flood peaks and designing erosion protection features can be found in Draft Regulatory Guide, "Design of Long-Term Erosion Protection Covers for Reclamation of Uranium Mill Sites."

4.3 Regulatory Evaluation Criteria

A thorough evaluation of the surface water flooding and erosion protection aspects of the site design and the basic data and analyses supporting all conclusions are necessary. Criteria relevant to an assessment of the acceptability of information, data, and analyses submitted pertinent to each area of review are listed in the following sections.

4.3.1 Hydrologic Description of Site

Acceptance of the information presented is based on a qualitative evaluation of the completeness and quality of information, data, and maps. In accordance with 10 CFR 61.12, the description of structures, facilities, and erosion protection designs is sufficiently complete if it allows independent evaluation of the effects of flooding and intense rainfall. Site topographic maps are acceptable if they are of good quality and of sufficient scale to allow independent staff analysis of pre- and post-construction drainage patterns.

4.3.2 Flooding Determinations

Because of the risks associated with the flooding and/or release of low-level wastes during the period of vulnerability when wastes may not be covered or protected, the staff concludes that the probable maximum flood (PMF) and the probable maximum precipitation (PMP) provide acceptable bases for the design of flood protection features. Although use of the PMF is clearly acceptable for the operational design of low-level waste facilities, its use is not required. On a case-by-case basis, the staff will review site designs that are based on floods less than a PMF. The acceptability of using such floods must be documented by the applicant. The analyses must conclusively document the integrity of the site, particularly in light of the uncertainties associated with the magnitude and occurrence of rare floods.

The PMF is defined in American National Standards Institute/American Nuclear Society Standard ANSI/ANS 2.8-1981 and should be estimated for all adjacent streams, rivers, and site drainage channels.

The staff will review the applicant's analyses pertinent to the identification of the design-basis-flood magnitudes, levels, and velocities. Acceptance of the analyses is based on general agreement of the staff's and the applicant's estimates of static flood level and peak discharges and the adequacy of the computational methods used for such estimates.

4.3.3 Dam Failures

Acceptance criteria for dam-failure flood analyses and hydraulic designs are identical to those presented in SRP 6.3.1.

4.3.4 Flood Control Designs

Flood control features should be either (1) capable of preventing erosion and flooding of disposal units or (2) designed so that inundation does not result in the release of wastes from the disposal area. In general, flood control measures that are designed to accommodate an occurrence of the PMP or PMF provide an acceptable design. Details and acceptable methods of analysis of floods and flood velocities may be found in Draft Regulatory Guide, "Design of Long-Term Erosion Protection Covers for Reclamation of Uranium Mill Sites." If the design assumptions and calculations are conservative, reasonable, and accurate and/or compare favorably with independent staff estimates, the designs are found to be acceptable.

In many instances, engineering designs will be provided that will be used during both the postclosure period and the operational period. Specific examples of such designs include diversion channels and riprapped embankments. For those cases, acceptable design procedures and methods of analysis are also presented in SRP 6.3.1.

5. EVALUATION FINDINGS

5.1 Introduction

If the evaluation by the staff, based on a complete review of the hydraulic engineering aspects of the site design, confirms that regulatory guidelines have been met, documentation of the review will state that, in accordance with 10 CFR 61.51(a)(5) and (a)(6), the flood analyses and investigations adequately characterize the flood potential at the site, are appropriately documented, employ an acceptable level of conservatism, and/or represent a feasible plan for ensuring that disposal units will not be subject to flooding and erosion during the operational period.

5.2 Sample Evaluation Findings

The staff has reviewed the erosion and flood control system for [name of facility] low-level waste disposal facility according to Standard Review Plan 3.4.4.

During the operation of the facility, rock-protected diversion channels and flood embankments will be constructed to protect the site from the effects of onsite flooding. The diversion ditches will eventually become part of the long-term design against flooding.

For both offsite and onsite local flooding, the NRC staff independently estimated peak flood flows and velocities to determine the adequacy of the design features. These features were analyzed in accordance with the hydrologic procedures discussed in SRP 6.3.1. On the basis of these independent analyses, the staff concludes that the design of the facility meets the requirements of 10 CFR 61.51(a)(5) and (a)(6), so that site hydrologic features, when enhanced with the proposed design features, will prevent erosion and flooding of the disposal units during operation. Additional details related to the staff analysis are found in SRP 6.3.1, particularly for those features that will become part of the long-term design.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Same as those listed in Section 7 of SRP 6.3.1.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 4.1
RECEIPT AND INSPECTION OF WASTE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Technical Branch (LLTB)

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will determine if the applicant has adequate procedures in place to ensure that arriving shipments are in compliance with applicable Federal regulations and waste acceptance criteria that might be incorporated in the disposal facility license as conditions. These regulations and acceptance criteria govern the acceptability of waste packages for routine handling operations and for long-term disposal. This provides reasonable assurance that the waste receipt and inspection process conducted in accordance with 10 CFR 61.81 will be performed in a manner that assists in meeting the performance objectives of 10 CFR 61.41 through 10 CFR 61.44. The staff also will determine if the applicant's procedures are adequate to verify that the classification and characteristics of waste entering the site are in accordance with 10 CFR 61.55 and 10 CFR 61.56. Of primary importance in the review are the applicant's ability and objective to protect individuals during operations (10 CFR 61.43). In addition to ensuring conformance with applicable regulations, the staff will review the applicant's procedures to determine the applicant's ability and commitment to identify and respond to waste packages requiring remediation. Waste not in compliance with regulations and license conditions should be prohibited from entering the site disposal area.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review the applicant's waste receipt and inspection procedures and waste acceptance criteria to ensure that waste entering the site will be checked and to provide reasonable assurance that waste characteristics have been accurately recorded on a manifest in accordance with NRC and U.S. Department of Transportation regulations. The applicant's procedures should delineate actions to be taken when a violation is discovered that poses a safety or environmental hazard. These violations will be reported to the

inspections should be performed on selected packages picked at random intervals.

(3) Destructive sampling on packages identified by either the licensee or regulatory inspectors and determined to be appropriate because of their waste type and activity. This sampling, and the associated waste analysis, would normally be performed on an "as needed" basis. The sampling would further supplement the QA/QC program and nondestructive inspection to provide reasonable assurance that the waste is being properly classified and characterized by the generators.

The tiered approach is structured according to emphasis that the applicant should place on the respective elements. Primary emphasis should be placed on the review and audit of information provided by the generator. Next, the applicant should rely on information gathered at the site about the incoming wastes. Finally, if necessary, the applicant may perform, or have performed for it, independent analyses to determine that waste classification and verify the characteristics of the waste form.

Of primary importance in the review is the applicant's ability to protect individuals during operations (10 CFR 61.43). The staff will verify conformance with applicable regulations, and review the applicant's procedures and commitment to identify and address waste packages requiring remediation.

3 REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information in the SAR on the receipt and inspection of waste in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the applicant's waste receipt and inspection procedures and waste acceptance criteria and determine whether or not they are adequate to ensure that waste entering the site will be checked to provide reasonable assurance that waste characteristics have been accurately recorded on a manifest in accordance with NRC and U.S. Department of Transportation (DOT) regulations. The applicant's procedures should delineate actions to be taken when a violation is discovered that poses a safety or environmental hazard. These violations will be reported to the licensing authority in accordance with any reporting requirements in State or Federal regulations or in keeping with burial site license conditions. Flagrant and consistent violations could result in actions such as cessation of the receipt process, remedial actions to curtail releases and unwarranted exposures, and suspension or revocation of the shipper's disposal privileges.

The staff will review the information in the SAR on the applicant's receipt and inspection procedures to determine if the procedures provide for the following inspections:

(1) Visual examination of the shipping documents, including any required compliance certificates and the waste manifest, to acknowledge receipt of the waste. (The person generating the waste (waste generator) should have notified the facility that the waste was coming.) These procedures should ensure that the manifest contains the items of information required by 10 CFR 20.2006.

(2) Inspection of the waste package and its manifested contents for integrity and conformance with the NRC and DOT packaging requirements of associated waste analysis, would normally be performed on an "as needed" basis. The sampling would further supplement the QA/QC program and nondestructive inspection to provide reasonable assurance that the waste is being properly classified and characterized by the generators.

The tired approach is structured according to emphasis that the applicant should place on the respective elements. Primary emphasis should be placed on the review and audit of information provided by the generator. Next, the applicant should rely on information gathered at the site about the incoming wastes. Finally, if necessary, the applicant may perform, or have performed for it, independent analyses to determine the waste classification and verify the characteristics of the waste form.

Of primary importance in the review is the applicant's ability to protect individuals during operations (10 CFR 61.43). The staff will verify conformance with applicable regulations, and review the applicant's procedures and commitment to identify and address waste packages requiring remediation.

3 REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information in the SAR on the receipt and inspection of waste in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the applicant's waste receipt and inspection procedures and waste acceptance criteria and determine whether or not they are adequate to ensure that waste entering the site will be checked to provide reasonable assurance that waste characteristics have been accurately recorded on a manifest in accordance with NRC and U.S. Department of Transportation (DOT) regulations. The applicant's procedures should delineate actions to be taken when a violation is discovered that poses a safety or environmental hazard. These violations will be reported to the licensing authority in accordance with any reporting requirements in State or Federal regulations or in keeping with burial site license conditions. Flagrant and consistent violations could result in actions such as cessation of the receipt process, remedial actions to curtail releases and unwarranted exposures, and suspension or revocation of the shipper's disposal privileges.

The staff will review the information in the SAR on the applicant's receipt and inspection procedures to determine if the procedures provide for the following inspections:

(1) Visual examination of the shipping documents, including any required compliance certificates and the waste manifest, to acknowledge receipt of the waste. (The person generating the waste (waste generator) should have notified the facility that the waste was coming.) These procedures should ensure that the manifest contains the items of information required by 10 CFR 20.2006.

(2) Inspection of the waste package and its manifested contents for integrity and conformance with the NRC and DOT packaging requirements of 10 CFR Part 71. The procedures should call for checking the waste package to observe any irregularities in markings, labeling, and probably waste contents, and determine whether the package is correctly described on the waste manifest as to its size, type, and waste contents. In addition, visual checks should be performed and procedures should be in place to confirm that the "routine determinations" required by 10 CFR 71.87 have been made and the procedures for loading, receiving, and opening packages have been carried out as required by 10 CFR 20.1906.

The staff will confirm that the SAR describes the applicant's procedures to conduct verification surveys of the non-fixed (removable) radioactive contamination levels on the external surfaces of packages and vehicles to determine if they are within the limits of 10 CFR 71.87 and 49 CFR 173.443. In addition, procedures should be in place to verify that the external radiation levels around waste packages and in transporting vehicles are within the limits of 10 CFR 71.47 and 49 CFR 173.441.

The staff will make certain that the SAR contains procedures and information on waste package testing and appropriate test equipment. It will also review the applicant's ability to verify the accuracy of the waste class assigned to individual packages in accordance with 10 CFR 20.2006 and 10 CFR 61.55. The procedures should be consistent with the guidance in section 4.2 of this SRP and should include a method for verifying package content and a protocol for sampling waste packages to verify the classification and concentration of radionuclides (a list of these radionuclides is presented in Tables 1 and 2 of 10 CFR 61.55). These procedures should be generally capable of validating activity concentrations with a factor of 10 as is expected of the waste generator (see "Technical Position on Waste classification for 10 CFR Part 61"). The applicant's procedures should also contain provisions for determining concentrations of the difficult-to-measure radionuclides listed in 10 CFR 61.55. This may include, but is not limited to, radiochemical analysis.

Although the procedures may indicate that the applicant is aware of the method used for waste classification by the waste generator (see "Technical Position on Waste Classification for 10 CFR Part 61," pp. 3-6), the procedures should

have provisions for detecting and quantifying radionuclides other than those reported on the waste manifest and as independent of the source as practicable.

The amount of sample analysis and destructive testing should be based on the factors listed below. The frequency of these tests and analyses should be less than that proposed for non-destructive testing.

The staff will review the SAR to ensure that procedures are in place to verify that the waste received at the site will meet the waste characteristic and waste form stability requirements. This verification testing my incorporate conducting, either individually or collectively, direct sampling, real-time radiography and real-time radiological monitoring or other real time verification techniques deemed practicable for a particular application. Destructive testing (e.g., coring and cutting) will require that facilities be available (on site or through a contractor) to remotely handle, test, and repackage waste of all classes. Methods should be available to identify the chemical components of the waste and to determine that U.S. Environmental Protection Agency requirements on identifying and listing (40 CFR Part 261) are met for hazardous waste that may enter the site.

The staff will determine that procedures are provided to ensure that waste acceptance criteria are met in accordance with the license conditions that will be part of the facility license. The staff will ensure that waste acceptance criteria, which become license conditions, have been considered in the development of these procedures.

3.3 Requests for Additional Information

Upon conducting its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4.

4 ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The staff shall use the requirements of 10 CFR 61.55, 61.56, 61.81, 71.87, and 20.2006 and 49 CFR 173.441 and 173.443 and the performance objectives of 10 CFR 61 to determine the acceptability of the applicant's procedures for receiving and inspecting waste. The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 20, Subpart C, "Occupational Dose Limits," as it relates to the total occupational dose an individual may receive in a restricted area

(2) 10 CFR 20.1906, "Procedures for Picking up, Receiving, and Opening Packages," as it relates to receiving and opening packages

(3) 10 CFR 20.2006, "Transfer for Disposal and Manifests," as it relates to

the transfer of radioactive waste intended for disposal at a land disposal facility and the establishment of a manifest tracking system

(4) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity," as it relates to limits on radiation doses from land disposal facilities to the general public and requirements on the licensee to maintain doses as low as it reasonable achievable

(5) 10 CFR 61.42, "Protection of Individuals From Inadvertent Intrusion," as it relates to ensuring that intruder protection is provided by proper waste classification

(6) 10 CFR 61.43, "Protection of Individuals During Operations," as it relates to maintaining occupation exposures as low as is reasonably achievable

(7) 10 CFR 61.44, "Stability of the Disposal Site After Closure," as it relates to eliminating to the extent practicable the need for ongoing active maintenance of the disposal site after closure

(8) 10 CFR 61.55, "Waste Classification," as it relates to the methodology for properly classifying waste for near-surface disposal

(9) 10 CFR 61.56, "Waste Characteristics," as it applies to the minimum waste form stability and intruder protection requirements for waste entering the disposal site

(10) 10 CFR 61.81, "Tests at Land Disposal Facilities," as it pertains to test of radioactive wastes and facilities used for receipt, storage, treatment, handling, and disposal of radioactive wastes

(11) 10 CFR 71.47, "External Radiation Standards for all Packages," as it relates to external radiation standards for all packages, and

(12) 10 CFR 71.87, "Routine Determinations," as it relates to transport conditions required for packages and to ensuring that waste packages and their contents satisfy transportation regulations.

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the following documents:

NRC Regulatory Documents

(1) "Technical Position on Low-Level Radioactive Waste Classification and Manifest Reporting," providing the Commission's guidance for 10 CFR Part 61, as it pertains to acceptable procedures for classifying waste

(2) "Technical Position on Waste Form (Revision 1)," providing the

Commission's guidance for 10 CFR Part 61, as it pertains to ensuring stability for nonsegregated Class A waste and Class B and C waste

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review of this SRP are given in the following sections.

4.3.1 Examination of Shipping Documents

The applicant's procedures are acceptable if they: (1) provide reasonable assurance (for example, through the use of checklists) that NRC and DOT waste manifest information requirements are met; and (2) require written certification by a knowledgeable and responsible individual (such as the radiation safety officer (REO) or the REO's authorized representative) that such information has been provided on the manifest as required by 10 CFR 20.311.

4.3.2 Visual Check of the Waste Package

The applicant's procedures are acceptable if they provide for (for example, through the use of check lists) examination of the waste package for its integrity and conformance with DOT packaging requirements for shippers as codified in 49 CFR 173.4. Package markings, labels, probable waste contents (as evidenced by the type of package), and the waste manifest should correctly describe the size, type, and waste contents of the package. The procedures for visual inspection should determine that the "routine determinations" of 10 CFR 71.87(a) through (h) are satisfied. These procedures should include: (1) required written certification by a person of reasonable knowledge and authority; and (2) reporting requirements for found to be in noncompliance and requirements for the disposition of these items.

4.3.3 Survey for Non-Fixed (Removable) Contamination and External Radiation Levels

The applicant's procedures are acceptable if they contain methods for determining non-fixed (removable) contamination and external radiation levels in the most appropriate locations as required by 10 CFR 71.87. The non-fixed levels determined by taking smear samples should be compared with the maximum permissible limits of Table V, "Removable External Radioactive Contamination Wipe Limits," in 10 CFR 71.87. Procedures describing treatment of packages having non-fixed (removable) contamination above the maximum permissible limits should be in place. The external radiation levels around the package and around the vehicle should be compared with the limits specified in 10 CFR 71.47, "External Radiation Standards for all Packages." The disposition of waste packages, or vehicles, or both, exceeding the limits specified in 10 CFR 71.47 should be described in the applicant's procedures. Written certification should be required from a person of reasonable knowledge and authority (such as the REO or the REO's authorized representative), and reporting requirements should be mandatory for measurements that do not meet

the limits prescribed in the regulations cited above.

4.3.4 Verification of Waste Classification

The applicant's procedures are acceptable if the following conditions are met:

(1) The applicant has access to equipment or facilities capable of performing the waste classification determinations required by 10 CFR 20.2006.

(2) The analytical procedures and equipment demonstrate the applicant's capability to periodically perform, or have performed on the applicant's behalf, quantitative determinations for the waste generator in "Technical Position on Waste Classification for 10 CFR Part 61."

(3) The applicant's procedures, equipment, or vendor service should be capable of confirming the absence of significant chemicals in the waste, in particular those chemicals exhibiting a hazardous characteristic (see 40 CFR Part 261, Subpart C) or listed as hazardous (see 40 CFR Part 261, Subpart D) by the U.S. Environmental Protection Agency.

The applicant should characterize the chemical constituents of the waste form to ensure that no materials are included in an LLW package that are specifically excluded by regulation (40 CFR Part 261, Subpart A) from being disposed of in a facility licensed solely pursuant to the Atomic Energy Act of 1954 as amended or by operational consideration from being disposed of with LLW. The chemical characterization of heterogeneous solid wastes by traditional analytical techniques is extremely difficult to accomplish with any acceptable degree of confidence because of the diversity and variable time dependence of most waste streams and sampling methods. Thus, when such techniques such as a waste characterization method are used, they must be reproducible and valid and must have a known associated uncertainty. Consequently, much of the chemical characterization activity for LW will depend upon process knowledge, using relative concentrations and quantities in an analysis of the waste generation process, and will depend primarily upon data from the waste generator.

An acceptable frequency for direct sampling assay should be specific to the site and the waste stream, and should account for factors including the results of generator audits and other reviews of generator documents and programs, the anticipated volumes and activities received at the site, the performance history of various generators, and the results of nondestructive examinations. These tests and analyses should be performed where other information indicates problems that may require further investigation through more detailed testing and analysis.

4.3.5 Verification of Minimum Waste Form and Stability Requirements

The procedures and equipment are acceptable if the tests can be performed for all waste classes as outlined in the "Technical Position on Waste Form for 10 CFR Part 61":

(1) Solidified Class A Segregated Waste Products

These procedures should, as a minimum, allow identification of the wastes as a freestanding monolith and provide assurance that the waste has less than 0.5% freestanding liquid.

(2) Solidified Class A Waste Co-mingled with Stable Class B and Class C Waste

(a) Procedures should, as a minimum, provide for the verification of the structural stability including compressive strength following immersion testing of cored, solidified waste specimens.

(b) Class A solidified waste should have less than 0.5% freestanding liquid by volume of the waste and should be solidified completely.

(3) Solidified Class B and C Waste

These wastes should be demonstrated structural stability and be tested as in (2) above.

(4) High-Integrity Containers

(a) The maximum free liquid in a high-integrity container (HIC) should be less than 1% the waste volume.

(b) Procedures should include methods for verifying that specific HIC materials comply with HIC certificates of compliance. They should also include methods to verify that the HIC design is appropriate for any anticipated corrosive and chemical effects of the disposal environment by acknowledging that site parameters are within the design parameters established in the certificate.

4.3.6 Identification of Packages Requiring Remediation

The procedures are acceptable if the following types of waste can be identified and made safe:

(1) waste that does not meet the DOT's external radiation or surface contamination levels

(2) waste that is not packaged properly

(3) waste containing unacceptable materials including hazardous, biological,

and pathogenic material not authorized for LLW disposal

(4) waste that exceeds the maximum allowable activity levels and concentrations for specific radionuclides

(5) waste that does not meet the applicable waste form requirements

(6) waste that does not carry the proper manifest (e.g., waste that does not contain information required for identification of major constituents or pertinent information on the identification of the person(s) shipping the waste)

4.3.7 Disposition of Unacceptable Packages

The staff should verify that the applicant has procedures in place to handle waste packages that are not acceptable for disposal and that cannot be remediated on site.

4.3.8 Records and Reports

The staff should verify that the applicant's procedures implement the requirements of 10 CFR 61.80(f) and Appendix F to 10 CFR Part 20 for maintaining records and issuing reports.

5 EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements in 10 CFR Part 61 and 10 CFR Part 20 and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the applicant's procedures for the receipt and inspection of waste entering the [name of facility] low-level waste disposal facility according to Standard Review Plan 4.1 and finds that the information is as requested in NUREG-1199, Section 4.1.

The applicant's procedures will result in routine inspections that provide reasonable assurance that waste entering the disposal facility meets the packaging, labeling, placarding, and survey requirements of the U.S. Department of Transportation and 10 CFR 71.

The applicant's procedures will provide for the verification of the waste manifest requirements, as necessary and appropriate, of 10 CFR 20, Appendix F including identification of the waste class, chemical and physical contents, identification of the person shipping the waste, and probable assurance that

the waste meets the requirements for waste form and waste classification as required by 10 CFR 61.55 and 61.56.

The applicant's procedures provide for adequate and reasonable measures to ensure that the waste does not contain hazardous constituents as defined by the U.S. Environmental Protection Agency's regulations in 40 CFR Part 261 Subparts C and D.

The applicant's procedures provide for adequate and reasonable measures to clean up vehicles and dispose of waste packages that do not comply with applicable regulations.

The applicant's procedures help to ensure that the performance objectives of 10 CFR 61, Subpart C, will be met with regard to the following:

(1) protection of the general population from releases of radioactivity and effective implementation of policies that maintain any releases as low as is reasonably achievable as required by 10 CFR 61.41;

(2) protection of individuals from inadvertent intrusion as required for certain waste classes that are identified and verified by the applicant's inspection procedures and as required by 10 CFR 61.42;

(3) protection of individuals during operations as determined by a comparison of exposures against 10 CFR 20 limits for occupational exposures and as required by 10 CFR 61.43;

(4) stability of the disposal site after closure (10 CFR Part 61.44) as ensured by meeting the minimum waste form and stability requirements of 10 CFR 61.56.

6 IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7 REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," Title 40, "Protection of Environment," and Title 49, "Transportation," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, "Technical Position on Low-Level Radioactive Waste Classification and Manifest Reporting," February 1986.

---, "Technical Position on Waste Classification for 10 CFR Part 61," May 1983.

---, "Technical Position on Waste Form," January 24, 1991.

General

American Nuclear Society, ANS 55.1, "American National Standard for Solid Radioactive Waste Processing System for Light Water Cooled Reactor Plants," La Grange Park, IL, 1979.

American Society for Testing and Materials, ASTM C-39, "Compressive Strength of Cylindrical Concrete Specimens," Philadelphia, PA, 1979.

---, ASTM D 1074, "Compressive Strength of Bituminous Mixtures," Philadelphia, PA, 1980.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 4.2
WASTE HANDLING AND INTERIM STORAGE

1 RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist

1.2 Secondary - Civil Engineer

1.3 Supporting - None

2 AREAS OF REVIEW

The staff will review the information on waste handling and interim storage to ensure that the waste will be handled safely and segregated properly following receipt at the disposal facility and that sufficient storage will be provided. Additionally, the review is to ensure that the storage provided will be carried out in a safe manner and in a way that will prevent contact of water with the stored waste. Waste handling includes: (1) the procedures and equipment that will be used to safely move waste from the receipt area; and (2) the operations to define, identify, and segregate Class A, Class B, and Class C wastes properly for disposal. Depending on the disposal operations proposed by the applicant to provide for intruder protection and on the stability of Class A waste forms to be received, Class A, Class B, and Class C wastes may be disposed of together in one disposal unit or in separate disposal units. Proper segregation will depend on the proposed actions, and the staff's review will depend on this necessary segregation. Waste storage includes the procedures, buildings, and equipment that will be used to store waste after receipt for a short time before disposal.

The evaluation of waste handling and interim storage will include a review of the descriptions in the SAR, specifically of the following areas:

(1) Procedures, processes, and equipment used to segregate waste for disposal: Depending on the disposal operations proposed by the applicant, Class A, Class B, and Class C wastes may be disposed of in one disposal unit or in combinations in more than one disposal unit.

(2) Procedures, processes, buildings, and equipment to store waste for a short time before disposal: Specific attention should be paid to the means of preventing contact of water with waste during storage.

3 REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that this review procedure is complete and will use and emphasize material from this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on waste handling and interim storage in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the information on waste handling and interim storage in the SAR to determine if the applicant has followed the regulations and the guidance of applicable references and industry standards and has demonstrated that the applicant's methods will provide the stated performance. The areas of review discussed in the following section will be reviewed.

3.2.1 Waste Handling

The staff will review the information and determine the adequacy with specific attention to

(1) the procedures and processes for the receipt area

(2) the operations to define, identify, and segregate Class A, Class B, and Class C wastes

(3) the procedures and processes for remediation waste packages damaged in storage

(4) the procedures and processes for handling unique containers (extreme weight, shape or radiation levels)

(5) the procedures and processes for retrieving waste packages from interim storage

(6) the procedures for segregating waste packages.

The staff should determine the adequacy of procedures to protect workers handling waste, especially those procedures for handling wastes that represent a significant radiological or physical hazard. The staff should evaluate (1) the effect of segregation procedures on the integrity of packages and (2) the proposed repackaging processes for any packages damaged. The staff should review the use of equipment for handling the different classes of waste

according to applicable industry standards. Review under this section of the SRP should be coordinated with the review under SRP 3.3.2.

The staff should evaluate the licensee's procedures for manifesting and disposing of waste generated at the site.

3.2.2 Interim Storage

The staff will review the information and determine the adequacy of interim onsite storage with specific attention to

(1) the availability of storage space when necessary

(2) the procedures for efficient use of storage space

(3) the maximum allowable time that waste will be permitted to be placed in storage before disposal

(4) the use of interim storage for efficient testing container and contents of the waste packages

(5) the processes for maintaining security in the interim storage area

(6) the procedures for maintaining the safety of the workers during the transfer of waste packages into and out of interim storage and the observance of all Federal and State safety regulations

(7) elements of the applicant's radiation protecting program which specifically address waste in storage

(8) the applicant's criteria for waste storage

(9) procedures for maintaining waste packages in a condition suitable for disposal during interim storage.

The staff will evaluate the method proposed to protect stored waste from the effects of adverse weather conditions and water runoff. The staff should also evaluate the method proposed for operating the facility during and after sustained rainfall or other adverse weather conditions. The staff should review the manner in which the applicant installs, uses, and maintains equipment according to the applicable industry standards. The staff should coordinate this review with the review under SRP 3.3.2.

3.2.3 Combined Handling and Storage Considerations

The staff will evaluate the processes for handling and storing waste that have elements common to both such as:

(1) equipment commonly used in the industry and specialized equipment for handling and storage of waste onsite

(2) the staffing requirements for handling and storing waste at the disposal site

(3) the creation of decontamination waste, the procedures and processes for handling, storing, and disposing of this waste

(4) the methods used to minimize waste generation during decontamination activities

(5) the methods to minimize worker exposure and dose commitments, and the procedures for record keeping

(6) the contingency procedures and processes for emergency equipment failure, accidents, and extreme natural phenomena

(7) the procedures and processes for handling and storing fissile materials with regard to security, safety, strategic significance, and criticality safety

The staff should evaluate the adequacy of the procedures and processes that describe the method for monitoring vehicles before their release off site. The procedures should specify the number and location of readings and smears, the actions to be taken if the contamination is above limits, and the results of the resurvey of any areas over limit.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4 ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (f), as it relates to the procedures for and areas of waste segregation

(2) 10 CRF 61.43, "Protection of Individuals During Operations," which requires that operations at the land disposal facility be conducted in compliance with the standards for radiation protection in 10 CFR 20 and that every reasonable effort be made to maintain radiation exposures as low as is reasonably achievable

(3) 10 CFR 61.51, "Disposal Site Design for Land Disposal Site Closure," (a)(1), which requires that the disposal site be designed to minimize to the extent practicable the contact of water with waste during storage and disposal

(4) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(1), which requires that wastes designated as Class A be segregated from other wastes by placing them in disposal units that are sufficiently separated from disposal units for the other waste classes so that any interaction between Class A wastes and other wastes will not result in failure to meet the performance objectives in 10 CFR 61, Subpart C; this segregation is not necessary for Class A wastes if they meet the stability requirements for waste in 10 CFR 61.56(b)

4.2 Regulatory Guidance

Guidance is provided in Section 3.3 of the "Branch Technical Position on Near-Surface Disposal Facility Design and Operation" as it relates to waste storage and the efforts needed to minimize the contact of water with waste containers. Guidance for implementing the 10 CFR 61 waste form requirements is provided in "Technical Position on Waste Form."

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 2 of this SRP are given in the following sections.

4.3.1 Waste Handling

The information on waste handling is acceptable if the procedures proposed provide for the proper handling and segregation of Class A, Class B, and Class C wastes at all times. The proposed procedures should provide for the protection of workers during all phases of handling with special emphasis on the procedures when handling wastes that present a significant radiological or physical hazard. Segregation procedures should provide for the protection of any packages against damage. Handling procedures should contain contingency plans for damaged packages and propose repackaging procedures. Equipment to be used should meet industry standards and have the capability to permit safe handling of waste and to carry out its intended design functions.

4.3.2 Interim Storage

The information on interim storage of waste is acceptable if the procedures proposed result in the use of dedicated short term storage space when necessary, the efficient use of storage space, and the disposal of waste as soon as possible after receipt. The proposed storage system is acceptable if the waste, buildings, and equipment will be protected from the adverse effects of precipitation, and waste will be protected from contact with surface water. Equipment to be used should meet industry standards and be installed to meet the intended safety functions of the disposal facility. Criteria for interim storage should reflect the need for prompt disposal of waste material. Storage procedures should address the maintenance of waste package integrity that is consistent with disposal requirements.

4.3.3 Combined Handling and Storage Considerations

The information provided by the applicant for combined handling and storage considerations for waste received for disposal is acceptable if the applicant (1) has provided adequate rationale for equipment and staffing requirements for waste handling and storage, (2) has provided a realistic assessment of waste creation and subsequent disposition during the handling and storage of waste received for disposal, (3) has provided a realistic assessment of increased worker exposure during waste handling and storage and has procedures in place to maintain such exposures ALARA, (4) has provided an adequate rationale for methods of handling fissile materials, and (5) has provided an adequate basis for the release of transport vehicles off site following off loading and, if necessary, vehicle decontamination.

5 EVALUATION FINDINGS

5.1 Introduction

The staff should verify that the applicant provided sufficient information in the SAR to satisfy the applicable 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. Upon reviewing this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the waste handling and interim storage operations for the [name of facility] low-level waste disposal facility according to Standard Review Plan 4.2.

The staff concludes that the waste handling and interim storage operations are designed to (1) maintain radiation exposures as low as is reasonably achievable, (2) minimize contact of water with waste while it is in storage, and (3) appropriately segregate Class A unstable wastes from stable Class B and Class C wastes during disposal. The facility, therefore, meets 10 CFR 61.43 as it relates to radiation protection of individuals during operations, 10 CFR 61.51(a)(6) as it pertains to minimizing contact of water with waste, and 10 CFR 61.12(f) and 61.52(a)(1) as they relate to the storage and segregation of waste. In meeting these requirements, the applicant has used the methods recommended in "Branch Technical Position on Near-Surface Disposal Facility Design and Operation," including those for (1) minimizing the extensive storage of waste, (2) disposing of waste after receipt as soon as possible, (3) protecting any needed storage areas from precipitation by the use of shelters or covers, (4) protecting any needed storage areas from surface water runoff by grading or by lacing the waste on platforms so that it is above surface water runoff, and (5) the proper handling of waste during receipt that will ensure the segregation of waste designated as unstable Class A.

The staff concludes that the applicant will conduct operations for both the storage and handling of waste using appropriate staffing and equipment. Worker exposures will be maintained ALARA. Security and safeguards are appropriate for the quantities of SMN to be received for disposal. The applicant will implement proper administrative controls to ensure criticality safety. The applicant will minimize the amount of incidental waste generated and will properly manifest and dispose of that which is generated. Contingency planning is adequate for the maximum credible onsite emergency during handling and storage.

The staff concludes that the applicant's procedures for surveying and releasing waste transport vehicles are adequate to ensure proper disposition of transport vehicles.

6 IMPLEMENTATION

This SRP provides guidance to the HRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes and acceptable alternative methods for complying with the Commission's regulations, the staff will use the methods described herein.

7 REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, "Branch Technical Position on Near-Surface Disposal Facility Design and Operation," November 1982.

---, "Technical Position on Waste form for 10 CFR Part 61," May 1983.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

STANDARD REVIEW PLAN 4.3
WASTE DISPOSAL OPERATIONS

1 RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist

1.2 Secondary - Civil Engineer

1.3 Supporting - None

2 AREAS OF REVIEW

The staff will review the information on waste disposal operations to ensure that all waste disposal operations are carried out in a safe manner. Specific aspects of the disposal operations that will be reviewed include (1) waste emplacement procedures for maintaining the integrity of waste packages during movement, clarifying placement in disposal units, reducing void spaces between packages, and segregating waste that has not otherwise been segregated for regulatory or administrative reasons during handling and storage; (2) procedures for filling void spaces between packages after emplacement; (3) the covering of wastes in individual disposal units that will result in the surface radiation doses to the disposal facility worker meeting applicable regulations; (4) procedures for locating disposal units and marking unit boundaries; (5) closure and stabilization of individual disposal units; and (6) development of a buffer zone around and beneath the disposal facility. Waste disposal operations discussed in this SRP include all of the above procedures, any additional necessary procedures or operations, and waste handling and interim storage before the individual disposal units are closed and stabilized. The information on operations and procedures to be provided by the applicant should include a description of the equipment and supplies necessary to perform the stated procedures, and this information will be coordinated with the review under SRP 3.3.2.

The staff shall also review information on procedures to produce and maintain such rewards as are required to demonstrate adherence to the conditions of the license, rules, regulations, and orders of the Commission. The staff will conduct the review with specific attention to

(1) location of radioactive waste in the disposal unit

(2) the need for administrative segregation of radioactive waste to optimize disposal unit stability but minimize worker radiation exposure

(1) location of radioactive waste in the disposal unit

(2) the need for administrative segregation of radioactive waste to optimize disposal unit stability but minimize worker radiation exposure

(3) conditions of the package

The staff's evaluation of the waste disposal operations will include a review of the description in the SAR of the following areas:

(1) Procedures, processes, and equipment to emplace all classes of waste in their proper disposal units, with specific attention to procedures that maintain package integrity and minimize void spaces between packages and that provide for intruder protection. The staff review of proposed intruder protection measures will be performed as indicated in SRP 6.2.

(2) Procedures, processes, materials, and equipment used to fill any void spaces that may be between waste packages placed in disposal units.

(3) Procedures, processes, materials, and equipment used to cover disposed wastes in the disposal unit so that radiation doses meet applicable regulations.

(4) Procedures, processes, materials, and equipment used for locating and marking disposal units, for providing for survey control points within the disposal facility boundaries, and for accurately mapping and recording locations and boundaries of disposal units.

(5) Procedures, processes, and documentation used for establishing a sufficiently sized buffer zone both within the facility areal boundary and below the emplaced waste.

(6) Procedures, processes, materials, and equipment used for closing and stabilizing each individual disposal unit with specific attention to the procedures for ensuring that ongoing disposal operations will not disturb closure and stabilization measures already completed and for ensuring that closure and stabilization of individual disposal units are compatible with the final closure and stabilization plan for the disposal facility.

(7) Procedures used for emplacing packages containing significant quantities of Special Nuclear Materials (SNM).

3 REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that this review procedure is complete and will use and emphasize material from

this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on waste disposal operations in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the information on waste disposal operations in the SAR to determine if the applicant has followed the regulations and the guidance of applicable references and has demonstrated that its methods will provide the stated performance. The staff will evaluate the areas of review discussed in the following sections.

3.2.1 Waste Segregation

The staff will review and evaluate the information on waste segregation and disposal during its review under SRP 4.2, including procedures for segregating waste to comply with 10 CFR 61.12 and 61.55. The staff shall review and evaluate the information on the methods to be used in handling and disposing of wastes containing chelates or other non-radiological substances that might affect the achievement of performance objectives. The staff shall also evaluate the need for additional segregation measures within disposal units in order to optimize radiation protection both on site and off site and to affect disposal unit stability in accordance with current NRC guidance.

3.2.2 Waste Emplacement

The staff will review the information on waste emplacement and will place special emphasis on the procedures and operations proposed to emplace unstable Class A wastes and stable Class A, B, and C wastes in their respective disposal units. The review will concentrate on the methods that will be used to (1) prevent damage to packages, (2) minimize void spaces within and between waste packages, and (3) protect workers from exposure during waste emplacement operations. In describing these methods, the applicant needs to coordinate this information with the applicable portions of Section 3.2 in SRPs 3.3.1 and 3.3.2.

The staff will also review information on specific emplacement procedures which address high surface radiation packages, heavy or irregularly shaped packages, and packages with other unique disposal needs.

3.2.3 Filling of Void Spaces

The staff will review the information on the filling of void spaces between waste containers and give special attention to the materials that will used as fill and the procedures and operations proposed to minimize subsidence of

excavation covers and caps. Appendix A to this SRP provides staff recommendations and guidance on filling void spaces around waste containers that are emplaced in low-level waste land disposal excavations.

The scope of the review will include the properties of the material that will be used to fill the void spaces, such as density, low compressibility, permeability, and other engineering properties that demonstrate its ability to minimize subsidence; the properties of the material related to conformability that allow it to fill the void spaces, such as grain size and cohesionless characteristics; and the procedures and equipment that will be used for the placement and compaction of the material. The staff will require information on the quality and chemical composition of the fill materials and a discussion that addresses the long-term performance of the fill materials in recognition of the disposal environment that these fill materials will be subjected to.

3.2.4 Waste Covering

The staff will review the information on waste coverings giving specific attention to the procedures, materials, and operations proposed that will limit the radiation dose rate to the disposal facility worker at the surface of the cover to required levels that, at a minimum, will permit the applicant to comply with all the provisions of 10 CFR 20. The scope of the review will include information on the shielding provided for the waste that will be disposed of in each type of proposed disposal unit, the methods that will be used to cover waste after its emplacement in the disposal units, and the thicknesses and designs of covers and caps and their abilities to provide shielding. Information on the proposed use of cement, grout, or other engineering material should be provided with a discussion on these materials' ability to provide shielding and remain stable for the long term along with a description of the equipment to ensure that it will be properly placed and serve its intended design function.

Information on waste covering should include all the materials and operation and construction activities required to complete and close an individual disposal unit. Operations and activities required for permanent site closure that would involve the covering of all of the disposal units are addressed in SRP 5.1.2.

3.2.5 Locating Disposal Units and Boundary Markers

The staff will review the information and determine the adequacy of locating disposal units and boundary markers to comply with 10 CFR 61.52 (a)(7) giving specific attention to

(1) the procedures proposed to survey the facility

(2) the procedures to accurately map the disposal units and the facility

(3) the procedures to mark the disposal units and facility boundaries with long-term durable monuments

The staff will review the information and determine the adequacy of procedures to identify the location of the disposal units and the waste within them by means of engineering surveys and permanent markers or monuments. The review will cover

(1) the qualifications of the survey personnel

(2) the methods to establish horizontal and vertical controls and the level of field survey control that will be required

(3) the procedures and documentation to create a permanent record of the disposal units and facility boundaries to comply with 10 CFR 61.80

The information to be visible on permanent markers of disposal units will include

(1) the total activity of radioactive material in curies

(2) the total amount of source term material in kilograms

(3) the total amount of special nuclear material in grams

(4) the disposal unit number

(5) the dates the excavation was opened and closed, and

(6) the volume of waste in the disposal unit excavation

3.2.6 Disposal Unit Closure and Stabilization

The staff will review the information on disposal unit closure and stabilization giving specific attention to the procedures and operations that are intended to ensure that ongoing waste disposal operations will not disturb completed and closed disposal units. The scope of the review will include

(1) the methods proposed for closing individual disposal units and for placing cover materials over the waste or the disposal unit

(2) the design and construction features of completed units to ensure compatibility with final closure and stabilization plans (e.g., compatibility of final cover and grading with surface water management plan and erosion control measures

(3) provisions for regular inspections and monitoring of completed units for subsidence, ponding of water, erosion, and infiltration resulting from

unsuccessful erosion protection measures

(4) construction operations to be completed if problems are identified during the regular inspections

3.2.7 Buffer Zone

The staff will review the information on the buffer zone giving special attention to the procedures and documentation for establishing a buffer zone in three dimensions within the facility. The review will cover the distances proposed for all three dimensions (areal and depth) with specific attention paid to the ability of the applicant to carry out the proposed operational and post-operational environmental monitoring and surveillance activities that are reviewed under SRPs 4.4 and 5.3, especially groundwater flow direction and velocity. In establishing the buffer zone distances, considerations should be given to allowing adequate space and dimensions for the taking of mitigative measures should the monitoring records show that remedial measures are required.

3.2.8 Nuclear Criticality Safety

The staff will review the procedures that would be in place to ensure that a nuclear criticality could not take place during the life time of the facility. NRC staff is writing specific guidelines for criticality safety verification at LLW facilities. These guidelines will be included in subsequent revisions of this document. The staff will consider such parameters as package geometry, package configuration, administrative procedures for handling, storage, and disposal of SNM, and disposal scenarios which could lead to the physical reconfiguration of buried waste.

3.2.9 Operational Responsibilities

The staff will review with degree to which the applicant has established operational responsibilities with specific attention to

(1) organizational charts showing the corporate management and technical support structure for waste disposal and the rest of the corporate organization

(2) identification of organizational units, augmented organizations, and other personnel that will manage or execute any phase of the licensee's program, including the responsibilities and authority of the principal participants

(3) educational background and experience requirements for each of the following:
- engineering (materials, geotechnical, hydraulic, and structural)
- engineering geology

- health physics and radiation protection
- maintenance support
- operations support
- quality assurance
- outside contractual assistance

4 ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) and (f), which requires that a description of the design features and construction and operation of the land disposal facility be included in the SAR and that this description include, as a minimum, waste emplacement, procedures for and areas of waste segregation, onsite traffic and drainage systems, survey control program, methods to control surface water and groundwater access to the wastes, and methods to be used in the disposal of wastes containing chelating agents or other non-radiological substances;

(2) 10 CFR 61.43, "Protection of Individuals During Operations," which requires that operations at the land disposal facility be conducted in compliance with the standards for radiation protection in 10 CFR 20 and that every reasonable effort be made to maintain radiation exposures as low as is reasonably achievable

(3) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(2), which requires that the disposal site design and operation be compatible with the disposal site closure and stabilization plan and lead to disposal site closure that will provide reasonable assurance that the performance objectives of Subpart C of 10 CFR 61 will be met

(4) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(4), which requires that wastes be emplaced in a manner that will maintain package integrity during emplacement, minimize the void spaces between packages, and permit the void spaces to be filled

(5) 10 CFR 61.52(a)(5), which requires that void spaces between waste packages be filled with earth or other material to reduce subsidence within the fill

(6) 10 CFR 61.52(a)(6), which requires that waste be placed and covered in a manner that will limit the radiation dose rate at the surface of the cover to levels that, at a minimum, will permit the licensee to comply with all provisions of 10 CFR 20.1301(c), 20.1301(d) at the time the license is transferred pursuant to 10 CFR 61.30

(7) 10 CFR 61.52(a)(7), which requires that (a) boundaries and locations of each disposal unit be accurately located and mapped by means of a land survey; (b) near-surface disposal units be marked in such a way that boundaries of each unit can be easily defined; (c) three permanent survey marker control points, referenced to U.S. Geological Survey (USGS) or National Geodetic Survey (NGS) survey control stations, be established on the site to facilitate surveys; and (d) the USGS or NGS control stations provide horizontal and vertical controls as checked against USGS or NGS record files

(8) 10 CFR 61.52(a)(8), which requires that a buffer zone of land be maintained between any buried waste and the disposal site boundary and beneath the disposed waste and that the buffer zone be of adequate dimensions so that the environmental monitoring activities specified in 10 CFR 61.53(d) and mitigative measures, if needed, can be performed

(9) 10 CFR 61.52(a)(9), which requires that closure and stabilization measures as set forth in the approved site closure plan be carried out as each disposal unit is filled and covered

(10) 10 CFR 61.52(a)(10), which requires that active waste disposal operations not have an adverse effect on completed closure and stabilization measures

4.2 Regulatory Guidance

The NRC provides guidance in "Technical Position Paper on Near-Surface Disposal Facility Design and Operation," November 1982, on the waste disposal operations that are covered in this SRP.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 2 of this SRP are given in the following sections.

4.3.1 Waste Emplacement

The information on waste emplacement is acceptable if the procedures, processes, and equipment ensure that all classes of waste will be placed in their proper disposal units at all times in a manner that will maintain package integrity, minimize void spaces between packages, and protect facility workers from exposure. Emplacement procedures should include information on personnel protection during emplacement of wastes, especially Class C wastes. Equipment should meet industry standards and be operated safely according to commonly accepted industry procedures.

4.3.2 Filling of Void Spaces

The information on the filling of void spaces is acceptable if the procedures, processes, and equipment proposed provide for the filling of void spaces that between packages in all disposal units in a way that will minimize the subsidence of disposal unit covers and caps. Acceptable methods for filling void spaces are presented in Appendix A to this SRP. Equipment to be used for filling voids should meet industry standards and be operated safely according to commonly accepted industry procedures and have the capability to fulfill the required function of minimizing the void spaces.

4.3.3 Waste Covering

The information on waste covering is acceptable if the procedures, processes, materials, and equipment that are proposed result in the disposal of all classes of waste in a way that will limit the radiation dose rate at the surface of the cover to levels that, at a minimum, will permit the applicant to comply with all provisions of 10 CFR 20. The information should include the class of waste to be buried in each disposal unit and information on the shielding that will be provided by the waste container and cover materials. Equipment used to place waste cover materials should meet industry standards and be operated safely according to commonly accepted industry procedures.

4.3.4 Locating Disposal Units and Boundary Markers

The information on locating disposal units and boundary markers is acceptable if the proposed procedures, processes, materials, and equipment enable the applicant to accurately locate disposal units and facility boundaries in the field and accurately provide for permanent mapping and marking of the disposal units and the facility boundaries. Three permanent survey marker control stations must be established on the site, and these must provide horizontal and vertical controls as checked against USGS or NGS record files. The procedures, processes, and materials that are established are acceptable if they result in a permanent record of the boundaries of the disposal units and the facility and include durable monuments in the field for the period that the wastes will remain hazardous and good quality office records that are to be made available before the period of institutional control. At a minimum, the survey personnel and procedures should meet the requirements necessary to perform a third-order, Class III survey level of control. Equipment should meet industry standards and be properly calibrated and operated according to commonly accepted industry procedures.

4.3.5 Disposal Unit Closure and Stabilization

The information on disposal unit closure and stabilization is acceptable if the procedures, processes, materials, and equipment ensure that ongoing operations will not disturb completed disposal units and that the individual disposal unit closures are compatible with the final closure and stabilization plan for the disposal facility. Acceptable closure methods should include appropriate fill and compaction of waste cover materials to minimize water

infiltration and to facilitate drainage that ties into the surface water management plan of the facility and that may include the planting of appropriate vegetation growth or the use of durable, good-quality rip-rap, or similar methods for erosion control. The procedures for the closure of individual disposal units must provide for a program of regular inspections to include identification of areas of unsuccessful vegetation growth, subsidence, water ponding, infiltration, or unsuccessful diverting of surface water drainage. The closed disposal units should be separated from disposal units in use so that operations at the active units will not be interfered with and required equipment will be able to travel and operate. Drainage from waste disposal areas that are in use should be directed away from completed and closed disposal units. Location and access to fill and borrow areas should be planned and controlled so that their use does not interfere with the integrity of the completed disposal units. Roadways and traffic controls should direct traffic away from completed and closed units where engineered intruder barriers have been installed.

4.3.6 Buffer Zone

The information on the buffer zone is acceptable if the provisions established result in an area that is large enough so that adequate environmental monitoring activities can be completed and reasonably anticipated mitigative measures can be performed. The buffer zone provisions must consider the three dimensions of the disposal facility, and the information on the buffer zone should describe how the buffer zone beneath the disposal units will function. Waste may not be disposed of in any portion of the buffer zone. The applicant must show that other waste disposal activities will not interfere with monitoring and/or mitigative actions in the buffer zone. The buffer zone must surround the entire area containing disposal units. An acceptable buffer zone should be a minimum of 30 meters wide around the entire facility. A desirable feature of a buffer zone would be to have wider dimensions in the downstream direction of groundwater flow. The information on the buffer zone should demonstrate that site geology and topography, soil and rock characteristics, direction, depth, and velocity of surface and groundwater flow, location of wells and water users, and sufficient space for performing mitigative measures were considered in its design.

4.3.7 Nuclear Criticality Safety

The applicant's information on nuclear criticality safety is acceptable if the applicant has provided evidence of commitment to ensure nuclear criticality safety, which includes procedures for verifying the SNM content of packages, maintaining package configurations as required during disposal, and providing for adequate margins of safety for the maximum credible circumstance which could contribute to a criticality event in the indefinite future.

4.3.8 Operational Responsibilities

The applicant's information on operational responsibilities is acceptable if the applicant has provided organizational charts which demonstrate a clear line of responsibility, clearly defined primary and supplemental organizational units reasonable for implementing disposal activities, and a commitment to hire and retain personnel who are qualified by training and experience to carry out the licensee's responsibilities for disposal.

5 EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the waste disposal operations for the [name of facility] low-level waste disposal facility in accordance with Standard Review Plan 4.3.

The staff concludes that the waste disposal operations are designed to (1) segregate wastes designated as Class A unstable wastes from stable Class B and Class C wastes; (2) emplace waste packages in a manner that maintains package integrity, minimizes void spaces between packages, and permits void spaces between packages to be filled with an acceptable backfill material; (3) place and cover wastes in a manner that limits water infiltration and the radiation dose rate at the surface of the cover to levels that, at a minimum, will permit the applicant to comply with all the provisions of 10 CFR 20; (4) locate, map, and mark boundaries and locations of each disposal unit properly; (5) provide for a buffer zone between buried waste and the boundary of the disposal site and beneath the disposed waste that is large enough so that environmental monitoring activities and mitigative measures, if needed, can be performed; (6) be compatible with the approved site closure and stabilization plan; and (7) close and stabilize each disposal unit according to the approved site closure plan as each disposal unit is filled and covered.

Void spaces between waste packages will be filled with materials that meet staff recommendations; therefore, consolidation of the backfill will not result in significant subsidence.

Waste will not be disposed of within the buffer zone. The buffer zone will surround the entire area containing the disposal units, and its configuration has been based on consideration of such factors as site geology and topography, soil and rock characteristics, direction and velocity of surface and groundwater flow, locations of wells and water usage, and sufficient space

to take mitigative measures, if needed.

Adequate distances will be provided for between disposal units, proper filling and compaction techniques will be used for filled disposal units, proper site grading and surface water management will be implemented, proper quality control in the form of regular inspections of completed disposal units will be carried out, and proper techniques to minimize wind and water erosion will be implemented.

Third-order, Class III surveying control will be used for identifying and surveying the locations of disposal units and facility boundaries.

The staff concludes that the applicant's waste disposal operations procedures adequately address nuclear criticality safety and that there is reasonable assurance that the applicant's operations will be in compliance with 10 CFR 61.23(j).

The staff concludes that the applicant has provided documentation which demonstrates a complete understanding of operational responsibilities for disposing of low-level waste at a licensed disposal facility.

In summary, the staff concludes that the applicant's waste disposal operations have been acceptably addressed and meet the pertinent provisions of 10 CFR 61.12(b) and (f), 61.43, 61.51(a)(2), and 61.52(a)(4) through (a)(10).

6 IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7 REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, "Technical Position Paper on Near-Surface Disposal Facility Design and Operation," November 1982.

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LOW-LEVEL WASTE DISPOSAL LICENSING PLAN

STANDARD REVIEW PLAN 4.3 - APPENDIX A
NRC STAFF RECOMMENDATIONS FOR FILLING VOID SPACES AROUND WASTE CONTAINERS EMPLACED IN LOW-LEVEL WASTE LAND DISPOSAL EXCAVATIONS

1 INTRODUCTION

The low-level waste management regulation, 10 CFR 61, sets forth technical requirements for the emplacement of waste packages in land disposal facilities as well as the requirement that void spaces between the packages be filled to reduce future subsidence within the disposal unit (10 CFR 61.52 and 61.56). The staff is providing guidance to States, site operators, and waste generators on the proper procedures that should be used for filling the voids between waste containers in low-level waste (LLW) disposal excavations. Specific criteria on soil material or other fill material to be used for filling the voids are provided to ensure the long-term stability of the disposal unit.

The staff's recommendations for filling void spaces apply to all waste classes. These recommendations for filling void spaces apply where Class B wastes and Class C wastes are placed in land disposal excavations and for Class A wastes where the stability of the Class A waste form permits and results in the Class A waste being disposed of in the same unit with the Class B and C wastes. The void spaces should be properly filled to supplement the stability of the packages, thus providing for the overall stability of the disposal unit.

These staff recommendations apply for different reasons where Class A wastes are separately placed in reserved disposal units and the performance of these separate disposal units, containing only the Class A wastes, will not adversely affect the safe long-term performance of adjacent but distinct disposal units containing the Class B and C wastes. In this case, filling void space will minimize disposal unit subsidence and limit its potential to that associated with the gradual deterioration of Class A packages.

The staff is making these suggestions for filling the void spaces around Class A waste packages because of the lower radionuclide concentrations in Class A waste and the less stringent requirements for Class A waste form stabilization. A disposal site operator would still need to fill the void spaces between Class A waste containers. A site operator should anticipate, and be prepared to provide in an SAR, a commitment to perform maintenance operations that restore, as necessary, the top cover surface to prevent infiltration of water into a disposal unit. The extent of the maintenance

operations needed would be related to the actual stability condition of the emplaced waste form and the care exercised in filling the voids between the waste containers. The maintenance operations would have to continue for a period that is commensurate with the hazardous life of the buried waste.

This appendix does not cover the placement and compaction requirements for materials placed above the top of the waste in the disposal units. The topic of waste covering is discussed in SRP 4.3.

2 FILL MATERIAL CONSIDERATIONS

If large voids are permitted to exist between the containers when the waste packages are initially placed, then large deformations (settlement/ subsidence) in the materials placed above the wastes could result (if the voids were not filled) and this condition could likely lead to loss of stability of the waste cover as a result of water infiltration and erosion of surface materials. It is the recognition of these mechanisms for deformation and the resulting problems with subsidence that encourages the selection of a stable fill material in order to minimize the voids. A stable fill would have the following characteristics:

(1) Conformability, so that when placed by the usual construction placement method (discharging or dumping over the waste drums and liners without any controlled spreading or compaction effort so that workers would not have to enter the excavation being filled with the LLW), the backfill material would freely move into and fill the voids between waste containers. Bridging of soil between containers and the formation of soil clumps that could result in large void openings remaining between the containers would thereby be avoided.

(2) Low compressibility in the fill material despite the usual method of placement which requires no formal densification effort.

(3) Gradation, which would ensure a sufficiently permeable fill material to allow any percolating water to drain to the excavation bottom. Allowing drainage would help avoid prolonged contact of water with the waste, but the gradation would yet have an upper size limit that would prevent migration of the finer sized particles in the waste cover material from moving down into the intergranular pores of the fill materials placed between the waste containers.

To have an appreciation of the extent of voids in a typical disposal unit, the staff estimated the volume of voids that could reasonably be expected to exist between containers using two types of fill materials by (1) allowing for the placement of a cohesionless fill soil and (2) allowing for the placement of a cohesive soil.

The conditions assumed in the estimate included the following:

(1) A disposal unit of 45.7 meters (150 ft) in width, 304.8 meters (1,000 ft) in length, and 11.3 meters (7 ft) in depth.

(2) A systematic placement of the 208 liter (55-gallon) waste drums, which were stacked vertically and in a 6-pack arrangement. On the basis of this assumption, the volume of open space between four adjacent drums was computed to be approximately 0.6 meters (2 ft).

(3) Backfilling with a cohesionless soil, which had a maximum dry density of 1.84g/cm^3 (115 lbs/ft^3) and a minimum dry density of 1.52g/cm (95 lbs/ft^3). A 30 percent relative density was conservatively assumed for the cohesionless fill at the time of placement. (Relative density expresses the degree of denseness of a cohesionless soil with respect to its loosest and densest condition. A soil in the loosest condition would have a relative density of 0 percent, and in its densest state would have a relative density of 100 percent.)

(4) Backfilling with cohesive soils that allowed for bridging and clumping of the soil and resulted in only one-half of the open space between the drum containers being filled. This estimate of filling was not a calculated value but was assumed on the basis of experience in the excavation and fill placement of cohesive soils under a wide range of naturally occurring moisture contents with no tamping or compaction.

With the passage of time, the cohesionless soil placed between the waste containers may settle. If the fill soil is conservatively assumed to eventually reach its maximum density (condition 3 above), an increase in the disposal unit void volume of 0.006 m^3 (0.20 ft^3) is computed to occur in the space between the four containers, because of the assumed cohesionless soil settlement and resulting densification. This is in comparison to the 0.3 m^3 (1.0 ft^3) void volume change that could be expected to occur in the cohesive fill (based on condition 4 above).

If the above changes in void volume occurred over the entire assumed disposal unit area, where drums were stacked adjacent to each other, the potential for settlement with resulting cracking and infiltration of the disposal unit cover would be on the order of 5 times greater for the cohesive fill than for the cohesionless fill.

If compared to the total disposal volume of the assumed LLW disposal unit, this change in void volume resulting from the compression of the fill materials is 1.8 percent for the disposal unit filled with cohesionless soil and 8.8 percent for the disposal unit filled with a cohesive soil. The results of this comparison are consistent with the statements in NUREG/CR-3144, which indicate that sands and gravel (cohesionless soils) make better backfill materials because they are less compressible than silts and clays (cohesive soils). On the basis of the comparison of the void volume change, the staff recommends the use of a cohesionless soil, with material controls that are subsequently provided, for filling LLW disposal facilities in order to meet the technical requirements of 10 CFR 61.

It is of interest to note that the estimated volume of voids in a single 208 liter (55-gallon) drum that is 90 percent filled with waste is 0.02 m^3 (0.80 ft^3), which if considered over the entire assumed disposal unit area

would be approximately 7 percent of the total disposal unit volume. This recognition should encourage the applicant to fill waste drums to more than 85 to 90 percent of their capacity because of the subsidence that could occur if the containers were to fully corrode and deteriorate.

3 RECOMMENDATIONS

Fill material for LLW disposal excavations should consist of cohesionless soils that have less than 12 percent fine particles by weight passing the number 200 mesh sieve and not more than 40 percent by weight of particles that are coarser than the 1.9 cm (3/4 in.) size and a maximum particle size not greater than 7.6 cm (3 in.). Limiting the percentage of fines to 12 percent will help provide a relatively free-draining soil that is not subject to bridging and the formation of soil clumps. Establishing a limit on the 1.9 cm (3/4 in.) size is intended to ensure that the backfill soils will not have too great a percentage of large stone sizes, but will be reasonably graded with smaller sizes in order to fill the irregular void spaces. The 7.6 cm (3 in.) maximum particle size is recommended on the basis of the anticipated size of the unfilled intercontainer void space when 208 liter (55 gallon) drums are used. This maximum particle size may be changed, and in some cases should be changed, if different size containers are used or if specific site placement conditions (e.g., random arrangement of containers in the trench) differ significantly from those assumed by the staff in this study. The staff recommendation is made to ensure that bridging of large stones and rocks between containers will not occur and the smaller sizes of the cohesionless fill materials will move freely into the void spaces around containers.

The cohesionless fill material should be in a loose, dry condition during placement and should be placed after each successive waste container layer is placed. Fill placement could be remotely performed by the controlled dumping from a clamshell bucket or by successful improvisation of hoppers, chutes, or conveyor belts that direct the fill into the voids. Allowing several layers of waste containers to be placed on top of each other before backfilling the intercontainer voids should not be permitted because of the reduced effectiveness in completely filling the voids and the resulting adverse and larger settlements that could then occur. Exemption to this requirement for filling after each successive layer is placed can be made on a case-by-case basis, provided sufficient information and justification were submitted by the applicant. In any request for an exemption, the applicant would need to establish and identify the maximum void size that would be permitted (e.g., by a planned and controlled stacking arrangement that minimizes voids) and above which construction operations would be immediately required to fill, before proceeding with waste emplacement.

The use of wooden pallets when handling and placing waste containers should be minimized to the extent practicable, because of the voids that are inherent in the design of a pallet and the voids that are likely to develop in the future because of the decomposition of the wooden materials. The voids resulting from the use of wooden pallets should be filled with fill or cement grout after each pallet layer of waste is placed. Use of flat metal pallets, which would not have voids, is encouraged where pallets are necessary to minimize

worker exposure.

If a soil other than that recommended by the staff is considered as a fill material at a proposed land disposal facility, there should be a requirement for an early demonstration, including confirmatory field testing, that the intercontainer voids are being filled and that bridging and clumping of the fill materials around containers are not occurring. A test project that duplicates anticipated waste container placement and backfill conditions (e.g., configuration of excavation, similar container arrangements and construction methods and equipment, similar material type and range in placement moisture contents) should be required for proposed cohesive soils using the backfilling procedures planned for the disposal excavation. The volume change resulting from soil compression around the containers and the corresponding percentage of the total disposal trench volume that will not be filled because of voids in the backfill should be determined, and the results of the test project should be submitted to the proper regulatory authority for evaluation and approval of the proposed backfill operation.

The applicant would have to demonstrate that other proposed options for filling around containers (grouting, densification measures, etc) meet the technical requirements of 10 CFR 61 by successfully completing a field test demonstration and by submitting a technical report to the proper regulatory agency for evaluation and approval.

4 CONCLUSIONS

The regulation, 10 CFR 61, sets forth technical requirements for the emplacement of waste packages in disposal excavations as well as the requirement that void spaces between the packages be minimized to reduce future subsidence within the excavation. The staff has estimated that the potential for settlement would be on the order of 5 times greater for a disposal trench where a cohesive soil is used as fill between waste containers than for a trench filled with a cohesionless soil.

The factors that would influence the compressibility of a cohesive fill are more numerous and their effect is less predictable than those that would influence the compressibility of a cohesionless fill. For a cohesive fill, the factors that would influence compressibility would include the natural moisture content at time of placement, the extent of soil clumping and bridging, and the higher natural compressibility characteristics of the cohesive soils. The large uncertainties associated with these widely varying factors would suggest that the use of cohesive soils as fill in LLW disposal facilities should be determined on a site-specific basis.

The cohesionless soils have desirable fill material characteristics if they (1) allow the soil to better conform to the irregular openings between containers, (2) allow the soil to exhibit lower compressibility even when initially placed without a compactive effort, and (3) minimize the time that the LLW would be in contact with percolating water, if any, because of the fill soil's permeability. Because of these desirable characteristics, the staff recommends that cohesionless soils be required in filling LLW disposal

facilities and has provided guidance on fill material specifications and placement procedures.

Alternatives (e.g. grouting, densification) to using cohesionless fill would be acceptable to the staff provided that a field test is completed before the actual placement of the LLW and the results of the test project successfully demonstrate that the technical requirement of 10 CFR 61 (10 CFR 61.52(a)(4) and 61.56(b)(3)) covering reduction of voids spaces between waste packages will be met.

5 REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. G. Tucker, U.S. Department of the Army, Army Engineer Waterways Experiment Station, February 1983.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 4.4
PREOPERATIONAL ENVIRONMENTAL MONITORING AND SURVEILLANCE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrologist/Meteorologist/Geochemist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff* will evaluate how well the applicant's proposed monitoring program during the operational phase meets the following objectives: to provide reasonable assurance that the exposure limits of 10 CFR 20.105(b) will not be exceeded, to meet the performance objectives of 10 CFR 61.41, and, in accordance with 10 CFR 61.53, to provide data for the evaluation of potential health and environmental effects during the operation of the facility, to provide early warning of releases of radionuclides from the disposal site before they leave the site boundary, and to enable the evaluation of the need for mitigative measures.

The LLTB staff (with assistance from the LLOB staff in the evaluation of the organization and from the LLTB staff in the evaluation of groundwater) will review the areas of the SAR discussed in the following sections as they relate to the operational phase of the environmental monitoring and surveillance program.

2.1 Organization

The applicant should justify any changes in the organization of the environmental monitoring or training programs that relate to the authority and responsibility of those persons responsible for the environmental monitoring program. The LLTB staff will review the experience and qualifications of any new personnel responsible for the environmental monitoring and surveillance programs and for sampling and handling radioactive material.

*Although the primary review responsibility resides with the LLTB staff, the term "the staff" as used in this SRP generally will refer (unless stated otherwise) to the NRC staff as a whole.

2.2 Equipment, Instrumentation, and Facilities

For each area outlined in Section 2.2 of SRP 2.9, the staff will review the applicant's justification for any changes in equipment, instrumentation, and facilities proposed by the applicant from those used for measurements during the site characterization monitoring phase. Special care will be taken to evaluate the placement of instruments, equipment, and monitoring wells to be used in sumps and drainage pits in trenches where waste is to be buried.

2.3 Description of the Environmental Monitoring Program

The staff's review will focus on how the applicant's monitoring program, which was developed during the site characterization phase (see Section 2.3 of SRP 2.9), has been modified or improved for onsite and offsite monitoring of radiological and nonradiological contaminants during the operational phase.

3. REVIEW PROCEDURES

The staff will obtain and use such information as is necessary to ensure that the review procedure is complete. The staff will use and emphasize material from this SRP as may be appropriate for a specific case. The staff will verify that the applicant has properly used the monitoring data collected during the site characterization phase as a basis for the design of the sampling and analysis procedures during the operational monitoring phase. This design will be reviewed against the procedures described in Section 3 of SRP 2.9 and in the "Draft Technical Position on Environmental Monitoring of Low-Level Waste Disposal Facilities" prepared by the Low-Level Waste Management and Decommissioning. The staff should evaluate the extent to which the applicant has kept the locations of the monitoring stations established during the characterization phase the same as those during the operational phase (in order to make legitimate statistical comparisons of measured data from each phase).

The staff will determine how the environmental monitoring program will be used during the operational phase to carry out the following functions:

(1) Provide an Early Warning of a Release Before It Reaches the Site Boundary and Evaluate the Neee applicant has kept the locations of the monitoring stations established during the characterization phase the same as those during the operational phase (in order to make legitimate statistical comparisons of measured data from each phase). The staff will determine how the environmental monitoring program will be used during the operational phase to carry out the following functions:

(1) Provide an Early Warning of a Release Before It Reaches the Site Boundary and Evaluate the Need for Mitigative Measures

The staff will determine if the applicant has identified reporting levels

and action levels (concentrations in the media monitored) for each radiological and nonradiological contaminant and specified what mitigative actions are to be taken if these levels are exceeded.

(2) Evaluate Health and Environmental Effects

If it is necessary to verify the data on health effects reported by the applicant, the staff will use the BEIR III (U.S. National Research Council, 1980) risk estimators to convert dose (or dose equivalent) into health effects until these are superseded by other national standards.

As far as is practicable, the applicant's estimates of health effects should reflect the projected compositions of future populations and consider competing risks. Because the expected environmental effects are site specific, they should be clearly defined and documented by the applicant. It is to be expected that much of this information will be prepared by consultants; therefore, a complete description of their qualifications should have been included with the SAR.

(3) Estimate Dose As Required by 10 CFR 20.105(b) and 10 CFR 61.41

The staff will evaluate the methods to be used by the applicant to determine dose (annual dose and 50-year dose commitment) to workers and the public from direct radiation, from a concentration of material deposited onsite or offsite that originates in the plume, and from inhalation or ingestion of contaminants. For an evaluation of the dose to the offsite population when the measured concentrations of pollutants are below the limits of detection of state-of-the-art instrumentation, calculations based on mathematical or computer models as discussed in SRPs 6.1.3 an 6.1.4 may be necessary to augment calculations based on measured monitoring data. The staff will review the methods for these calculations as submitted by the applicant to determine if all pertinent dose pathways and transfer parameters have been properly considered and documented. In some cases, the staff may have to verify the applicant's calculations using a computer model that is capable of using the applicant's site-specific information.

(4) Assist in Emergency Response Planning if Accidental Releases Were To Occur

The staff will determine if the applicant has included an emergency response plan with the application. This plan should be based on the protective action guides (PAGs) developed by the U.S. Environmental Protection Agency (EPA-520/1-75-001, June 1980). The applicant's plan should include those protective and restorative actions to be taken if an unplanned release of pollutant from a low-level radioactive waste disposal site were to occur. The applicant should have used the PAGs to define an

emergency planning (buffer) zone around the disposal site.

3.1 Acceptance Review

The staff will review for completeness the information on the operational monitoring program in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP by comparing the applicant's submittal and methods with the regulations and guides and by checking the applicant's references to such guides or to proposed alternatives.

The staff will verify that the alternatives are equivalent to or improvements on the methods cited in the referenced regulatory guides. Otherwise, alternatives are likely to be disapproved.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify its submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review in this SRP are 10 CFR 61.12, 61.41, and 61.53 and the sections of 10 CFR 20 listed in Section 4.1 of SRP 2.9 as they apply to environmental monitoring during the operational phase.

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the documents listed in Section 4.2 of SRP 2.9.

4.3 Regulatory Evaluation Criteria

Acceptance criteria necessary to meet the relevant requirements of the regulations for the areas of review described in Section 2 of this SRP are discussed in Section 4.3 of SRP 2.9 (the word "operational" should be substituted for the word "preoperational").

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR and subsequent amendments to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the operational environmental monitoring plan for [name of facility] low-level waste disposal facility according to Standard Review Plan 4.4. On the basis of the following findings, the staff concludes that the operational monitoring and surveillance program is acceptable and meets 10 CFR 20 and 10 CFR 61.

The applicant has met the following objectives of the operational environmental monitoring and surveillance program: to provide reasonable assurance that the limits of 10 CFR 20.105(b) will not be exceeded, to meet the performance objectives of 10 CFR 61.41, and, in accordance with 10 CFR 61.53, to provide data to evaluate the potential health and environmental effects during the operation of the facility, to provide early warning of releases of radionuclides from the disposal site before they leave the site boundary, and to enable the evaluation of the need for mitigative measures.

The applicant has described the program for the physical surveillance of the monitoring stations, site facilities, and site environs. This includes visual inspection of monitoring stations, equipment, and instrumentation to confirm operational status; inspection of trench covers to verify their integrity; and inspections to detect evidence of erosion and subsidence and indications of intrusion by humans, animals, or vegetation. The surveillance program is in accordance with "Draft Technical Position on Environmental Monitoring of Low-Level Waste disposal Facilities" and is acceptable.

[The remaining sample evaluation findings are the same as those that follow Paragraph 2 in Section 5.2 of SRP 2.9 (the word "operational" should be substituted for the word "preoperational").]

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Same as those listed in Section 7 of SRP 2.9.

U.S. Environmental Protection Agency, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," EPA-520/1-75-001, draft revision, Washington, DC, June 1980.

U.S. National Research Council, Committee on the Biological Effects of Ionizing Radiations, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980," National Academy Press, Washington, DC, 1980.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 5.1
SITE STABILIZATION

This SRP Consists of the following:

SRP 5.1.1 Surface Drainage and Erosion Protection
SRP 5.1.2 Geotechnical Stability

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 5.1A
SITE CLOSURE AND STABILIZATION CONSIDERATIONS FOR BELOW-GROUND VAULTS AND EARTH-MOUNDED CONCRETE BUNKERS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - Hydrogeologist

2. AREAS OF REVIEW

The staff will review the information on the closure and stabilization of disposal sites where engineered below-ground vaults (BGVs) or earth-mounded concrete bunkers (EMCBs) are to be constructed to ensure that the applicable portions of the performance objectives in Subpart C and the technical requirements in Subpart D of 10 CFR 61 related to site closure and stabilization are met. The objectives of the review under this SRP are similar to the objectives of the review under SRP 5.1.2, "Geotechnical Stability," and include the evaluation of the acceptability of (1) the overall site grading plan for providing adequate cover over the waste and for proper surface grading in directing the flow of surface water away from the completed disposal units, (2) a monitoring program under which needed observational data are established to verify satisfactory performance, and (3) the filter and drainage systems in minimizing infiltration and controlling subsurface water.

The information identified in both SRP 5.1.2 and this SRP is needed in a license application. The differences between these SRPs are essentially related to the expanded discussions on site closure and stabilization considerations that result from the construction of the engineered BGV and EMCB structures. The staff will coordinate its evaluation of site closure and stabilization with the review under other appropriate SRPs including the review of (1) the structural design of BGVs and EMCBs (SRP 3.2A) and (2) the construction and operation considerations for BGVs and EMCBs (SRP 3. 3A).

3. REVIEW PROCEDURES

The staff will obtain and use such information as is required to ensure that this review procedure is complete and will use and emphasize material from this SRP as may be appropriate for a specific case. In addition to the review of

the information provided by the applicant in the SAR, the staff may visit the site to verify satisfactory performance of individually closed disposal units and to confirm the acceptability of final stabilization features.

3.1 Acceptance Review

The staff will review for completeness the information in the SAR on site closure and stabilization in regard to BGVs and EMCBs in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine whether the applicant has followed the guidance in this SRP by comparing the applicant's submittals and methods with the regulations and the information in the SRP as well as by evaluating the applicant's alternatives, if proposed. Alternative plans that are neither equivalent to nor improvements on the methods in this SRP are not likely to be approved.

The staff will evaluate the information provided in the areas of review that are discussed in the following sections.

3.2.1 Structural Performance Monitoring

The staff will review the information on the structural performance monitoring program provided by the applicant to determine if the proposed program is adequate in scope and detail to verify important structural design assumptions and if the proposed types of monitoring instruments and their locations are suitable for confirming structural performance and stability. In addition to verifying that the program has been carefully planned, the staff will determine whether reasonable procedures for implementing the program and evaluating the recorded data have been established. Section 2.b of NUREG/CR-50~1 provides guidance on the features that should be considered in a performance monitoring program. The scope, extent, and duration of monitoring the parameters for structural performance should be coordinated with the parameters' importance in demonstrating that the performance objectives and technical requirement of 10 CFR 61 are met. As an example, a properly installed and functioning monitoring well, constructed as part of the drainage system, should provide data and records that demonstrate with reasonable assurance that groundwater intrusion, perennial or otherwise, into the waste is not occurring [10 CFR 61.50(a)(7)] and that the design of the engineered structure has minimized the contact of percolating or standing water with wastes after their disposal 10 CFR 61.51(a)(6)].

NUREG/CR-5041 recommends that the following parameters be monitored to demonstrate structural performance and stability: loads, stresses, deformations, strains, water levels, and flow quantities that are measured in the drainage collector sumps. The monitoring of the following parameters is considered essential for demonstrating acceptable structural performance: (1) water levels and flow quantities in monitoring wells, (2) strains in the engineered structures at anticipated locations of maximum stress, (3) total and differential settlements of the completed structures, and (4) joint movements to check for the potential for liquid seepage into and out of the vaults. Monitoring of the following parameters is considered optional: (1) stresses

that develop in the structural concrete or in the steel reinforcement, (2) deflections that would indicate load deformation characteristics, (3) settlements of the in situ soils and foundation drainage blanket as a result of imposed loading, and (4) pore pressures in the concrete. Optional monitoring is the monitoring that would be very useful in developing records to project long-term structural behavior and early warning should the development of adverse conditions occur.

The staff will review the applicant's description of (1) the types and locations of monitoring instruments, (2) typical installation details and procedures, (3) the frequency of monitoring and evaluating of the recorded data, (4) the experience and qualification requirements for personnel responsible for the monitoring program and for installing the instruments, (5) the methods used to establish limiting values for the measured parameters with the bases, and (6) the procedures established for remedial actions in response to the approaching of limiting values.

NUREG/CR-5041 provides guidance for establishing limiting values for monitored parameters and discusses (1) important references and standards related to monitoring, (2) the assessment of the sensitivity and reliability of the proposed instruments, and (3) data acquisition systems.

3.2.2 Filter and Drainage Systems

The staff will review the information on the filter and drainage systems to be installed around and below vaults at disposal facilities to determine the adequacy and level of conservatism in the systems for handling potential infiltration through the waste cover system. The major objective of the filter and drainage system is to conservatively allow for the possibility of infiltrating water or subsurface water laterally approaching the vault structure where it would be safely collected and removed, thereby ensuring that the contact of water with waste after disposal has been minimized [10 CFR 61.51(a)(6)].

NUREG/CR-5041 provides guidance on the following items that should to be addressed by the applicant and includes figures that illustrate conceptual design features: (1) filter material selection, gradation, placement, and compaction to prevent internal erosion and piping; (2) design of the drainage system to safely control conservatively estimated drainage rates and volumes; (3) longterm performance, (4) important and pertinent standards and test methods for the various types of drainage pipes that may be used; and (5) the selection and placement of fill around the waste packages.

The staff will review the information on the filter design to determine if (1) the filter criteria (for resisting piping and internal erosion and ensuring permeability and rapid drainage) have been met, (2) the properties of the selected materials (e.g., in resisting chemical attack and clogging) are compatible with the waste disposal environment, and (3) the materials will be properly placed and compacted.

The staff will review the information on the proposed drainage system which should include (1) the type and size of drainage pipes and features and the computational results supporting the established drainage capacities; (2) the capability of the drainage features to resist corrosion, encrustation, and

clogging and measures that would be taken to restore clogged or ineffective drains; (3) internal drainage provisions (e.g., slope of concrete vault floor; type, size, and shape of drain openings; and method of acceptance testing), (4) the type, location, and configuration of collector sumps and the procedures for determining inflow quantities and the chemical constituents in collected flows; (5) typical details of the foundation drainage blanket and drainage zone encircling the concrete vaults including the procedures for placing and compacting the drainage fill in restricted and unrestricted areas, and the basis for fill acceptance (e.g., the attainment of a specified relative density).

3.2.3 Waste Cover System

The staff will review the information on the waste cover system to be constructed over the completed engineered BGV or EMCB structure. Some of the information identified to be reviewed in this section of the SRP overlaps the information identified in SRPs 4.3 and 5.1.2. An applicant needs to provide the information in only one section of an SAR and then cross-reference it with the other pertinent sections. The staff analysis of infiltration and percolation is discussed in SRP 6.1.2.

The information on a waste cover system should include details on (1) the vault roof (materials; provisions for supporting the roof and minimizing void spaces over the waste and beneath the roof slab; measures for sloping to promote drainage and for sealing and controlling cracks to prevent infiltration; and reliance as intruder barrier, if assumed, with supporting basis; (2) low permeability cover materials (e.g., geomembranes, bentonite panels, and clay soils) including pertinent industrial standards and engineering characteristics (e.g., range in coefficients of permeability); (3) placement methods (for soils, lift thicknesses, specified degree of compaction, and controls on placement moisture content); and (4) acceptance testing methods and frequency. The applicant should discuss and provide the basis for how the proposed waste cover system will limit the radiation dose rate at the top surface to minimum levels as required by 10 CFR 61.52(a)(6).

The applicant should provide information on the outermost cover materials such as topsoil and vegetation or rock protection to resist erosional forces. If topsoil and vegetation are proposed, the information should include the soil type and the ability of this outer cover to resist erosion and frost heave, promote runoff, and minimize infiltration. The information on vegetation should include a description of the expected depth of root systems, recognizing design features that could influence the depth of penetration as well as the specific climate and habitat conditions. The design of soil and rock protection for the outer cover layer should follow the guidance provided in SRP 5.1.1.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) and (c) which require descriptions of design features and principal design criteria and their relationship to disposal site closure and stabilization and to the performance objective

(2) 10 CFR 61.12, "Specific Technical Information," (9), which requires a description of the disposal site closure plan, including those design features that are intended to facilitate site closure and to eliminate the need for ongoing site maintenance

(3) 10 CFR 61.13, "Technical Analyses," (a) and (d) as they relate to clearly identifying the role performed by the natural disposal site characteristics and design features in isolating the wastes, and to the analyses of long-term stability and the elimination of the need for ongoing active maintenance after closure

(4) 10 CFR 61.23, "Standards for Issuance of a License," (b),(c),(e) and (f) which require that the applicant's proposed disposal site closure, and postclosure institutional control are adequate to protect the public health and safety and provide reasonable assurance that the performance objectives of 10 CRF Part 61, Subpart C, and the technical requirements of Subpart D

(5) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41 through 61.44 which present the performance objectives of which present performance objectives of which the applicants disposal site closure, and postclosure institutional control must contribute toward the achievement

(6) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(2), which requires that the disposal site design and operation be compatible with the disposal site closure and stabilization plan and lead to disposal site closure that will provide reasonable assurance that the performance objectives of Subpart C of 10 CFR 61 will be met

(7) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(4) and (a)(6) which require design features to be directed toward long-term isolation and avoidance of need for continuing active maintenance after site closure, for covers to resist degradation by surface geologic processes and biotic activity, and for the disposal site to minimize the contact of percolating or standing water with wastes after disposal

(8) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(6), which requires that waste be placed and covered in a manner that will limit the radiation dose rate at the surface of the cover to levels that, at a minimum, will permit the licensee to comply with all provisions of 10 CFR 20.105 at the time the license is transferred pursuant to 10 CFR 61.30

4.2 Regulatory Guidance

Guidance and recommendations for review criteria on site closure and stabilization considerations for a BGV or an EMCB including structural performance monitoring, filter and drainage systems, and waste cover system are provided in NUREG/CR-5041, Volumes 1 and 2, Sections 2.6, 2.7, and 2.8. Additional guidance on the design and construction of waste cover systems is provided in NUREG/CR-5432, Volumes 1, 2, and 3.

4.3 Regulatory Evaluation Criteria

Regulatory evaluation criteria pertaining to the areas of review in Section 2 of this SRP are given in the following sections.

4.3.1 Structural Performance Monitoring

The information on structural performance monitoring is acceptable if (1) the monitoring program described is adequate in scope and detail for verifying structural design assumptions and for confirming structural performance and stability and (2) the performance monitoring is generally consistent with the General Design Criteria and Specific Design Review Criteria in Sections 2.6.1, 2.6.2.1 through 2.6.2.4, and 2.6.2.7 through 2.6.2.9 of NUREG/CR-5041.

4.3.2 Filter and Drainage Systems

The information on the design of filter and drainage systems is acceptable if (1) the systems conservatively allow for the handling of infiltration and subsurface waters before the water would contact the waste and provide for the safe collection and removal of any liquid flows and (2) the design is generally consistent with the General Design Criteria and Specific Design Review Criteria in Sections 2.7.1, and 2.7.2.1 through 2.7.2.6 of NUREG/CR-5041.

4.3.3 Waste Cover System

The information on the design of the waste cover system over engineered BGY or EMCB structures is acceptable if (1) the cover system provides the required protection against radiation; minimizes infiltration, ponding, and erosion; protects inadvertent intruders; and provides long-term stability without the need for active maintenance; and (2) the design is generally consistent with SRP 6.1.2 and the General Design Criteria and Specific Design Review Criteria in Sections 2.8.1, and 2.8.2.1 through 2.8.2.3 of NUREG/CR-5041. The regulatory evaluation of the waste cover system that is to remain after site closure will include consideration of the objectives of the guidance that is provided in Appendix A of SRP 3.2. The design of the soil and rock protection for the outer cover layer will be evaluated in accordance with SRP 5.1.1.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and generally address the

guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the site closure and stabilization features for the below-ground vault [or earth-mounded concrete bunker] for [name of facility] according to Standard Review Plan 5.1A.

The information provided by the applicant clearly describes a structural performance monitoring program that will allow verification of important design assumptions and confirmation that the structure is stable and performing as designed. The applicant has committed to monitor with experienced and qualified personnel the essential parameters of structural performance that include strains, settlements, joint movements, water levels, and flow quantities at suitable locations and at reasonable intervals of time. In addition, the optional monitoring to be performed on stresses, deflections under loading, and settlements of the in situ soils will provide a conservative approach for projecting long-term structural behavior and an early warning system should adverse conditions begin to develop.

The applicant's description of the proposed filter and drainage systems is comprehensive and indicative of conservative, good engineering practice that should result in safe control, collection, and removal of any liquids in the vicinity of the below-ground vault or earth-mounded concrete bunker]. The applicant's design complies with established filter criteria, thereby ensuring resistance to internal erosion and adequate permeability and drainage. Features of the drainage system that include drain pipes and openings and collector sumps have been sized to ensure adequate capacity in handling conservatively estimated flow quantities. The construction materials selected for the filter and drainage systems are of high quality and have been carefully chosen

to remain functional under the severe conditions that could develop in the waste disposal environment.

The applicant has adequately described the waste cover system to be constructed over the engineered BGV or EMCB] structure. The information and details provided on the closing and sealing of the vault roof and on the placement and compaction controls to be followed for the cover materials over the waste provide reasonable assurance that the waste cover system will function as designed. The proposed waste cover system will (1) protect against radiation, (2) minimize infiltration, (3) protect inadvertent intruders, and (4) ensure long-term stability without requiring active maintenance.

On the basis of the findings, the staff concludes that the applicant's proposed structural performance monitoring, filter and drainage systems, and waste cover system are acceptable and that there is reasonable assurance that the applicable regulatory requirements 10 CFR 61.12(b),(c) and (g), 61.13(a) and (d), 61.23(b),(c),(e), and (f), 61.41 through 61.44, 61.51(a)(1),(a)(2),(a)(4), and (a)(6) and 61.52(a)(6) will be met as a result of the applicant's plans and activities for closing and stabilizing the site where the BGVs [or EMCBs] are to be constructed.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for an engineered structure at a low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-5041, "Recommendations to the NRC for Review Criteria for Alternative Methods of Low-Level Radioactive Waste Disposal," Vols. 1 and 2, R. H. Denson, R. D. Bennett, R. M. Wamsley, D. L. Bean, and D. L. Ainsworth, U.S. Army Engineer Waterways Experiment Station, November 1987 (Vol. 1) and January 1988 (Vol. 2).

U.S. Nuclear Regulatory Commission, "Recommendations to the NRC for Soil Cover Systems Over Uranium Mill Tailings and Low-Level Radioactive Wastes: Identification and Ranking of Soils for Disposal Facility Covers," NUREG/CR5432, Volume 1, R.D. Bennett, U.S. Army Engineer Waterways Experiment Station, February 1991.

---, "Recommendations to the NRC for Soil Cover Over Uranium Mill Tailings and Low-Level Radioactive Wastes: Laboratory and Field Tests for Soil Covers," NUREG/CR-5432, Volume 2, R.D. Bennett, U.S. Army Engineer Waterways Experiment Station, February 1991.

---, "Recommendations to the NRC for Soil Cover Over Uranium Mill Tailings and Low-Level Radioactive Wastes: Construction Methods and Guidance for Sealing Penetrations in Soil Covers, "NUREG/CR-5432, Volume 2, R.D. Bennett, U.S. Army Engineer Waterways Experiment Station, February 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 5.1.1
SURFACE DRAINAGE AND EROSION PROTECTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Surface Water Hydrologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the hydrologic analyses and design details that demonstrate that designs and closure procedures have been provided to adequately prevent erosion and surface flooding during closure of the facility in accordance with the requirements of 10 CFR 61.12(9), 61.23, and 61.52. The major review areas related to this aspect of the site design are identical to those qiven in SRP 3.4.4, with regard to site closure hydraulic design features.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on surface drainage and erosion protection in the SAR in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply more information or an explanation. The staff, at this time, may recommend that the application be rejected or accepted for documentation, pending the submittal of the requested information.

If the staff finds that the information furnished by the applicant is adequate, the technical analyses will begin.

3.2 Safety Evaluation

The general review procedures that will be used by the staff in the evaluation are identical to those in SRP 3.4.4 with respect to the hydraulic design features that protect the site from flooding and erosion during the closure period.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

Requirements related to the adequacy of information and technical evaluations are found in 10 CFR 61.12(g) and 61.13. Basic acceptance criteria pertinent to the flooding aspects of these reviews are provided in 10 CFR 61. 51 and 61.52, which require that site design be capable of meeting the performance objectives of Subpart C by preventing erosion and flooding of disposal units.

4.2 Regulatory Guidance

Acceptable methods for estimating flood peaks and designing erosion protection features can be found in Draft Regulatory Guide, "Design of Long-Term Erosion Protection Covers for Reclamation of Uranium Mill Sites."

4.3 Regulatory Evaluation Criteria

A thorough evaluation of the surface water flooding and erosion protection aspects of the site design and the basic data supporting all conclusions are necessary. Criteria relevant to an assessment of the acceptability of information, data, and analyses submitted pertinent to each area of review are identical to those listed in SRP 3.4.4.

5. EVALUATION FINDINGS

5.1 Introduction

If the evaluation by the staff, based on a complete review of the hydraulic engineering aspects of the site design, confirms that regulatory guidelines have been met, documentation of the review will state that, in accordance with 10 CFR 61.52, the flood analyses and investigations adequately characterize the flood potential at the site, are appropriately documented employ an acceptable level of conservatism, and represent a feasible plan for ensuring that disposal units will not be subject to flooding and erosion during the closure period.

The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the surface drainage and erosion protection features for [name of facility] low-level waste disposal facility according to Standard Review Plan 5.1.1.

During site closure, the applicant proposes to construct the various hydrologic features needed for long-term protection of the site, including placement of the rock for the trench cover and removal of the temporary flood protection embankments. The applicant proposes a 5-year period for careful monitoring and observation of the engineered features to ensure that they are functioning properly.

The staff concurs with the applicant that these measures represent an adequate plan for ensuring that the disposal units will not be subject to erosion and flooaing. Additionally, the staff concludes that the measure are adequate to

verify that: (1) differential settlement of the cover is not occurring or if it has occurred, it will be mitigated; (2) the erosion protection features have been properly placed and continue to perform as expected without degradation;

egetation is established properly; (4) significant windblown or waterborne sedimentation is not occurring; and (5) there is no gullying or lowering of base levels. On the basis of its review, the staff concludes that, with respect to hydrologic design features, the applicant has met the requirements of 10 CFR 61.23 and 61.52 to protect the health and safety of the public during the closure period.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an **SAR for** a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Same as those listed in Section 7 of SRP 6.3.1.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 5.1.2
GEOTECHNICAL STABILITY

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - Hydrogeologist, Hydrologist

2. AREAS OF REVIEW

The staff will review the information on the geotechnical stability aspects of the site closure plan for a low-level waste disposal facility (LLWDF) in accordance with 10 CFR regulations. The objectives of the review are to ensure that (1) the overall site grading plan provides for adequate cover over all the disposal units with appropriate grading to direct the flow of surface water away from the units and takes into consideration the long-term settlement and/or subsidence at the site; (2) all the natural and artificial slopes of dikes and ditches at the disposal site will be stable in the long term and that the disposal site will require minimal care and maintenance during the institutional control period; (3) the monitoring program to evaluate the performance of the disposal unit excavations is adequate in scope so the needed data can be collected; (4) the applicant has committed to use all the data collected during the operational phase of the facility to revise and/or to improve the final site closure plan that will be submitted before site closure; and (5) the information provided in the SAR meets the guidance and acceptance criteria in SRP 5.1.2. To achieve the above objectives, the staff will review the information in the SAR and from other sources to ensure that (1) the site closure plan adequately describes how the disposal unit excavations are to be backfilled, how the excavation covers are to be constructed, and how the performance of the first few excavations to be filled and closed will be monitored; (2) the applicant has committed to analyze the monitoring program data from the first few disposal units, either to validate the predicted performance of the excavation cover or to change, if necessary, the design and/or construction procedure to enhance the performance of the backfill and excavation cover of the remaining disposal units; (3) the applicant's proposal for final grading of the site provides for a cover of adequate thickness on all disposal units, provides appropriate grading to direct the flow of surface water away from the disposal units, and furnishes geotechnical details of the surface and subsurface drainage systems designed to function during both operations and the institutional control period; (4) the scope of' the geotechnical monitoring program for settlement and infiltration is adequately

presented and the applicant has committed to use the data collected and the experience gained during the initial stage of operations to review and/or to improve the site closure plan that will be submitted for NRC's review during the final stage of operations; and (5) all engineered and natural slopes within the disposal site will be stable in the lonq term.

The staff will evaluate the following information that is relevant to the geotechnical stability aspects of the site closure plan: (1) the applicant's conclusions on the long-term stability of the earth and rock slopes at the site as controlled by mass wasting and erosion phenomena and (2) the geochemical aspects of the long-term effects of the disposal facility environment and rain water on the properties of the soil and rocks at the site.

The staff will coordinate its evaluation of the geotechnical stability aspects of the site closure plan with other appropriate SRPs. These evaluatlons will include the engineering and geotechnical aspects of (1) the disposal facility, disposal units, and principal design features (SRP 3.1); (2) construction considerations (SRP 3.3.1); (3) site plans, engineering drawings, and construction specifications (SRP 3.3.1); (4) waste disposal operations (SRP 4.3); (S) long-term stability of slopes (SRP 6.3.2); and (6) long-term settlement and subsidence (SRP 6.3.3).

3. REVIEW PROCEDURES

NRC publications (NUREGs) and other publications that will be needed in this review are listed in Section 7 of this SRP. In addition to the review of the information provided by the applicant in the SAR, site visits are an integral part of the review process.

3.1 Acceptance Review

The staff will review for completeness the information on the geotechnical stability aspects of the site closure plan in the SAR in accordance with N~REG-1199 and this SRP

3.2 Safety Evaluation

The staff will determine whether the applicant has followed the regulations and industry standards referenced in this SRP both by comparing the applicant's submittal and methods with the regulations as well as by checking the applicant's references to proposed alternatives. The staff will evaluate whether the alternatives are either equivalent to or improvements on the methods cited in the references. Otherwise, alternatives are likely to be disapproved.

Site Closure Plan

(1) Disposal Unit Excavation Cover

The staff will review the geotechnical engineering and construction information on the soil cover over the disposed waste containers and the excavation cap for each disposal unit as it pertains to the geotechnical stability aspects of the site closure plan and will consider the adequacy of the applicant's information on the following items:

(a) The staff will evaluate the applicant's proposal for constructing the cover on each disposal unit excavation - whether each excavation will be capped immediately after it is filled or whether it will be covered with a temporary soil cover/cap, which will be covered later by a permanent cap when all the excavations are filled. The design and construction details of the excavation cover will be reviewed. The staff will review the implications of placing a temporary cover to be covered later by a permanent cover to evaluate the effect on the LLWDF's compliance with the performance objectives in the requlations.

(b) The staff will evaluate the applicant's plan for monitoring the settlement of and any infiltration into the first few filled disposal unit excavations to ensure that the data to be collected will be relevant and applicable in evaluating the performance of the disposal units. The staff will review the applicant's commitment to analyze the monitored data to verify the predicted performance of the disposal units and the applicant's proposals for remedial actions, if excessive settlement and/or infiltration into the excavation should occur, to ensure that they are technically feasible. The applicant's commitment to remedial actions should extend to all the disposal unit excavations at the site, if necessary, so that all disposal units will perform satisfactorily.

The information should be adequate to enable the staff to conclude that the applicant intends to monitor the filled disposal unit excavations and perform remedial actions, if necessary, before general site closure so that the disposal units will perform as designed.

(2) Overall Site Cover

The staff will review the geotechnical aspects of the overall site cover such as thickness and extent of soil cover over the site, grading of the site to drain the surface water away from the disposal unit evcavations, and slopes of permanent dikes and/or ditches at the site. It will consider the following items in its review:

(a) Because each filled disposal unit excavation will be mounded to promote drainage away from the excavation, the staff will review the information on the filling and grading of the area surrounding the excavation during site closure. If the depression or drainage area between the disposal unit excavations is to be filled, the staff will review the integration of the operational-phase drains in that area with the permanent drains and their protection against clogging. If the site closure plan provides for a second infiltration barrier (similar to the excavation cap) covering all the disposal unit excavations at the site, the staff will review the design and construction details of that barrier. It will also review the final grading of the site (with fill above the second barrier, if used) to ensure that the ground contours will provide for the drainage of the surface water away from the dispoal unit excavations. Long-term settlement and/or subsidence at the site (reviewed according to SRP 6.3.3) will be considered in the staff's evaluation of the effectiveness of the final grading of the site. Recognizing that the permanent drainage facilities have to perform for a long period, the staff will verify the adequacy of filters used in drainage systems by checking the filter's design against accepted engineering criteria. The soil and/or rock erosion aspects of the site closure plan will be reviewed under SRP 5.1. 1.

(b) The staff will review the applicant's proposals for geotechnical monitoring (settlement and infiltration in the backfilled excavations) of the facility after site closure and during the initial 5 years of the observation and surveillance period to ensure that the data collected are representative of a successfully closed disposal facility. The staff will seek a license condition commitment by the applicant to analyze the monitored data for the 5-year period and to carry out remedial actions if the monitoring records show the actions to be necessary. The staff will require the establishment of settlement and infiltration action levels in the applicant's proposed monitoring program.

(c) The staff will review the long-term stability (both static and dynamic stability) of both engineered and natural site slopes, in soil and rock, according to SRP 6.3.2. Permanent slopes of any drainage ditches and dikes proposed as a part of the site closure plan will be reviewed for their long-term stability in accordance with SRP 6.3.2.

The above reviews should result in reasonable assurance that the disposal facility when closed according to the site closure plan will not experience instability of slopes, that there is no potential for excessive settlement and/or subsidence that would result in the infiltration of water into the backfilled disposal unit excavations, and that the site will not require active maintenance during the institutional control period. If the staff concludes that the information is insufficient, it will request that the applicant supply additional information to justify the applicant's conclusions. The final staff conclusion will be based, in part, on professional judgment and will take into consideration the complexities of the subsurface conditions at the site.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are:

(1) 10 CFR 61.12, "Specific Technical Information," (c) and (g), which require a description of the principal design criteria and their relationship to the performance objectives and of the disposal site closure plan, including those design features which are intended to facilitate disposal site closure and to eliminate the need for ongoing active maintenance

(2) 10 CFR 61.13, "Technical Analyses," (a) and (d), as they relate to the analyses that must clearly identify and differentiate between the roles performed by the natural disposal site characteristics and design features in isolating and segregating the wastes, and the analyses of the long-term stability of the disposal site and the need for ongoing active maintenance after closure

(3) 10 CFR 61.23, "Standards for Issuance of a License," (b) through (f), which require findings that the applicant's proposed disposal site closure, and postclosure institutional control provide protection of the public health and safety and reasonable assurance that the performance objectives in 10 CFR 61, Subpart C, and the applicable technical requirements in Subpart D will be met

(4) 10 CFR 61, Subpart C, "Performance Objectives," 10 CFR 61.41, 61.42, and 61.44, which present the performance objectives of which the geotechnical stability of the land disposal facility after closure must contribute toward the achievement

(5) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(1), (a)(2), (a)(4), and (a)(6), which require site design features to be directed toward long-term isolation and avoidance of need for continuing active maintenance after site closure, to be compatible with site closure and stabiization plan, to include covers to resist degradation by surface geologic processes and biotic activity, and to minimize the contact of percolating or standing water with wastes after disposal

4.2 Regulatory Guidance

There are no regulatory guides or NUREGs that directly apply to geotechnical stability following disposal site closure. The following sections along with some of the pertinent references may assist in evaluating geotechnical stability in a license application.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 2 of this SRP are given below.

Site Closure Plan

(1) Disposal Excavation Cover

Information on the proposed method of filling the disposal unit excavations with waste containers and backfill, including information on the placement of the excavation cover, drainage ditches around the disposal unit excavations, and monitoring the performance of the disposal unit excavations, is reviewed in conjunction with the review under SRP 4.3 to ~valuate the geotechnical long-term stability aspects of the site closure plan. The information in the SAR is acceptable if it is sufficient with regard to the following:

(a) Sequence of placing the soil cover over the disposed waste containers and on constructing the excavation cap for each disposal unit excavation. If the proposal calls for a temporary cover to be covered later by a permanent cover for each disposal unit excavation, the applicant should discuss the time of their placement and the performance evaluation of the cover. If the application calls for a cover on individual excavations and a second single cover as the final barrier over all the disposal unit excavations at the site, the applicant should provide details on this proposal.

(b) Details of the drainage system during the operations phase, if the drainage features have to function during the period of institutional control. If so, to be acceptable, the applicant should provide detailed information on the drainage system design, location, size, lateral and longitudinal slope, bedding, and compliance with filter requirements for long-term performance. The applicant's plans for abandoning the operational drainage system (e.g.,

grouting to sealoff) that is not required after site closure should be provided.

(c) Proposal for monitoring. The applicant's proposal is acceptable if it includes sufficient information on (i) the type, location, and typical installation details of the monitoring devices; (ii) the number of devices to yield reliable data and the applicant's plan for replacing them if some devices were to fail; (iii) the frequency of monitoring; (iv) the procedures for analyzing the information gathered; and (v) a commitment by the applicant to initiate remedial actions if excessive settlement or infiltration were to be observed.

The information should be adequate so that the staff can independently determine that, before site closure, the applicant intends to ensure that each of the filled disposal unit excavations will be performing as designed.

(2) Overall Site Cover

Information on the geotechnical aspects of the overall site cover is acceptable if it includes the following:

(a) Engineering details on the components of the overall site cover and the general site grading for the closure phase. These items should include information on the type of material to be used and the placement specifications for the various materials proposed for the general site cover, information on final grading to verify that all the surface water will be drained away from the disposal unit excavations, and information to show that all the permanent drains will be adequately constructed with durable filter material of high quality to prevent clogging and migration of fines. The final grading plan should accommodate, without any adverse effect, the estimate of longterm settlement and/or subsidence expected at the site.

(b) Proposed monitoring of the settlement of excavation covers and infiltration into the disposal unit excavations during the site closure phase and the initial 5 years of the observation and surveillance period. The monitoring should be similar in scope to that proposed for the period before site closure. The applicant's recommendations for long-term monitoring during the full period of active institutional control should also be provided along with the justification for any modifications to the program resulting from observed performance during the initial 5-year period.

(c) Evaluations of the long-term (static and dynam;c stability) performance of all permanent slopes at the site and the long-term settlement and/or subsidence at the site. These evaluations should be performed according to the acceptance criteria in SRPs 6.3.2 and 6.3.3, respectively.

The information on the geotechnical aspects of the overall site closure plan should be sufficient to allow the staff to determine that there is reasonable assurance that the disposal site will not experience instability of slopes, excessive settlement and/or subsidence, and unacceptable amounts of water infiltration into backfilled disposal unit excavations and will not require active maintenance during the institutional control period.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Finding~

the staff has reviewed the geotechnical stability aspects of the proposed site closure plan for the [name of facility] low-level waste disposal facility according to Standard Review Plan 5.1.2. The objectives of the review were to ensure that (1) the overall site grading plan provides for adequate cover on all the disposal unit excavation caps and for appropriate grading to direct the flow of surface water away from the disposal unit excavations, taking into consideration the anticipated long-term settlement and/or subsidence at the site; (2) all the natural and engineered slopes of dikes and ditches at the disposal site will be stable in the long term and the disposal site will require minimal care and maintenance during the institutional control period; (3) the monitoring programs to evaluate the performance of the disposal unit excavations are adequate in scope so that the needed data can be collected; and (4) the applicant has committed to use all the data collected during the operational phase of the facility to revise and/or improve the final site closure plan that will be submitted before site closure.

The staff reviewed the information in the SAR to determine if

(1) the applicant has adequately described how the disposal unit excavations will be backfilled, how the excavation covers will be constructed, and how the performance of the first few disposal unit excavations to be filled and closed will be monitored

(2) the applicant has committed to analyze the monitoring program data from the first few disposal unit excavations, either to validate the predicted performance of the excavation cover or to change, if necessary, the design and/or construction procedures to enhance the performance of the backfill and cover of the remaining disposal unit excavations

(3) the applicant's proposal for final grading of the site provides for a cover of adequate thickness on all disposal unit excavations and appropriate grading to direct the flow of surface water away from the disposal units

(4) all artificial and natural slopes of the dikes and ditches within the disposal site will be stable in the long term

(5) the long-term monitoring program to evaluate the performance of the geotechnical aspects of the disposal site is adequate in scope and presented in appropriate detail

(6) the applicant has committed to use the data and experience gained during the operational phase to revise and/or improve the site closure plan that will be submitted for the staff's review during the final stage of the operational phase

The information on the geotechnical stability aspects of the site closure plan in the SAR is adequate to satisfy the objectives of the staff review. On the basis of its review of the information provided, the staff concludes that there is reasonable assurance that the disposal facility, if closed according to the site closure plan, will satisfy the regulatory provisions of 10 CFR 61.12(c) and (g), 61.13 (a) and (d), 61.23(b) through (f), 61.41, 61.42 and 61.44 and 61.51(a)(1), (a)(2), (a)(4) and (a)(6).

On the basis of its review, the staff concludes that the geotechnical stability aspects of the site closure plan in the SAR meet the applicable regulations and are acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensee regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

American Society for Testing and Materials, Annual Book of ASTM Standards, Philadelphia, PA, revised annually.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

Terzaghi, K. and R. B. Peck, Soil Mechanics in Engineering Practice, 2nd edition, John Wiley & Sons, New York, 1967.

U.S. Army Corps of Engineers, Engineering Manual EM 1110-2-1902, "Engineering and Design Stability of Earth and Rock-Fill Oams," Office of the Chief of Engineers, U.S. Department of the Army, Washington, DC, 1970.

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---, Engineering Manual EM 1110-2-1907, "Soil Sampling," Office of the Chief of Engineers, U.S. Department of the Army, Washington, DC, March 1972.

---, Engineering Manual EM 1110-2-1908, "Instrumentation of Earth and Rockfill Dams," Office of the Chief of Engineers, U.S. Department of the Army, Washington, DC, August 1971.

U.S. Department of the Interior, Bureau of Reclamation, Earth Manual, Denver, CO, 1968.

U.S. Department of the Navy, NAVFAC DM 7-1, DM 7-2, and DM 7-3, "Soil Mechanics, Foundations, and Earth Structures," Alexandria, VA, May 1982.

---, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. G. Tucker, U.S. Department of the Army, Army Enqineers Waterways Experiment Station, February 1983.

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NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 5.2
DECONTAMINATION AND DECOMMISSIONING

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist/Nuclear Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the actions necessary to return the low-level waste disposal facility to a condition that will not require active ongoing maintenance during the institutional control period. This requires that the facility be decommissioned in such a way that future risk (from earlier operations) is reduced and maintained within acceptable limits. The applicant's commitment to this concern should be described in detail in the decommissioning plan that is submitted as part of the application to operate a low-level waste disposal facility. This SRP examines the proposed procedures in the applicant's decommissioning plan and provides for a limited examination of the estimated cost and surety mechanism associated with the applicant's proposed decontamination and decommissioning method. The procedures submitted as the decontamination and decommissioning plan are part of the closure plan required by 10 CFR 61.28. The performance objectives of 10 CFR 61 are paramount in assessing the adequacy of a decontamination and decommissioning plan.

Arrangements or plans for postclosure observations (SRP 5.3) should consider changes to disposal facility operations that might affect closure determinations. It is intended that the applicant's proposed decontamination and decommissioning plan be a dynamic document that will be revised when significant changes in disposal facility operations require reevaluation to determine that the performance objectives of 10 CFR 61, in particular 10 CFR 61.41, are met. This is not limited to, but includes, signific,ant changes to waste acceptance criteria, which could require more stringent and rigorous decontamination and decommissioning procedures and techniques.

3. REVIEW PROCEDURES

3 1 Acceptance Review

The staff will review for completeness the information on the decontamination and decommissioning plan in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The LLTB staff will review the facility's radiation protection design features in coordination with the review of the radiation protection design features under SRP 7.3 to determine that acceptable surface radiation levels can be maintained to reduce decontamination requirements and help to eliminate large "decon-waste" disposal volumes before the license is terminated.

The staff will evaluate the adequacy of the survey methods proposed by the applicant for characterizing and identifying equipment and structures requiring decontamination to meet applicable regulatory limits and guidelines before the activities associated with dismantlement, transfer, release for unrestricted use, or disposal on site take place.

The staff will assess the procedures for dismantlement of equipment or above-ground structures (10 CFR 61.62(a)) and the details of the final means of disposal for adequacy and reasonableness.

The staff will determine if the applicant has provided an estimate of the volume activities (waste class for significant radionuclides) and a description of the anticipated waste that will be generated during decontamination and decommissioning.

The staff will review the applicant's procedures for processing and disposing of waste generated during decontamination and decommissioning operations to provide reasonable assurance that they meet waste form, packaging, and acceptance criteria and that the final waste disposal operations are in accordance with 10 CFR 61.

The staff will review the decommissioning plan to assess the occupational exposure anticipated during decommissioning operations and to determine that these levels are in accordance with applicable regulations and are as low as is reasonably achievable. The staff should verify that decontamination wastes generated during decontamination and decommissioning operations are included in the proposed source term for pathway analysis.

The staff will review the applicant's procedures for site surveys to ensure that fixed and removable contamination of buildings and grounds are at acceptable levels. This contamination could potentially result from (1) surface contamination on waste packages, (2) routine release of gases and particulates from partially breached waste packages, and (3) accidental spills not completely removed.

The staff will review the proposed limits on residual contamination and external gamma radiation levels taking into consideration the potential restrictions on land use and the estimated dose to the maximally exposed individual

following decommissioning. This review will include an assessment of the adequacy of the applicant's proposed measurements and equipment to radiologically characterize the site in a manner generally consistent with the procedures given in Section 2.2.3 of SRP 5.3.

The staff will review the applicant's commitment and procedures to maintain records for transfer to the custodial agencY (the agency that will become c:aretaker of the site).

The staff will assess the applicant's estimate of required funding for the decontamination and decommissioning activities to ensure that sufficient funds are available for closure as required by 10 CFR 61.62.

3.3 Request for Additional Information

The staff may request additional information after conducting the review procedures in Section 3.2 of this SRP. If this additional information requires a significant and substantial change to the applicant's **decontamination and** decommissioning plan, guidance in the form of regulatory positions, approved applications, or meetings with the staff may be appropriate.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The proposed decontamination and decommissioning plan and the associated activities are acceptable if the applicant has met the requirements of 10 CFR 61.62(a) and the performance objectives of 10 CFR 61.41 through 61.44 have been considered.

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 20.101, "Radiation Dose Standards for Individuals in Restricted Areas," as it relates to the total occupational dose an individual may receive in a restricted area

(2) 10 CFR 61.28, "Contents of Application for Closure," as it relates to contents of an application for closure

(3) 10 CFR 61.29, "Post-Closure Observation and Maintenance," as it relates to monitoring of the disposal facility to determine if maintenance and repairs are required

(4) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity," as it relates to limits on radiation doses from land disposal facilities to the general public and requirements on the licensee to maintain these doses as low as is reasonably achievable (ALARA)

(5) 10 CFR 61.43, "Protection of Individuals During Operations," as it relates to maintaining occupational exposures ALARA

(6) 10 CFR 61.44, "Stability of the Disposal Site After Closure," as it relates to eliminating to the extent practicable the need for ongoing active maintenance of the disposal site after closure

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Sec-t.ion 4.1 is provided in the following documents:

(1) Draft Regulatory Guide, "Guidelines for Closure and Stabilization of LLW Disposal Sites," as it relates to allowable, direct gamma radiation on disposal site surfaces and to compilation and transfer of records

(2) NUREG/CR-0570, "Technology, Safety, and Costs of Decommissioning a Reference Low-Level Waste Burial Ground," as it relates to methodology for cost-benefit considerations of methods of decontamination and decommissioning (not to calculation of doses)

(3) Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors," as it relates to acceptable surface contamination levels for equipment and structures

(4) Regulatory Guide 8.8, "Information Relevant To Ensuring That Occupational Exposure at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable," as it provides a basis for the staff to determine whether actions have been taken in the design of low-level waste disposal facility operations, structures, and equipment to ensure that exposures are ALARA and to minimize contamination of equipment

(5) Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposure As Low As Is Reasonably Achievabl~," as it relates to keepinq doses to onsite occupational personnel ALARA

(6) "Technical Position on Low-Level Radioactive Waste Classification and Manifest Reporting," as it relates to the classification of waste generated during decommissioning activities before final disposition

(7) "Technical Position or, Waste Form for 10 CFR Part 61," as it relates to the proper packaging of waste generated during decommissioning activities and to waste stability

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the following areas of review that will form the basis for the staff's determination that the requirements of the above regulations and the recommendations of the referenced guides have been met are given in the following sections.

4.3.1 Design Features Important in Reducing Decontamination Requirements

The design features are acceptable if the applicant's design methods, approach, and interactions comply with the ALARA provisions of 10 CFR 20.1(c) and Regulatory Guide 8.8 and incorporate the following: -measures for reducing the time spent in radiation areas, measures to improve the accessibility to components requiring periodic maintenance or inservice inspection, measures for ensuring that occupational radiation protection during decommissioning will be ALARA, review of the design by competent **radiation protection** personnel,

instructions to designers and engineers regarding ALARA design, and continuing facility design reviews.

4.3.2 Survey Methods for Contaminated Equipment

The staff will evaluate the survey methods for contaminated equipment on a case-by-case basis because of the many different kinds of equipment and structures requiring decontamination. However, importance will be placed on the sensitivity and accuracy of the survey instruments, the competency of the personnel conducting the survey, and the reasonableness of the proposed technique to accurately survey a structure or a specific piece of equipment.

4.3.3 Dismantlement Methods

The dismantlement methods are acceptable if the applicant's proposed alternative assessments that incorporate limited cost-benefit considerations for the various methods of decontamination and decommissioning are similar to the alternative approaches recommended in NUREG/CR-0570, Vols. 1 and 2.

4.3.4 Disposal of Decontamination Waste

The procedures for the disposal of waste generated during decontamination activities are acceptable if the waste's characteristics and form meet the recommended criteria in "Technical Position on Waste Form for 10 CFR Part 61" and "Technical Position on Low-Level Radioactive Waste Classification and Manifest Reporting," as a basis of compliance with 10 CFR 61.

4.3.5 Exposure Received During Decommissioning Operations

The information on exposure received during decommissioning operations is acceptable if the estimated exposure levels are within the limits for occupational exposure in 10 CFR 20 and if the applicant's operating philosophy during decommissioning operations shows a commitment to the ALARA principle contained in Regulatory Guide 8.10. Also, wastes generated during decontamination and decommissioning activities should not result in excessive doses to inadvertent intruders or releases in excess of the performance objectives of 10 CFR 61.

4.3.6 Applicant's Methodology and Commitment To Radiologically Characterize the Site

The applicant's methodology and commitment to radiologically characterize the site are acceptable if the methodology contains clear, detailed, and accurate information including the following:

(1) The background characteristics of radioactivity in the soil for the significant radionuclides determined in item (3) below should be evaluated a~ i n

(2) A site map indicating soil sampling and gamma s~rvey points on square grid locations should be provided. Each grid location should contain at least five equally spaced gamma survey measurements and soil sampling points. The grid spacing should be based on considerations of site radiological conditions, necessary adequacy of survey meter measurements, and the level of confidence required for required measurements.

(3) Direct radiation dose rates and radionuclide concentrations should be reported for each of the locations indicated in item (2) above. Direct radiation measurements should be taken 1 m above the ground surface. Soil samples taken for determinating radionuclide concentrations should characterize the 50il cnncentrations down to 15 cm.

4.3.7 Comparison of Site Structures and Equipment With Applicable Regulatory Limits or Recommended Criteria

The site structures and equipment are acceptable for release for unrestricted use or for interim site use (only those buildings and structures required for the "minor custodial care" indicated in 10 CFR 61.44 should remain on site during the institutional control period) if the surface contamination levels are below the criteria in Regulatory Guide 1.86 and are ALARA.

4.3.8 Comparison of Fixed and Removable Radiation Levels With Applicable Regulatory Limits or Recommended Criteria. The basis for determining acceptable building and surface soil concentration limits will be an evaluation of the applicant's projected radiation exposure and resulting individual dose commitments to individuals off site and to the maximally exposed individual considering anticipated land-use restrictions for the site. The total dose to the maximally exposed individual (caretaker on site) during the institutional control period shall not exceed 25 mrem per year (or the current NRC and U.S. Environmental Protection Agency exposure guidelines) from all radiation sources (both fixed and removable). This dose should be calculated from the soil concentrations determined from the sampling and analysis conducted for the assessment required in Section 4.3.6 of this SRP. The calculated dose may then be used to determine an acceptable soil concentration for various radionuclides. In any case these concentrations shall be as low as is reasonably achievable.

4.4.9 Applicant's Commitment To Maintain Complete Records Pertaining to Decommissioning

lhe application's commitment and procedures to maintain records pertaining to decommissioning are acceptable if the applicant has supplied (1) the information requested in Section 5.2 of NUREG-1199, including information on site c:haracterization, reports and studies on site maintenance, engineering designs and specifications, as-built plans, operations surveys, vehicle surveys, and monitoring equipment calibration records including quality assurance documentation, and (2) other information requested in Section B(3) of Draft Regulatory Guide, "Guidelines for Closure and Stabilization of LLW Disposal Sites."

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the decontamination and decommissioning plan for the [name of facility] low-level waste disposal facility according to Standard Review Plan 5.2.

The staff has verified that (1) sufficient information has been provided in the SAR and amendments to meet 10 CFR 61.29; (2) fixed and removable levels will be maintained below the levels specified in Regulatory Guide 1.86 and are ALARA; (3) wastes generated from decontamination operations will be disposed of in accordance with 10 CFR 61; (4) all materials secured on site will be licensed for possession, and surveillance will be maintained where required; (5) the site will meet the performance objectives of 10 CFR 61 following decommissioning; (6) before the facility is released for unrestricted use, the applicant will have entered into an agreement with the site owner and/or custodian to provide the assurances recommended in Draft Regulatory Guide, "Guidelines for Closure and Stabilization of LLW Disposal Sites"; and (7) the applicant has verified that residual contamination levels are sufficiently low so that (a) potential doses to an onsite individual during the institutional control period are less than 25 mrem per year and ALARA and (b) potential doses to offsite individuals meet the performance objectives of 10 CFR 61.

On the basis of its review, the staff concludes that the decontamination and decommissioning plan meets all applicable regulations and is acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington DC, revised annually

U.S. Nuclear Regulatory Commission, Draft Regulatory Guide, "Guidelines for Closure and Stabilization of LLW Disposal Sites," 1985.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, JanuarY 1991.

---, Regulatory Guide 1.86, "Termination of Operatinq Licenses for Nuclear Reactors."

---, Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Exposure at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable."

---, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposure As Low As Is Reasonably Achievable."

---, "Technical Position on Low-Level Radioactive Waste Classification and Manifest Reporting," February 1986.

---, "Technical Position on Waste Form for 10 CFR Part 61," May 1983.

General

---, NUREG/CR-0570, "Technology, Safety, and Costs of Decommissioning a Reference Low-Level Waste Burial Ground," Vols. 1 and 2, Battelle Pacific Northwest Laboratory, June 1980.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 5.3
POSTOPERATIONAL ENVIRONMENTAL MONITORING AND SURVEILLANCE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrogeologist/Meterologist/Geochemist/Civil Engineer/Health Physicist

1.2 Secondary - Operations Branch (LLOB)

1.3 Supporting - None

2. AREAS OF REVIEW

The staff* will review the proposed postoperational (postclosure) environmental monitoring and surveillance program at the disposal site in accordance with the requirements of 10 CFR 61.53(d). The staff will evaluate how well the applicant's postoperational (postclosure) environmental monitoring and surveillance program meets the following objectives: to determine existing radiation levels and concentrations of radiological and selected nonradiological constituents** using selected locations, media, and methods established during the operational phase; and to provide the necessary data needed for early warning of releases of radionuclides from the disposal site before they leave the site boundary for evaluation of the need for corrective measures in compliance with 10 CFR 61.44 and 10 CFR 61.53(d).

The staff will review the following using information given in Section 5.3 of the SAR and information available from other sources as they relate to the postoperational phase of the environmental monitoring and surveillance program: (1) description of the postoperational environmental monitoring and surveillance program; (2) equipment, instrumentation, and facilities; (3) data recording and statistical analysis; (4) organization; and (5) quality assurance and quality control. The LLTB staff will review Items (1), (2), (3) and

*Although the primary review responsibility resides with the LLTB staff, the term "the staff" as used in this SRP will generally refer (unless stated otherwise) to the NRC staff as a whole. Special aspects of the review conducted by the LLOB staff are explicitly identified in this SRP.

**In this SRP, the term "selected nonradiological constituents" refers to

the water quality parameters identified in Environmental Standard Review Plan 3.4.2.2, "Groundwater Quality" (NUREG-1300). These include parameters such as concentrations of major inorganic and organic constituents, as well as Ph, total dissolved solids, turbidity, and temperature. For the balance of this SRP these constituents are simply referred to as nonradiological or other (meaning other than radiological).

(5, technical aspects only), and the LLOB staff will review Items (4) and (5, administrative aspects only). The staff will be aware of and use the results of the reviews required by other SRPs that could influence the postoperational environmental monitoring program, such as those associated with design and construction (SRP 3.4.4), site closure and institutional control (SRPs 1.4, 5.1, and 5.2), and safety assessment (SRPs 6.1.4, 6.1.5, 6.2, and 6.3).

3. REVIEW PROCEDURES

The staff will obtain and use such information as is necessary to ensure that the review is complete. The staff will use and emphasize material from this SRP, the NRC technical position paper on environmental monitoring (NRC, 1988), and the recommendations to the NRC for environmental monitoring review criteria (NUREG/CR-5054), as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the information on the postoperational environmental monitoring and surveillance program in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP by comparing the applicant's submittal and methods with the regulations and guides and by verifying the applicant's references to such guides or to proposed alternatives. The staff will verify that the alternatives are equivalent to or improvements on the methods cited in the referenced regulatory guides. Otherwise, alternatives are likely to be disapproved. The scope of the staff review will be similar to that of the operational environmental monitoring program review as defined in Section 3.2 of SRP 4.4 except for minor changes to reflect sitespecific conditions and postoperational activities.

3.2.1 Description of the Postoperational Environmental Monitoring and Surveillance Program

The staff's review will focus on how the applicant's operational environmental monitoring program has been modified, both in scope and level of detail, for monitoring radiological and nonradiological contaminants during the postoperational phase. The staff will evaluate the overall acceptability of the monitoring program with respect to the necessary finding that there is reasonable assurance that the program will yield data sufficient to assess continued long-range compliance with regulatory requirements and acceptance criteria. This will include evaluating the adequacy of the applicant's information in response to the following concerns:

(1) Is the program based on the requirements of 10 CFR 61.53(d)?

(2) Does the program include plans for the licensee to remain at the site for a 5-year postclosure and observation period as required by 10 CFR 61.7 and 10 CFR 61 29?

(3) Does the information provided include a requirement that the postclosure monitoring program be operational for implementation by the site owner as required by 10 CFR 61.30(a)(4)?

(4) Do the surveillance activities include visual observations at appropriate frequencies and proper documentation of any evidence of subsidence, ponding, cracking of covers, erosion and/or gullies, excessive ground deformation such as a bulging slope, and unusual flora and fauna activities?

(5) Does the program identify action levels for various parameters monitored that would trigger a warning requiring further evaluation of a potential problem and possibly a mitigative action, if necessary?

3.2.2 Equipment, Instrumentation, and Facilities

The staff will determine whether the equipment, instrumentation, and facilities for evaluating radiation levels and radioactive and nonradioactive constituents in the environment are consistent with the measurement and sampling methods used during the operational period. The equipment, instrumentation, and facilities during the first 5 years of the postoperational phase should be similar to those used during the operational environmental monitoring program, and the review will include an evaluation of those items identified in Section 3.2.2 of SRP 4.4 as applicable during the early postoperational phase. Durability and long-term performance aspects of the equipment and instruments used in the postoperational environmental monitoring will be reviewed.

3.2.3 Data Recording and Statistical Analysis

The staff will review the data handling and recording and statistical analysis procedures for appropriateness in response to the questions in Section 3.2.3 of SRP 4.4, especially with respect to surveillance activities during the postoperational period.

3.2.4 Organization

The staff will review the organizational and functional responsibilities of person(s) responsible for the postoperational environmental monitoring and surveillance program, with special emphasis on the need to maintain continuity during the postclosure observation and maintenance period in accordance with 10 CFR 61.29 and for license transfer in accordance with 10 CFR 61.30(a)(4).

3.2.5 Quality Assurance* and Quality Control

The staff will evaluate the quality assurance and quality control aspects of the environmental monitoring program. In its review, the staff will consider

the adequacy of the applicant's quality assurance and quality control program in response to the questions in Section 3.2.5 of SRP 4.4.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify its submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are the specific sections identified below as they apply to environmental monitoring during the postoperational phase:

(1) 10 CFR 61.7, "Concepts," (c)(3), which requires that the licensee remain at the disposal site for a postclosure observation and maintenance period of 5 years to ensure that the disposal site is ready for institutional control

(2) 10 CFR 61.7 (c)(4), which requires that the site owner, following site closure and license transfer, carry out a program of monitoring to ensure continued satisfactory disposal site performance

(3) 10 CFR 61.29, "Post-closure Observation and Maintenance," which requires that the licensee observe and monitor the site for 5 years, or for a different time period, as established and approved by the NRC as part of the site closure plan, on the basis of site-specific conditions

(4) 10 CFR 61.30, "Transfer of License," (a)(4), which requires that the postclosure monitoring program be operational for implementation by the disposal site owner

(5) 10 CFR 61.44, "Stability of the Disposal Site After Closure," which requires that only surveillance, monitoring, or minor custodial care be needed after disposal site closure

(6) 10 CFR 61.53, "Environmental Monitoring," (d), which requires that the licensee be responsible for postoperational surveillance of the disposal site and maintain a monitoring system capable of providing early warning of releases of radionuclides from the disposal site before they leave the site boundary

*See footnote page 9.1-5.

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 of this SRP is provided in the NRC regulatory documents and other supporting references (e.g., industry standards and general guidance documents) identified in Section 4.2 of SRP 4.4.

4.3 Regulatory Evaluation Criteria

Evaluation criteria necessary to meet the relevant requirements of the regulations for the areas of review described in Sections 2 and 3.2.1 of this SRP are discussed in Section 4.3 of SRP 2.9 and 4.4 (the word "postoperational" should be substituted for the words "operational" and "preoperational"). Planned changes from the operational program design should be adequately described and justified by the applicant.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the postoperational (postclosure) environmental monitoring program of the [name of facility] low-level radioactive waste disposal facility for adherence to the requirements of 10 CFR 20 and 10 CFR 61 according to Standard Review Plan 5.3. The objectives of the review were to ensure that the applicant's postoperational environmental monitoring program was adequate to yield sufficient data to assess long-range compliance with the regulatory requirements and acceptance criteria applicable to the site.

In its review, the staff determined the following:

(1) The applicant provided a description of the postoperational environmental monitoring and surveillance program as required by 10 CFR 61.53(d). The staff further noted that the components of the program included monitoring groundwater, vegetation, and biota, and an active surveillance program that included visual as well as periodic photographic reconnaissance. The applicant's description of the program is therefore considered acceptable.

(2) The applicant's methods, techniques, and procedures for monitoring radiation and for sampling environmental media are consistent with "Technical Position on Environmental Monitoring of Low-level Radioactive Waste Disposal Facilities" (NRC, 1988) and are adequate for obtaining representative samples and performing applicable surveillance activities.

(3) Field and laboratory data, as committed to by the applicant in the license application, will be recorded in appropriate units (according to the requirements of 10 CFR 20.401) and will include appropriate descriptive

statistics, statistical analysis, reporting levels, action levels, and regulatory limits.

(4) The postoperational environmental monitoring program organization, lines of authority, and functional requirements comply with the requirements of 10 CFR 61.29 and 10 CFR 61.30(a)(4) to permit satisfactory site closure and license transfer.

(5) The quality assurance and quality control program is adequate and provides reasonable assurance that the applicant's postoperational environmental monitoring and surveillance program will be maintained according to acceptable standards.

The location of the sampling points and the type and frequency of samples obtained have been adequately justified by the applicant on the basis of site-specific data with regard to locations of critical pathways and their measured variability. Therefore, the staff concludes that the applicant's postoperational environmental monitoring and surveillance program meets the review criteria noted, thereby satisfying the requirements of 10 CFR 61.29, 10 CFR 61.30(a)(4), and 10 CFR 61.53(d).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility, including alternative disposal facilities relative to shallow land burial. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

The references for this SRP are the same as those listed in Section 7 of SRP 2.9.

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Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1
RELEASE OF RADIOACTIVITY - INTRODUCTION

The SRPs under SRP 6.1 (i.e., SRPs 6.1.1 through 6.1.6) provide guidance to the NRC staff for its review and assessment of the safety and performance of a low-level waste disposal facility with respect to release of radioactivity and possible resultant radiological impacts on individuals. The scope, form, and details of the assessments performed as part of the SRPs under SRP 6.1 will vary depending on the specific details of disposal facility design and operation and site environmental conditions. The performance assessments will furthermore require the contribution and integration of a number of technical disciplines.

This introduction summarizes the factors that influence the performance assessments as a whole.

BACKGROUND

Facility

For the purposes of SRP 6.1, a typical low-level waste disposal facility is assumed to include all of the land and buildings necessary to carry out waste disposal. The disposal site is that portion of the facility that is used for the disposal of waste and consists of a number of disposal units (or disposal cells) and a buffer zone. A disposal unit is a discrete portion of the disposal site into which waste is placed for disposal. A buffer zone is a portion of the disposal site that is controlled by the licensee and that lies under the site and between the boundary of the disposal site and any disposal unit. It provides controlled space to establish monitoring locations that are intended to provide an early warning of radionuclide movement.

Following the preoperational phase of the disposal facility, there are five periods during which disposed waste is present at the site. These include the operational period, the closure period, the observation and surveillance period, the "active" institutional control period (or institutional control period), and the "passive" institutional control period (or passive period).

During the operational period, the licensee receives waste from offsite sources (generally by truck transport but also possibly by other methods such as rail transport), and carries out disposal activities in accordance with applicable regulations and license conditions. The disposal facility is assumed to be designed and operated so that water runoff from the facility is controlled so that site drainage occurs at a limited number of designated points.

A facility environmental monitoring program is established by the licensee and conducted so that movement of radioactivity may be detected and controlled. The environmental monitoring program covers air pathways, direct radiation pathways, surface water pathways, biotic pathways, and groundwater pathways. The environmental monitoring program includes a site survey program in which contamination of site soil, grounds, and surfaces (fixed and removable radioactivity) is monitored and controlled. Action levels are established by the licensee for the various environmental monitoring locations and also for allowable levels of fixed and removable contamination. These various action levels would be typically incorporated into the disposal facility license as conditions of operation and would be established to ensure that radioactivity movement is detected - and mitigating measures taken - before regulatory standards are exceeded.

During the closure period, the licensee no longer receives waste from offsite sources and performs the final activities required to prepare the disposal facility so that ongoing active maintenance is not required during the institutional control period. However, some radioactive waste may be generated as part of decontamination and/or demolition of onsite grounds and structures. This waste must also be managed pursuant to applicable regulations and license conditions. During the closure period, the environmental monitoring program continues, but is adapted as necessary to the specific activities carried out (including closure-specific action levels).

The observation and surveillance period occurs after the closure period. During this time, the licensee remains at the site and carries out various site maintenance activities as needed. This period would normally be expected to last approximately 5 years and is intended to ensure that the site is stable and suitable for transfer to the site owner for institutional control. The environmental monitoring program continues.

The institutional control period begins when the disposal facility license is transferred to the State or Federal Government that owns the site. Under the conditions of the transferred license, the owner will carry out a program of environmental monitoring to verify continued satisfactory performance of the disposal facility, physical surveillance to restrict access to the facility, and miscellaneous minor custodial activities. During this period, productive uses of the land might be permitted if those uses do not affect the stability of the site and its ability to meet the performance objectives.

There is no fixed limit to the length of the institutional control period. However, for purposes of analysis of site performance, the institutional control period is separated into an "active" and a "passive" period. During the active period, which should normally be assumed to last no more than 100 years, the above custodial activities may be assumed to be carried out by the site owner. The passive period follows the active period, and during this period it should be assumed that relatively few custodial activities are carried out.

Scenarios

Over the lifetime of the disposal facility, a number of scenarios may be considered by which radioactivity may be released from the disposal facility and cause the potential for radiological impacts on individuals. Many of these

scenarios may be insignificant or bounded by other scenarios. In any case, they may be grouped into offsite scenarios due to normal conditions (both during and after the operational period), offsite scenarios due to operational accidents or unusual conditions, and onsite scenarios during the institutional control period. Typical lists of scenarios are provided as Tables 6.1-1 through 6.1-3.

These lists of potential scenarios are provided for the purposes of illustration and should not be construed as being necessarily complete. Other scenarios may also be considered based on waste, site, design, or operational specific conditions. Each scenario involves radioactivity release and transfer via particular transfer mechanisms, which may result in an accumulation of radioactivity at a human access location. On the basis of this accumulation of radioactivity, the potential for dose rates to humans may be determined and compared against regulatory limits. Transfer mechanisms of interest include groundwater, air, surface water, direct radiation, and biota.

It is important to note that the scenarios that should be considered will vary depending on the particular period of the disposal facility life. The assumptions for radionuclide release, transport, and impacts on humans may also vary. This is because different activities by different licensees are carried out in each period.

REGULATORY ASSESSMENT

Regulatory Criteria

The principal function of SRP 6.1 is to document, with reasonable assurance, that the following performance objective will be met:

10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity"

This regulation essentially states that radioactive releases to the general environment (that is, offsite releases) must not result in an annual dose exceeding an equivalent of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public.

Furthermore, reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment to levels as low as reasonably achievable. This should be interpreted as being applicable to normal conditions during the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods.

Two other sources of radiological impacts are also considered in this SRP. These include those on offsite individuals resulting from accidents or unusual operating conditions, and those on onsite individuals during the institutional control period. Note that radiological impacts on onsite individuals (site workers) during the operational, closure, and observation and surveillance periods are not addressed in this SRP. These impacts are addressed in SRP 7.

The Part 61 (10 CFR 61) regulation currently contains no design limits for impacts on offsite individuals resulting from accidents or unusual operating

Table 6.1-1 Typical scenarios - offsite impacts on individuals

Scenario	Radiation*	Release/transport mechanism	Human access location	Theoretical periods of concern**
(1) Doses to individuals near disposal site form parked waste delivery vehicles	g	None	Area at nearest off-site location to incoming truck park	O
(2) Doses to individuals near disposal site from site operations (e.g., hoisting liners by crane)	g	None	Area at site boundary	O
(3) Airborne releases from contaminated surfaces such as building and grounds	a,b,g	Air	Air at site boundary	O,C,S,I,P
(4) Airborne releases from decomposing waste (e.g., methane gas, CO_2)	b	Air	Air at site boundary	O,C,S,I,P
(5) Airborne disperson of contamination unearthed by plants and animals	a,b,g	Air	Air at site boundary	O,C,S,I,P
(6) Airborne discharges from disposal cells (e.g., evaporate water collected in trenches or sumps)	b	Air	Air at site boundary	O,C,S,I
(7) Airborne disperson of contamination associated with demolition activities	a,b,g	Air	Air at site boundary	C

See footnotes at end of table

Table 6.1-1 (Continued)

Scenario	Radiation*	Release/transport mechanism	Human access location	Theoretical periods of concern**
(8) Waterbone releases from contaminated surfaces such as buildings and grounds	a,b,g	Surface water runoff	nearest offsite watershed	O,C,S,I,P
(9) Waterbone disperson contamination unearthed by plants and animals	a,b,g	Surface water runoff	nearest offsite watershed	O,C,S,I,P
(10) Waterbone discharges from disposal cells (e.g., from trench sumps)	a,b,g	Surface water runoff	nearest offsite watershed	O,C,S,I,P
(11) Waterbone dispersion of contamination associated with demolition activities	a,b,g	Surface water runoff	nearest offsite watershed	C
(12) Radionuclide leaching and migration	a,b,g	Groundwater	Well water at site boundary and nearest watershed and nearest source of population water	O,C,S,I,P
(13) Release through biotic pathways	a,b,g	Biota	Individual in food chain	O,C,S,I,P

*a = alpha; b = beta; g = gamma.
**O = operational period; C = closure period; S = observation and surveillance period; I = active institutional control period; P = passive institutional control period.

Table 6.1-2 Hypothetical operational accidents - offsite impacts on individuals

Scenario		Radiation*	Release/transport mechanism		Human access location	
			Primary	Secondary	Primary**	Secondary**
(1)	Fire disposed or stored waste	a,b,g	Air	Surface water runoff	Area at site boundary	Nearest off-site watershed
(2)	Fire in transport vehicle	a,b,g	Air	Surface water runoff	Area at site boundary	Nearest off-site watershed
(3)	Expulsive or explosive release (e.g., H_2 combustion in waste container	a,b,g	Air	Surface water runoff	Area at site boundary	Nearest off-site watershed
(4)	Major accident involving mechanical dispersion of waste (e.g., liner dropped from crane)	a,b,g	Air	Surface water runoff	Area at site boundary	Nearest off-site watershed
(5)	Minor accident involving dispersion of waste (e.g., forklift puncturing a drum or box, liquid leakage from package	a,b,g	Air	Surface water runoff	Area at site boundary	Nearest off-site watershed

*a = alpha; b = beta; g = gamma.
**Exposure events are expected to principally involve release of radioactivity over a short duration - not more than a few hours - even for a major event such as a fire. The most significant impacts are expected to involve airborne release of radioactivity, in which case impacts would be calculated for an individual assumed to downwind of the event at the boundary of the disposal facility. In addition, all events may be assumed to deposit contaminated material on the surface, and a short period would ensue between the time the event is ended and the time that contaminated material is either recovered or fixed in place (e.g., by covering with earth). During this period, the contaminated material could be theoretically be transferred from the site by surface water runoff, in which case resultant radiological impacts could be determined on the basis of use of water into which the runoff discharges. The actual human access location would depend on the site environment and facility characteristics.

Table 6.1-3 Impacts on onsite individual during institutional control period

Scenario	Radiation*	Release/ transport mechanism	Human access location	Theoretical periods of concern**
(1) Direct radiation impacts on individuals maintaining site during institutional control period	g	None	Site surfaces	mrem/yr to individual
(2) Impacts on individuals resulting from dispersal of residual contamination	a,b,g	Air	Air above site surfaces	mrem/yr to individual
(3) Airborne releases from decomposing waste (e.g., methane, Co_2	b	Air	Air above site	mrem/yr to individual

*a = alpha; b = beta; g = gamma.
**As a working limit, potential dose rates to custodial personnel maintaining the site during the active institutional control period should be controlled so that they will not exceed 25 mrem per year to the whole body, 75 mrem per year to the thyroid, or 25 mrem per year to any other organ.

conditions. The NRC staff will therefore entertain the applicant's proposals for specific design limits on a site-specific basis.

The Part 61 regulation also contains no design limits for impacts on an onsite individual during the institutional control period, except for the requirement in 10 CFR 61.52(a)(6) that "waste must be placed and covered in a manner that limits the radiation dose rate at the surface of the cover to levels that at a minimum will permit the licensee to comply with all provisions of 20.105 of this chapter at the time the license is transferred pursuant to 61.30 of this part." This "onsite individual" refers to an agent or representative of the site owner who carries out various minor maintenance and monitoring activities during the institutional control period and normally should not be expected to come in contact with appreciable quantities of radioactive material. It was the intention of the Part 61 rulemaking that impacts on custodial personnel should be minimized; that is, the site grounds and remaining buildings should be "clean" of removable contamination, and impacts from fixed contamination should be negligible. It was believed that this should be not only readily achievable at well-operated disposal facilities, but was entirely consistent with the operating philosophy of the disposal facilities in operation at the time of the Part 61 rulemaking.

Given this, the NRC staff will accept a maximum residual contamination level following the observation and surveillance period so that an onsite individual performing routine maintenance and monitoring activities will not receive an annual dose exceeding an equivalent of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ. Reasonable effort should also be made to reduce potential impacts to levels as low as reasonably achievable. This working criterion is consistent with the above performance objectives for releases to an offsite individual.

The NRC staff will also consider an applicant's proposals for alternative higher limits; however, the proposed alternative limits should be justified by the applicant on the basis of the intended uses of the disposal site during the institutional control period. The applicant should furthermore provide the NRC staff with documentation indicating the acceptability of these alternative limits to the site owner.

Assessment Approach

The overall approach that should be taken is to first identify a complete set of possible release scenarios and pathways, and then by argument and/or assessment, to eliminate those that are insignificant, very unlikely, or both. The intent is to arrive at a set of bounding release/transport scenarios without performing lengthy evaluations of minor variations of similar scenarios. In this process, generic studies and analyses can be referenced.

This SRP emphasizes the performance of numerical performance assessments as a means of determining compliance with the above regulatory criteria. However, it should be noted that numerical performance assessments are only a portion of the tools that can be used to arrive at a regulatory decision. Other tools include specific regulatory requirements, the applicant's commitments and proposed limiting conditions of operations (e.g., proposals to limit site inventories of particular radionuclides or to impose particular requirements on waste form and packaging), past history (e.g., monitoring data from other

*disposal facilities), and the applicant's training and experience.

In a similar vein, it should also be noted that some performance assessments are more critical than others. That is, the NRC staff should emphasize those release/transport scenarios that are less easily monitored and eliminated or mitigated by operational change. An example is the groundwater pathway. Once the waste has been disposed of and depending on the circumstances, it may be difficult to reduce the potential for radionuclide release except via major alterations in operational procedures. In contrast, consider possible offsite impacts resulting from gamma radiation emitted by incoming waste delivery vehicles. The nearest offsite location to the radiation source can be monitored, and if a possible problem was observed, mitigating actions could be easily taken, for example, by relocating the radiation source.

However, the NRC staff should ensure that, to the extent that a monitoring program is counted on as providing assurance that regulatory criteria are met, the adequacy of this monitoring program is confirmed (i.e., through coordination with the staff review under SRP 4.4). The NRC staff should also confirm that the action levels proposed by the applicant are sufficient to ensure that adequate warning of radioactivity movement is provided before regulatory criteria are exceeded.

Finally, it should be noted that, in some cases, only preliminary assessments can and need be made. For example, one of the possible release/transport mechanisms during the closure period involves airborne release of contamination during possible demolition of contaminated structures. The applicant can and should provide a preliminary assessment of the potential impacts from this activity. A preliminary decision can thus be made regarding compliance with regulatory criteria for releases to the environment. However, the final assessment of these impacts would actually be made as part of review of the licensee's final closure plan pursuant to 10 CFR 61.28. At this time, the licensee should be able to provide much more specific details regarding the demolition plans, possible radioactive source terms (e.g., from actual measurements), and release mechanisms.

Assessment Structure

SRP 6.1 is divided into three basic parts: radioactivity release, transfer, and dose. This organization accomplishes two goals. First, it enables staff review of the pathways (air, soil, groundwater, surface water, plants, and animals) mandated for analysis in 10 CFR 61.13 and 10 CFR 61.41. Second, it separates NRC staff review of the applicant's analysis into individual portions generally corresponding to particular technical disciplines.

SRPs 6.1.1 through 6.1.4 address the overall subject of the radioactive source term and release mechanisms. SRP 6.1.5 is divided into SRPs 6.1. 5.1 through 6.1.5.4, which address the various ways in which radioactivity may be transferred, following release, to a location where it may result in impacts on individuals. These transfer mechanisms include groundwater, air, surface water, and biotic pathways. SRP 6.1.5.4 also addresses attenuation of gamma radiation between the source and the human access location. Finally, SRP 6.1.6 addresses the potential impacts (dose rates) resulting from an accumulation of radioactivity at a human access location.

The overall decision to be made is whether there is reasonable assurance that the above regulatory criteria will be met. However, the review under each SRP forms only part of the assessment. The actual evaluation findings with respect to compliance with regulatory criteria are made under SRP 6.1.6 ("Assessment of Impacts and Regulatory Compliance"). The evaluation findings under the other SRPs are essentially limited to determining the adequacy of that portion of the analysis represented by each particular SRP.

Finally, the NRC staff should bear in mind that the purpose of the performance assessment calculations is not to predict actual impacts from disposal facility performance. Rather the purpose is to bound potential impacts so that a regulatory decision can be made. In so doing, it is important that each portion of the analysis be sufficiently conservative so that the evaluation findings called for in all SRPs under SRP 6.1 are defendable. Nonetheless, the NRC staff is cautioned against conservatism so excessive that the overall results of the analysis are too far removed from reasonably expected circumstances.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.1
DETERMINATION OF TYPES, KINDS, AND QUANTITIES OF WASTE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Nuclear Engineer/Chemist/Chemical Engineer/Health Physicist

1.2 Secondary -

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR pertaining to the applicant's projections of the quantities and physical, chemical, and radiological characteristics of the low-level wastes to be disposed of at the disposal facility. Waste projections under consideration include: (1) waste delivered to the disposal facility during the operational period; and (2) waste generated as part of closure activities.

The findings and conclusions of the review under this SRP will be principally used, in conjunction with those of the reviews under SRP 6.1.2 ("Infiltration"), SRP 6.1.3 ("Radionuclide Release - Normal Conditions"), and SRP 6.1.4 ("Radionuclide Release - Accidents or Unusual Operational Conditions"), to analyze the applicant's estimates of potential releases from the disposal facility. The findings and conclusions of the review under this SRP will also assist in determining the adequacy of the applicant's plans to ensure sufficient availability of funds for closure (see SRP 5.2, "Decontamination and Decommissioning").

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on waste projections in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending the submittal of additional information.

3.2 Safety Evaluation

The staff will review the projections of radioactive waste provided by the

applicant and verify that the projections are reasonable. The staff will also verify that sufficient information has been provided to enable an independent evaluation of the releases expected from the disposal facility and to perform the safety evaluations called for in SRP 6.1.

3.2.1 Waste During Operational Period

The staff will review the applicant's projections of low-level wastes expected to be delivered to the disposal facility over its operational life. The staff's assessment of the adequacy of the projections should be principally based on past waste-generating history. Waste generated by each of the most significant generating facilities should be reviewed, and major discrepancies between the past and projected future generation rates should be clarified with the applicant. The staff should also consider contacting the principal generators directly for confirmation of current and future waste-generating plans. If a facility is not yet generating waste (e.g., a nuclear power plant is still under construction at the time of the application), then the staff should refer to generic estimates of waste generation. This could include information obtained from NUREG reports or other sources.

3.2.2 Waste During Closure Period

The staff will review the applicant's projections of low-level wastes expected to be generated on site and disposed of during the closure period. It should be recognized that these projections are preliminary in nature.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information reviewed under this SRP will be used, in conjunction with information reviewed under the other SRPs of SRP 6.1, to help assess the applicant's compliance with the following regulatory requirements:

(1) 10 CFR 20, "Standards for Protection Against Radiation"

(2) 10 CFR 61.13, "Technical Analyses," (a)

(3) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity"

(4) 10 CFR 61.43, "Protection of Individuals During Operations"

(5) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(6)

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to projections of waste types, kinds, and quantities.

4.3 Regulatory Evaluation Criteria

4.3.1 Waste During Operational Period

The information provided and the applicant's methods for determining the types, kinds, and quantities of waste will be acceptable if in its review, the staff can confirm that, at a minimum, the applicant has provided the following information:

(1) An identification of the region of concern, that is, the States forming the compact.

(2) A discussion of the potential for receipt of waste from outside the region of concern, as well as the conditions for such waste receipt.

(3) An identification of the major individual waste streams that constitute the majority of the waste volume and activity. These waste streams should furthermore be identified in terms of specific waste-generating facilities (e.g, activated metals from a particular power plant).

(4) An identification of the wastes streams that constitute the remaining waste volume and activity. These waste streams may be identified in terms of typical waste streams generated by a number of generators (e.g., a waste stream consisting of low-activity trash generated by all hospitals in the region of concern).

(5) Information on the physical, chemical, and radiological characteristics of each waste stream so identified in items (3) and (4) above. At a minimum this information should include: (a) annual volumes; (b) waste class; (c) average concentrations of the principal radionuclides constituting the waste stream (including those listed in 10 CFR 61.55); (d) the chemical and physical form; (e) the presence of chelating agents; (f) packaging characteristics (e.g., whether the waste will be disposed of in a high-integrity containers; and (g) solidification agent. Descriptions of the chemical and physical form should provide information important to an estimation of release rates (e.g., whether the waste stream consists of activated metals, sealed sources, ion-exchange resins, etc.).

(6) For the information discussed above on annual volumes, an estimate of trends - for example, whether the waste stream will be generated at a constant annual rate or only occasionally. Waste streams only expected to be generated at a future time (e.g., waste streams associated with decommissioning of a nuclear power plant) should be specifically identified.

(7) For major generators, any plans to alter waste generation rates (e.g., changes in volume reduction and decommissioning plans) over the first 5 years of the operational life of the disposal facility.

(8) A presentation and discussion of any limitations that will be imposed on waste receipt, form, packaging, or other characteristics that would influence assessments of disposal facility performance. Such limitations could potentially include limitations on total site inventories of radionuclides of concern (e.g., C-14, H-3, Tc-99, or I-129), or requirements on the structural stability of certain Class A wastes. These proposed limitations will be incorporated into disposal facility licenses as conditions of operation.

(9) A summary of the total projected waste volume and activity for each year of the operational life.

4.3.2 Waste During Closure Period

The information provided and the applicant's methods for determining the types, kinds, and quantities of waste will be acceptable if in its review, the staff can confirm that, at a minimum, the waste description provides sufficient information for the staff to independently assess potential closure costs and effects. The waste description should thus include information similar to that discussed in item (5) in Section 4.3.1 of this SRP.

5. EVALUATION FINDINGS

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. Documentation of conclusions should include a list of the applicant's commitments and/or limiting conditions of operations. These commitments and limiting conditions of operation will form the basis for staff development of disposal facility license conditions.

If the description of waste types, kinds, and quantities satisfies the review procedures and acceptance criteria in Sections 3 and 4 of this SRP, the staff will conclude that the information and results are adequate so that the staff can confirm the applicant's compliance with the regulatory requirements in Section 4.1 of this SRP. However, if the staff should find that the analyses and results are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U. S. Government Printing Office, Washington, DC, revised annually. U. S. Nuclear Regulatory Commission

NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.2
INFILTRATION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrogeologist

1.2 Secondary - Civil Engineer

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR related to the characterization of the water infiltrating through the cover system. The numerical and/or analytical analyses used in this characterization will also be reviewed.

The findings and conclusions from this SRP pertaining to the characterization of water flux through the cover system will be used in subsequent analyses of radioactive releases. Specifically, the information consists of the volume of water entering the disposal unit and the temporal and spatial distribution of infiltration. Indirectly, the evaluation of information in this section of the SAR will support findings on cover design reviewed by the staff under SRP 3.1.

2.1 Analytical Procedures

The staff will review

(1) the description of the types of infiltration analyses used, including documentation, assumptions, verification, and calibration

(2) the description of data used in the analyses, including geostatistical techniques, approximations, manipulation, data generation and/or reduction, conservatisms, and justification for optimizing the field or laboratory data to achieve better simulation results

2.2 Analytical Results

The staff will review the predictions of the volume of water entering the disposal unit and the temporal and spatial distribution of the infiltration events, caused by previously observed and design-basis meteorological events, so that conclusions relevant to 10 CFR 61.13(d) and 10 CFR 61.51(a)(4) and the performance objectives of 10 CFR 61.41 can be made.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on flux determination in the SAR in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending submittal of additional information.

3.2 Safety Evaluation

The staff will evaluate the data and analytical techniques used to estimate infiltration at the site. The staff will verify that the applicant has provided data on the physical characteristics of the cover system and confirm that the values are adequately conservative or realistic. The staff will evaluate any manipulations of data to conform with the modeling technique to ensure changes are justified and defensible. Data used in this analysis may be taken from other sections of the SAR. These information requirements are listed in Section 4 of this SRP.

The review will include an evaluation of the chosen numerical method, justification, documentation, verification, and calibration. The staff will evaluate the analytical results and confirm that the applicant considered site-specific environmental factors such as evapotranspiration and possible geochemical degradation of cover systems. The staff also will confirm that the applicant considered meteorological events common to the geographical area and design basis events such as probable maximum precipitation. Meteorological information will be reviewed according to SRP 2.2, "Meteorology and Climatology," and should include temporal distributions of probable rainfall events. The staff will verify that the applicant considered possible subsidence effects on the flux of water through the cover. The staff also will determine whether the applicant adequately considered infiltration differences between the engineered cover material and the adjacent undisturbed material. Long-term predictions should consider the effects of erosion, burrowing animals, and plant ecology on infiltration. Cover repair should not be assumed after the institutional control period. However, long-term predictions should consider the effects of final closure procedures.

Following review of this information, the staff will determine whether the applicant's conclusions are adequately conservative or realistic so that the applicable requirements of 10 CFR 61.51(a)(4) and 10 CFR 61.13(d) and the performance objective of 10 CFR 61.41 are met. However, if the staff considers that the applicant's results are based on inadequate analysis, it will communicate its concerns to the applicant. Alternatively, the staff may decide to conduct an independent analysis. If it does conduct an independent analysis, it will compare the results with those derived by the applicant to determine if the applicant's results are adequately conservative or defensible. A description of the staff's analysis, including documentation, verification, calibration, and results, will be included in the Safety Evaluation Report.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are:

(1) 10 CFR 61.13, "Technical Analysis," (d), as it relates to the analysis of the long-term stability of the cover and adjacent soils to reduce infiltration

(2) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(4), as it relates to the ability of the cover to minimize infiltration and to direct percolating water away from the waste

Conclusions from this SRP are input to reviews under subsequent SRPs on meeting 10 CFR 61.41, "Protection of the General Population From Release of Radioactivity," as it relates to source terms not leading to exposure criteria being exceeded.

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to characterization of infiltration for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

To adequately evaluate the information on determination of flux through the engineered cover system and the results of any calculations or analyses, the staff will need information pertaining to:

(1) the justification, documentation, verification, and calibration of any equations or program codes used in the analysis

(2) the description of data and justification for the manipulation of any data used in the analyses

Moreover, the staff may require information reviewed under the following SRPs:

(1) SRP 2.2, "Meteorology and Climatology," as it relates to information on amount and temporal distribution of rainfall and possible design-basis events for the site and vicinity

(2) SRP 2.4.2, "Groundwater Characterization," as it relates to the physical characteristics of the natural, unsaturated regime; the potential for lateral movement; and the development of perched aquifers

(3) SRP 3.1, "Principal Design Features," as it relates to the engineered design of the cover system, including thickness and lateral extent, grain size, slopes, total and effective porosity, hydraulic conductivity, and the relationship between moisture content and capillary potential to hydraulic conductivity (i.e., characteristic curves)

(4) SRP 6.3.3, "Settlement and Subsidence," as it relates to the possible formation of fractures and subsidence features that can result in increased infiltration

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows:

If the description and analyses of water flux through the engineered cover system satisfy the review procedures and acceptance criteria in Sections 3 and 4 of this SRP, the staff will conclude that the information and results adequately define the probable volume and temporal distribution of fluid entering the disposal area and indicate this in the Safety Evaluation Report. However, if the staff should find that the analyses and results are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

5.2 Sample Evaluation Findings

The staff has reviewed the information pertaining to the characterization of the water infiltrating through the cover system for [name of facility] low level waste disposal facility according to Standard Review Plan 6.1.2. The staff concludes that infiltration at the site has been adequately described.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of a SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.3
RADIONUCLIDE RELEASE - NORMAL CONDITIONS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Chemical Engineer/Chemist/Geochemist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR pertaining to the applicant's assessment of the types, significance and magnitudes of radioactivity release associated with normal disposal facility conditions.

The findings and conclusions of the review under this SRP will be principally used, in conjunction with those of the review under SRP 6.1.1 ("Determination of the Types, Kinds, and Quantities of Waste"), to analyze the applicant's projections of potential releases from the disposal facility resulting from normal conditions. The numerical calculations of radionuclide release provide the source term for calculations of transfer of radioactivity to offsite human access locations. Also considered under this SRP are releases that may result in impacts on custodial personnel during the active institutional control period. Radioactivity transport mechanisms are addressed in SRPs 6.1.5.1 through 6.1.5.4.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on radioactivity release in the SAR in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending submittal of additional information.

3.2 Safety Evaluation

The staff will review the information provided by the applicant and verify that it is reasonable. The staff will also verify that sufficient information has been provided to enable an independent evaluation of the releases anticipated

from the disposal facility. Radioactivity releases that will be considered include release through the groundwater pathway, release through air pathways, release through surface water pathways, emanation of gamma radiation, and release through biotic pathways.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information reviewed under this SRP will be principally used, in conjunction with information reviewed under the other SRPs of SRP 6.1, to help assess the applicant's compliance with the following regulatory requirements:

(1) 10 CFR 20, "Standards for Protection Against Radiation"

(2) 10 CFR 61.13, "Technical Analysis," (a)

(3) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity"

(4) 10 CFR 61.43, "Protection of Individuals During Operations"

(5) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(6)

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to the identification of release of radioactivity from low-level disposal facility facilities.

4.3 Regulatory Evaluation Criteria

The information in the SAR may be considered acceptable if it is sufficient to ensure a reasonable, yet conservative, assessment of radioactivity release into each of the most significant radioactivity transport mechanisms for each of the five periods of concern in the life of the disposal facility. The most significant radioactivity transport mechanisms include groundwater, air, surface water, direct radiation, and biotic pathways. The five periods of concern include the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods. The information must furthermore be sufficient to enable an independent staff evaluation of the releases anticipated from the disposal facility.

The information provided by the applicant should include an analysis that identifies and quantifies the most significant release scenarios on the basis of the specific details of the site environment, the facility waste acceptance criteria, and the facility design and operating practices. Significant release scenarios should include those that contribute at least 5% of the calculated impacts to an individual at the critical receptor point.

To the extent that calculations of radioactivity release are based on waste stream specific models, the applicant's assumptions and analyses for each individual waste stream should be defendable. Should the applicant propose to

assume similar release models or parameter values for groups of waste streams, then an acceptable approach would be to assume the most conservative radioactivity release model or parameter value for all waste streams in the group. Use of other than the most conservative release model or parameter value should be justified by the expected distribution of the characteristics of individual waste streams forming the group.

In addition, if credit is taken for the inhibition of radioactivity release as a result of special waste forms, waste packaging (e.g., disposal within high integrity containers), or disposal techniques; those waste streams that will be disposed of pursuant to these techniques should be identified. The influence of these special waste forms, packaging, or disposal techniques on radioactivity release should be quantified.

Further criteria applicable to each of the above radioactivity transport mechanisms are provided in the following sections.

4.3.1 Release Through Groundwater Pathway

The information provided, and the applicant's methods for determining radioactivity release through groundwater pathways, will be acceptable if in its review, the staff can, at a minimum, confirm the provision of the following information and the adoption of the following analytical approach:

(1) All significant points of radioactivity discharge from the disposal units are identified and quantified.

(2) Radioactivity release models or parameter values consider the influence of chelating or other chemical agents that may enhance the mobility of radioactivity.

(3) The relationship between infiltration of water into the disposal units and release of radioactivity is analyzed (see SRP 6.1.2).

4.3.2 Release Through Air Pathways

In its review, the staff will confirm that the applicant has identified and quantified the most significant scenarios for radioactivity release through air pathways. These scenarios may vary widely depending on the disposal site design and operation, the waste acceptance criteria, and site environmental conditions. However, a sample list of potential release scenarios, which are applicable during all periods of disposal facility life, include the following:

(1) decomposition of waste resulting in emanation of decomposition gases such as methane, CO2, or H2

(2) evaporation of water collecting in disposal units or sumps, or otherwise having the potential for contacting stored or disposed waste

(3) airborne release of removable contamination from site soil, grounds, buildings, or structures

(4) airborne release of radioactivity based on dispersal of contamination exhumed by plant roots or burrowing animals and insects

Other release scenarios may also be applicable. One additional release scenario, which would only be applicable during the closure period, involves airborne release associated with building decontamination or demolition activities.

The release scenarios will be used as source terms for estimating the impacts on offsite individuals associated with normal facility conditions, as well as source terms for estimating impacts on onsite individuals carrying out normal activities during the active institutional control period.

Otherwise, the information provided, and the applicant's methods for determining radioactivity release through air pathways, will be acceptable if in its review, the staff can, at a minimum, confirm the provision of the following information and the adoption of the following analytical approach:

(1) All significant points and area discharge points are identified and quantified.

(2) An assessment has been provided of any change in radioactivity release as a function of the period in the disposal facility's lifetime. In this regard, active measures for the control of radioactivity release (e.g., periodic surveys of the disposal facilities to identify and eliminate burrowing animals) should not be counted on over the entire life cycle of the disposal facility. In general, the applicant's assessments should assume that active measures during the active institutional control period are limited in scope, and that active measures during the passive institutional control period are not implemented.

(3) To the extent that airborne releases are controlled through action levels proposed as part of a site survey or environmental program, the action levels may be used as a basis for release calculations. This might be the case for the above release mechanisms associated with evaporation of onsite water or airborne release of removable contamination from facility grounds, surfaces, or buildings. This approach is acceptable if sufficient information is provided to confirm that the proposed environmental monitoring and survey program will detect the presence and/or movement of radioactivity from the locations of concern, and if the action levels are established sufficiently low so that radioactivity movement is detected before regulatory criteria are exceeded.

(4) For possible releases as a result of biotic contact with and exhumation of contamination, bounding analyses are acceptable that are based on the typical biota observed in the immediate site environment and on facility design and operational considerations (e.g., establishment of particular types of grasses and installation of biological barriers).

4.3.3 Release Through Surface Water

In its review, the staff will confirm that the applicant has identified and quantified the most significant scenarios for radioactivity release through surface water pathways. These scenarios may vary widely depending on the disposal site design and operation, the waste acceptance criteria, and site environmental conditions. However, a sample list of potential release scenarios, which are applicable during all periods of disposal facility life, include the following:

(1) discharge of water collecting in disposal units, drainage blankets, or sumps, or otherwise having the potential for contacting stored or disposed waste

(2) waterborne release of removable contamination from site soil, grounds, buildings, or structures

(3) waterborne release of radioactivity based on dispersal of contamination exhumed by plant roots or burrowing animals and insects

Other release scenarios may also be applicable. One additional release scenario, which would only be applicable during the closure period, involves waterborne release associated with building decontamination or demolition activities.

Otherwise, the information provided, and the applicant's methods for determining radioactivity release through surface water pathways, will be acceptable if in its review, the staff can, at a minimum, confirm the provision of the following information and the adoption of the following analytical approach:

(1) All significant points and, as necessary depending on site design, area discharge points are identified and quantified.

(2) An assessment has been provided of any change in radioactivity release as a function of the period in the disposal facility's lifetime. In this regard, active measures for control of radioactivity release (e.g., periodic surveys of the disposal facilities to identify and eliminate burrowing animals) should not be counted on over the entire life cycle of the disposal facility. In general, the applicant's assessments should assume that active measures during the active institutional control period are limited in scope, and that active measures during the passive institutional control period are not implemented.

(3) To the extent that waterborne releases are controlled through action levels proposed as part of a site survey or environmental program, the action levels may be used as a basis for release calculations. This might be the case for the above release mechanisms associated with evaporation of onsite water or airborne release of removable contamination from facility grounds, surfaces, or buildings. This approach is acceptable if sufficient information is provided to confirm that the proposed environmental monitoring and survey program will detect the presence and/or movement of radioactivity from the locations of concern, and if the

action levels are established sufficiently low so that radioactivity movement is detected before regulatory criteria are exceeded.

(4) For possible releases as a result of biotic contact with and exhumation of contamination, bounding analyses are acceptable that are based on the typical biota observed in the immediate site environment and on facility design and operational considerations (e.g., establishment of particular types of grasses and installation of biological barriers).

4.3.4 Emanation of Gamma Radiation

In its review, the staff will confirm that the applicant has identified and quantified the most significant scenarios for impacts on individuals caused by exposure to direct radiation. These scenarios may vary widely depending on the disposal site design and operation, the waste acceptance criteria, and site environmental conditions. However, a sample list of potential scenarios, which are applicable only during the facility operational period, include the following:

(1) gamma radiation emitted by a group of waste delivery vehicles waiting to enter the facility disposal area

(2) gamma radiation emitted as a part of disposal facility operations (e.g., handling a waste liner)

During the active institutional control period, the impacts on an onsite individual could result from: (1) gamma radiation from disposed waste as attenuated through disposal unit covers; and (2) gamma radiation from residual contamination on surfaces of site grounds and structures.

Otherwise, the information provided, and the applicant's methods for determining exposure via direct emanation of radiation, will be acceptable if in its review, the staff can, at a minimum, confirm the provision of the following information and the adoption of the following analytical approach:

(1) For gamma radiation emitted during the operational period, an assessment of radiation levels and times. For groups of waste delivery vehicles, an acceptable approach would be to assume a typical grouping of vehicles emitting radiation corresponding to maximum levels allowable pursuant to Department of Transportation regulations.

(2) For gamma radiation emitted during the institutional control period, an assessment of radiation levels. The applicant's commitments to the residual contamination and exposure levels that will also be analyzed under SRP 5.2 ("Decontamination and Decommissioning") are acceptable.

4.3.5 Release Through Biota

For possible releases through biotic pathways, the staff will confirm that the applicant has identified and quantified the principal mechanisms by which contamination can be released and transferred off site directly via biotic pathways. In this case, direct biotic transfer refers to contamination being

transferred from the site by the actual biota, as opposed to the situations considered in Sections 4.3.2 and 4.3.3 of this SRP in which the transfer mechanisms are air and water. An example might consist of a burrowing animal such as a rabbit that picks up contamination from the site and then leaves the site only to be killed and eaten by a hunter. In any case, bounding analyses are acceptable that are based on the typical biota observed in the immediate site environment and on facility design and operational considerations (e.g., establishment of particular types of grasses and installation of biological barriers).

5. EVALUATION FINDINGS

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows. Documentation of conclusions should include a list of the applicant's commitments and/or limiting conditions of operations. These commitments and limiting conditions of operation will form the basis for staff development of disposal facility license conditions.

If the description of radioactivity release satisfies the review procedures and acceptance criteria in Sections 3 and 4 of this SRP, the staff will conclude that the information and results are adequate so that the staff can confirm the applicant's compliance with the regulatory requirements in Section 4.1 of this SRP. However, if the staff should find that the analyses and results are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.4
RADIONUCLIDE RELEASE - ACCIDENTS OR UNUSUAL OPERATIONAL CONDITIONS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist/Chemical Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR pertaining to the applicant's assessment of the types, significance, and magnitudes of radioactivity release associated with accidents or unusual operational conditions.

The findings and conclusions of the review under this SRP will be principally used, in conjunction with those of the review under SRP 6.1.1 ("Determination of Types, Kinds, and Quantities of Waste"), to analyze the applicant's projections of potential releases from the disposal facility resulting from accidents or unusual operational conditions. The numerical estimates of radionuclide release form the source term for calculations of transfer of radioactivity to human access locations. These are expected to principally involve transport via air (SRP 6.1.5.2), but may also involve transport via surface water (SRP 6.1.5.3). Resultant radiological impacts are then determined under SRP 6.1.6 ("Assessment of Impacts and Regulatory Guidance").

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on radioactivity release in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending the submittal of additional information.

3.2 Safety Evaluation

The staff will review the information provided by the applicant and verify that it is reasonable. The staff will also verify that sufficient information has

been provided so that it can perform an independent evaluation of the releases anticipated from the disposal facility.

3.2.1 Identification of Accidents or Unusual Operating Scenarios

The staff will review the accidents or unusual operating scenarios identified by the applicant to ensure that they are complete and representative. The staff may base this review on the results of generic analysis, regulatory requirements, operational history and procedures at other disposal facilities, and the applicant's proposed waste acceptance criteria and proposed design and operational procedures.

3.2.2 Evaluation of Release

The staff will review the applicant's estimates of event frequency and radioactivity release for each of the principal scenarios identified by the applicant to ensure that they are reasonable, yet pessimistic. The staff also should confirm that sufficient information is provided to provide a source term for an independent analysis of potential impacts. The staff may base this review on the results of generic analyses, regulatory requirements, operational history and procedures at other disposal facilities, and the applicant's proposed waste acceptance criteria and proposed design and operational procedures.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information reviewed under this SRP will be used, in conjunction with information reviewed under the other SRPs of SRP 6.1, to help assess the applicant's compliance with 10 CFR 61.12(k) and 10 CFR 61.13(c).

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to the identification of accident or abnormal operational conditions at a low-level disposal facility or to assessments of accident frequency and radioactivity release.

4.3 Regulatory Evaluation Criteria

4.3.1 Identification of Accidents or Unusual Operating Scenarios

The information provided and the applicant's methods for identifying a bounding set of scenarios for accidents or unusual operating conditions will be acceptable if in its review, the staff can confirm that, at a minimum, the following information has been provided:

(1) The applicant has identified and discussed the principal accidents or unusual operating scenarios by which radioactivity may be released and result in impacts on offsite individuals. This discussion should first identify a complete spectrum of possible release scenarios and then eliminate those that are trivial or are bounded by other scenarios. This discussion should include justification as to the choice and ranking of possible scenarios. The intent is to go from a complete list of possible

scenarios to those that are representative and bounding.

(2) In the above discussion, the applicant may reference (a) general information and analyses, (b) regulatory requirements that preclude certain scenarios from occurring or otherwise limit the release of radioactivity (e.g., in terms of the rate at which radioactivity is released or the period of time during which the release rate occurs), and (c) proposed conditions of waste acceptance or facility design and operation that preclude certain scenarios from occurring or otherwise limit the release of radioactivity. The applicant's proposed operational procedures should be reviewed to ensure compliance with the above commitments.

4.3.2 Evaluation of Release

The information provided and the applicant's methods for determining releases resulting from accidents or unusual operating conditions will be acceptable if in its review, the staff can confirm that, at a minimum, the following information has been provided:

(1) For each of the principal scenarios identified in Section 3.2.1 of this SRP, its applicant has provided estimates of radioactivity release and event frequency that are reasonable, yet pessimistic. In so doing, the applicant may reference: (a) generic information and analyses; (b) regulatory requirements that limit or bound the possible event frequency or magnitude of release; and (c) proposed conditions of waste acceptance or disposal facility design and operation that limit or bound the possible event frequency or magnitude of release. Experience at other disposal facilities may also be referenced provided that the relationship between other and proposed disposal operations is clear.

(2) The applicant has provided information that enables quantification of the source term for the principal transfer mechanisms of concern. These transfer mechanisms may include air and surface water pathways.

5. EVALUATION FINDINGS

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows. Documentation of conclusions should include a list of the applicant's commitments and/or limiting conditions of operations. These commitments and limiting conditions of operation will form the basis for staff development of disposal facility license conditions.

If the description of radioactivity release satisfies the review procedures and acceptance criteria in Sections 3 and 4 of this SRP, the staff will conclude that the information and results are adequate so that it can independently confirm the applicant's compliance with the regulatory requirement in Section 4.1 of this SRP. However, if the staff should find that the analyses and results are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of a SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.5
RADIONUCLIDE TRANSFER TO HUMAN ACCESS LOCATIONS

This SRP consists of the following:

SRP 6.1.5.1 Transfer Mechanism - Groundwater
SRP 6.1.5.2 Transfer Mechanism - Air
SRP 6.1.5.3 Transfer Mechanism - Surface Water
SRP 6.1.5.4 Other Transfer Mechanisms

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.5.1
TRANSFER MECHANISM - GROUNDWATER

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrogeologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR on the ability of the groundwater environment to impede, disperse, or dilute radionuclide releases from low-level burial sites with emphasis on relating the effects of such releases to existing and known future uses of water resources. The following areas of the SAR will be reviewed as they relate to the groundwater pathways analysis:

(1) the conceptual model of the geologic and hydrogeologic system that describes potential groundwater pathways for radionuclide migration

(2) radionuclide transport models used to predict temporal and spatial distributions of radionuclides in groundwater

(3) hydrogeologic, geochemical, and radionuclide release data used as input parameters to contaminant transport models

(4) concentration estimates calculated from radionuclide transport models at appropriate receptor locations used for assessing radionuclide releases in terms of dose (presented in accordance with Section 6.1.4 of NUREG-1199)

The LLTB staff will coordinate its review under this SRP with the reviews under other SRPs that directly relate to groundwater pathways analysis, namely, "Geology and Seismology" (SRP 2.3), "Groundwater Characterization" (SRP 2.4.2), Geotechnical Characteristics" (SRP 2.5), "Geochemical Characteristics" (SRP 2.6), "Water Resources" (SRP 2.7.2), and "Determination of Types, Kinds, and Quantities of Waste" (SRP 6.1.1). In addition, information and data reviewed under this SRP are used directly as input for the review under SRP 6.1.6.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on groundwater pathways in the SAR in accordance with, but not limited to, the requirements of 10 CFR 61 and NUREG-1199. If the information is inadequate, the staff may request that the applicant supply additional information or an explanation through the comment process. The staff may recommend that the application be rejected or accepted for documentation, pending submittal of the additional information.

3.2 Safety Evaluation

The staff will review the information to ensure that the applicant has performed and presented a complete analysis of groundwater pathways using relevant assumptions and acceptable methods to predict long-term migration of radionuclides from the site. The areas of the applicant's analysis discussed in the following sections will be reviewed.

3.2.1 Conceptual Model

The analysis of groundwater pathways should begin with a review of the hydrogeologic, geologic, geotechnical, and geochemical site characteristics under SRPs 2.4.2, 2.3, 2.5, and 2.6, respectively. The staff should note the general stratigraphy and lithology of the site, the areal extent and thickness of aquifers, recharge and discharge zones, flow rates and travel times, and the hydrogeologic properties and contaminant transport characteristics of the site medium.

Upon review of the site-specific information obtained during the site characterization program pertinent to groundwater pathways, the staff will review the applicant's conceptual model, which schematically traces radionuclide migration from the disposal units to the site boundary and to existing and known future human access locations downgradient from the site. The applicant should describe, to the extent practicable, all possible groundwater pathways through which radionuclides could become accessible to humans, including all permeable layers between the surface and bedrock. The description of the conceptual models should include the physical environment and transport medium in relationship to the planned engineered design.

The staff will review the applicant's conceptual model for thoroughness to verify that all potential groundwater pathways for radionuclide migration have been clearly identified. The staff must ensure that the hydrogeologic, geologic, and geochemical information furnished in the conceptual analysis is consistent with the site-specific data presented in the site characterization sections of the SAR. Once the staff concludes that all major groundwater pathways for radionuclide migration have been adequately identified and described, it will review the numerical/analytical groundwater transport models, input parameters, and the results of the modeling analysis.

3.2.2 Input Parameters

The applicant should provide estimates of the input parameters (hydrogeologic, geochemical, and radionuclide release data) for the radionuclide transport analysis reviewed under this SRP, the computational methods and justification for which have been reviewed under SRPs 2.4.2, 2.6, and 6.1.1 through 6.1.4.

The staff will evaluate the input parameters for compatibility with the numerical/analytical transport model(s) used to calculate predicted radionuclide concentrations and representativeness with respect to the hydrogeologic and geochemical conditions of the site and vicinity. The values assumed in the analysis should be a conservative representation of the measured data. The staff should ensure that the use of the input parameters has been justified and that the data are sufficient to provide a reasonably accurate or conservative analysis regarding groundwater pathways. If adequate site-specific parameters are not available, the staff should ensure that adequate conservatism is applied. If there is uncertainty or inconsistency in the input parameters, the values should be compared with ranges of values found in the literature that have been determined for similar geologic media.

3.2.3 Contaminant Transport Models

The staff will compare the numerical/analytical transport models used by the applicant to predict radionuclide transport through the saturated and unsaturated zones for compatibility with the conceptual models reviewed under this SRP and the groundwater flow models used to characterize the flow regime reviewed under SRP 2.4.2. The staff will ensure that all potential groundwater pathways have been considered in the modeling effort. The staff will ensure that the applicant has considered in its analysis both potential radionuclide migration based on existing groundwater flow conditions (input data obtained from the review under SRP 2.4.2) and potential radionuclide migration based on transient flow conditions resulting from potential groundwater exploitation (input data obtained from the review under SRP 2.7.2) and other factors. The transport models will be evaluated for their defensibility, suitability, and basic conservatism and the conservatism of their application. The staff must ensure that the codes are based on sound physical, chemical, and mathematical principles (verified), and that the codes are correctly applied. The staff also will ensure that the codes are sufficiently documented as suggested in NUREG-0856.

3.2.4 Model Results

The staff will examine the applicant's results of the modeling analysis to confirm that the prediction of radionuclide contaminants was conducted in accordance with acceptable and defensible techniques, approaches, and practices. The staff will determine whether the predicted concentrations are reasonable representations of the anticipated response of the hydrogeologic system, as compared with background water quality data reviewed under SRP 2.6 and other hydrogeologic information reviewed under Section 2.4.2.

The staff initially will perform independent calculations of radionuclide concentrations at appropriate groundwater user and potential user locations at the site and vicinity using simple analytical modeling techniques with demonstrably conservative assumptions and coefficients. The staff's preliminary results will be compared with the applicant's results for conservatism. If the results are similar, no further analysis is warranted. If the applicant's results are more realistic than conservative, then the applicant must clearly justify the application and results of the model, including the underlying assumptions and input parameter values used in the analysis. If questions arise concerning the applicant's modeling effort, the staff may undertake more sophisticated numerical modeling techniques, which

rely on less conservative and more realistic assumptions to check the applicant's results.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or reevaluate its analysis and modify those areas that do not meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are

(1) 10 CFR 61.13, "Technical Analyses," (a), which requires information to demonstrate reasonable assurance that releases of radioactivity from the site will not exceed the dose limits in 10 CFR 61.41

(2) 10 CFR 61.23, "Standards for Issuance of a License," (f), and 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(2), which require information that demonstrates that the site is capable of being characterized, modeled, analyzed, and monitored

4.2 Regulatory Guidance

There are currently no NRC regulatory guides that apply to groundwater pathways for a low-level waste disposal facility. However, the NUREG reports listed in Section 7 of this SRP can be used as general guidance.

4.3 Regulatory Evaluation Criteria

The applicant should perform a technical analysis of groundwater pathways for contaminant migration and present the results of the analysis in terms of reasonably accurate or conservative concentrations at the site boundary and appropriate groundwater user locations downgradient of the site. So that the staff can perform an independent evaluation of the analysis, the applicant should provide the following information pertinent to the areas of review listed in Section 2 of this SRP.

(1) a complete description of the contaminant transport pathways between the engineered disposal unit and the site boundary and existing or known future groundwater user locations

(2) estimates and justification for the physical and chemical input parameters used in the transport models to calculate radionuclide concentrations

(3) a description of the contaminant transport models used in the analysis, including modeling procedures and complete documentation of the codes as required in NUREG-0856

(4) model output results in terms of radionuclide concentrations as a function of time and space, including a discussion of the inherent assumptions of

the model, the effect of the assumptions on the model results, and other associated uncertainties

The staff will find acceptable the applicant's information if it is complete and consistent with geologic, geotechnical, geochemical, and hydrologic data provided in related sections of the SAR and if the applicant's results compare favorably with those of the staff.

5. EVALUATION FINDINGS

5.1 Introduction

If the staff concludes that adequately conservative or defensible radionuclide transport models, with adequately conservative or justifiable site-specific hydrogeologic and geochemical parameters, have been used to calculate concentrations of radionuclides at appropriate distances and directions from the source, it can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the groundwater pathways analysis for [name of facility] low-level waste disposal facility according to Standard Review Plan 6.1.5.1.

The staff concludes that the concentration estimates are conservative and defensible and are appropriate for the assessment of dose. In addition, use of these values in dose assessment related to performance objective 10 CFR 61.41 will lead to reasonably accurate or conservative values of dose. This conclusion is based on the use of conservative or justifiable input parameters in the modeling effort performed by the applicant and the independent analysis performed by the staff.

In determining the distribution and concentration of radionuclides, the applicant has used realistic and reasonably conservative assumptions in the analysis and has discussed the uncertainties inherent in the modeling analysis.

[The Safety Evaluation Report also should include a brief summary of the relative concentrations of radionuclides calculated by the staff, reference to the analytical or numerical transport model(s) used, and a comparison of the values computed by the staff with those of the applicant.]

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-0856, "Final Technical Position on Documentation of Computer Codes for High-Level Waste Management," June 1983.

General

---, NUREG-0868, "A Collection of Mathematical Models for Dispersion in Surface Water and Groundwater," June 1982.

---, NUREG-0902, "Site Suitability, Selection and Characterization Branch Technical Position," April 1982.

---, NUREG-1165, "Environmental Impacts of Postulated Accidents Involving Releases of Radioactive Materials to Groundwater," November 1985.

---, NUREG-1199, " Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-2700, "Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton, P. G. Malone, R. B. Meade, et al., Department of the Army, Army Engineer Waterways Experiment Station, May 1982.

---, NUREG/CR-2917, "Review of Ground-Water Flow and Transport Models in the Unsaturated Zone," C. A. Oster, Battelle Memorial Institute, Pacific Northwest Laboratories, November 1982.

---, NUREG/CR-3038, "Tests for Evaluating Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton, D. K. Butler, R. B. Meade,, et al., U.S. Department of the Army, Army Engineer Waterways Experiment Station, December 1982.

---, NUREG/CR-3164, "Subsurface Monitoring Programs at Sites for Disposal of Low-Level Radioactive Waste," R. J. Lutton, W. E. Strohm, and A. B. Strong, U.S. Department of the Army, Army Engineer Waterways Experiment Station, April 1983.

---, NUREG/CR-4369, "Quality Assurance (QA) Plan for Computer Software Supporting the U.S. Nuclear Regulatory Commission's High-Level Waste Program," G. F. Wilkinson and G. E. Runkle, Sandia National Laboratories, January 1986.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.5.2
TRANSFER MECHANISM - AIR

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Meterologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the areas of the SAR given in the following sections as they relate to the air pathway analysis. The objectives of the air pathway analysis are to provide reasonable assurance that the limits in 10 CFR 20.105 will not be exceeded and, in accordance with 10 CFR 61.13, to demonstrate that there is reasonable assurance that the exposure to humans from the release of radioactivity will not exceed the limits in 10 CFR 61.41.

2.1 Atmospheric Transport and Diffusion Models

The SAR should include

(1) the models, computer codes, and computational methods for estimating atmospheric transport and dispersion of aerosols, vapors, or gaseous releases to the atmosphere from a low-level waste disposal site

(2) the applicability and accuracy of the models that simulate atmospheric transport and diffusion in the region of interest, and the computer code validation

(3) the flexibility of the models to incorporate special features to account for variable site conditions, and the sensitivity of the models to changes in the input data

The atmospheric transport and diffusion model should include

(1) the computational methods for simulating time-varying and frequency-varying releases (e.g., puff releases and continuous releases)

(2) the computational methods for simulating ground-level releases and for determining effective release heights (e.g., an elevated release due to fire)

(3) the computational methods for simulating variable source geometries (e.g., point source, areal source, and source shape)

(4) the source emission rates and the basis for resuspension models and computational schemes for resuspension rates

(5) the computational simulation of the effects of terrain and structures between sources and receptors

(6) the locations and elevations of the maximally exposed individual, the critical population, and other nearby offsite receptor points (i.e., the distance, direction, and elevation of the nearest residences, farms, milk cows, etc.)

(7) the range of downwind distances applicable to the models and the computational capability for determining plume concentrations at relatively short distances from the source

(8) the population distribution in each of the sixteen 22.5~ radial sectors centered on the disposal site (see SRP 2.1)

(9) the removal mechanisms and particulate deposition rates considered in the simulation of atmospheric transport and diffusion

(10) the computational schemes used to quantify removal mechanisms, wet and dry deposition rates, and deposition per unit area

2.2 Meteorological Data for the Model

For meteorological data, collected in accordance with SRP 2.2, the SAR should describe

(1) the applicability of the meteorological data to the atmospheric transport and diffusion model

(2) the sources of the meteorological data and the representativeness of the data for the site and its environs

(3) the applicability, limitations, and accuracy of site-specific input data and assumptions made in the modeling and computation of airborne concentrations (e.g., transfer factors)

(4) the specifications of the meteorological data measurements and summary of site meteorological data using the format given in Draft Regulatory Guide Task ES 401-4

2.3 Airborne Concentrations (Applicant-Calculated)

The SAR should include a tabular summary of the projected concentrations of airborne radioactivity and surface deposition

(1) at the site boundary points for each of the 22.5~ radial sectors centered on the 16 cardinal compass directions

(2) at the location of the maximally exposed individual (off site)

(3) at the nearest offsite present and known future receptors (i.e., residence, milk cow, milk goat, meat animal, and farm and vegetable garden larger than 50 m2) for each of the 22.5~ radial sectors

(4) to offsite individuals during the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods

(5) to offsite individuals as a result of operational accidents or abnormal conditions during the operational period

(6) to onsite individuals during the active institutional control period

3. REVIEW PROCEDURES

The staff will obtain and use such information as is necessary to ensure that the review procedure is complete. The staff will use and emphasize material from the SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness the description of the air pathway analysis in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations and regulatory guide referenced in this SRP by comparing the applicant's submittal and methods with the regulations and guides and by verifying the applicant's references to the guide or to proposed alternatives. The staff will verify that the alternatives are equivalent to or improvements on the methods cited in the referenced regulatory guide. Otherwise, alternatives are likely to be disapproved.

The staff will evaluate the areas of review given in Section 2 against the criteria listed in Section 4. The staff will

(1) Compare the technical description of the types of models and computational equations used by the applicant to predict atmospheric transport and dispersion with the types of models acceptable to the NRC staff.

(2) Determine if the models simulate atmospheric transport and diffusion in the site-specific region from source to receptor.

(3) Review the information on the sensitivity of the models to ensure valid predictions of transport behavior under a range of applicable variations in site-specific parameters.

(4) Determine the acceptability of the applicant's computational methods for simulating ground-level -releases, for estimating the effective release heights for vents or elevated release points, for simulating various source geometries such as point sources and areal sources, and for simulating releases of both short and long duration.

(5) Review the mathematical methods for quantifying removal mechanisms, wet and dry deposition rates, areal deposition, and plume depletion.

Computational consideration includes types of radionuclides released, site precipitation data, distances from source to receptor points, and stability classes for both ground-level and elevated-level release models.

(6) Verify that methods for estimating surface contamination resulting from wet and dry deposition take into account the characteristics of the radionuclide species, site meteorological conditions, and site terrain.

(7) Compare meteorological measurement specifications and collection with guidance provided in Draft Regulatory Guide Task ES 401-4.

(8) Determine whether the meteorological information is applicable and sufficient for the airborne transport and diffusion model used by the applicant.

(9) Review the sources of meteorological data for the models to ensure that the data are representative of the site and its environs.

(10) Verify that wind speed and wind direction have been measured in appropriate time steps and that time-averaged wind directions have been divided into an appropriate number of compass point sectors in accordance with Draft Regulatory Guide Task ES 401-4.

(11) Compare the applicant's means of establishing directionally dependent dispersion parameters and atmospheric stability classes for the calculation of airborne transport and diffusion for both ground-level and elevated-level releases with acceptable methods for determining such data as described in Draft Regulatory Guide Task ES 401-4.

(12) Verify the applicant's projected radioactive concentrations at all receptor locations using referenced, acceptable computational models and analytical methods.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant provide additional information or modify the submittal to meet the acceptance criteria in Section 4.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if it (1) meets the requirements of 10 CFR 61.13, 61.41, and 61.43; (2) meets the relevant requirements of 10 CFR

20.105 as it relates to control of radiation doses to individuals in unrestricted areas.

4.2 Regulatory Guidance

The following regulatory guide provides information, recommendations, and guidance and in general describes a basis acceptable to the staff for implementing the requirements of 10 CFR 20 and 61:

> Draft Regulatory Guide Task ES 401-4, "Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting," as it relates to obtaining appropriate meteorological information required for a valid estimate of atmospheric diffusion at a particular site, data accuracy, and suitable data reduction and compilation

4.3 Regulatory Evaluation Criteria

Acceptance criteria necessary to meet the relevant requirements of the regulations for the areas of review described in Section 2 of this SRP are discussed in the following sections.

4.3.1 Atmospheric Transport and Diffusion Model

The staff will determine the acceptability of the atmospheric transport and diffusion model based in part on (1) the representativeness of the site-specific input data used for the model, (2) the capability of the model to account for the physical characteristics of the site (such as structures, irregular terrain, and wet and dry deposition), and (3) the capability of the model to account for the physical and chemical characteristics of releases from the low-level waste disposal site (such as particle size and transformations during transport).

4.3.2 Meteorological Data for the Model

The staff will accept the site-specific meteorological data collected in the site-characterization monitoring phase (SRP 2.9) if they are in accordance with Draft Regulatory Guide Task ES 401-4 and with "Draft Technical Position Paper - Environmental Monitoring of Low-Level Waste Disposal Facilities" prepared by the Division of Waste Management. Other acceptable sources include nearby National Weather Service stations and other nearby, well-maintained meteorological facilities. The applicant should have provided locations, downwind distances, and elevations for each receptor point identified in Section 2.3 of this SRP (preferably on a topographic map) in order to enable the staff to verify the applicant's calculations.

4.3.3 Airborne Concentrations (Applicant-Calculated)

The staff will find this part of the SAR acceptable if the applicant has calculated airborne concentrations and the concentrations of contaminants deposited on terrestrial surfaces for all locations of the receptors identified in Section 2.3 of this SRP. Airborne concentrations should have been presented for the operational and postoperational monitoring phases for both routine and accident conditions. These concentrations should have been reported as annual average values for comparison to the performance objectives in 10 CFR 61.41.

However, for those concentrations calculated for intermittent or infrequent releases, consideration should also have been given to the frequency and duration of the release. The staff will accept the applicant's information if it is complete and consistent with meteorological, demographic, and transfer factor data provided in the related sections of the SAR and if the applicant's results compare favorably with estimates of concentrations determined independently by the staff.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the air pathway analysis for [name of facility] low-level waste disposal facility according to Standard Review Plan 6.1.5.2.

On the basis of the following findings, the staff concludes that the methodology for the analysis of airborne transport and diffusion is acceptable and meets 10 CFR 20 and 61.

The diffusion of individual plume elements is determined from the general Gaussian diffusion model.

The applicant's analysis methodology considers both ground-level releases and releases from vents at the level of solid structures. Wind speed, wind direction, and a measure of atmospheric stability data representative of actual release heights are available and have been appropriately considered.

Input data on classification of atmospheric stability and meteorological parameter values have been established to within specified recommended limits in accordance with Draft Regulatory Guide Task ES 401-4. Wind speed data have been appropriately presented in terms of suitable wind speed classes, and wind directions have been divided into 16 compass directions (22.5° sectors, centered on true north).

The representativeness of meteorological data has been adequately established by numerous site-specific meteorological measurements performed by the applicant during the site characterization period and by verification of the data by comparing the data with long-term information from nearby National Weather Service and/or well-established weather stations.

The applicant has appropriately used annual average meteorological data in considering the continuous-release source term (resuspension resulting from daily onsite activities). For emissions that are infrequent and of short duration (e.g., puff releases and short-term diffusion following an accidental spill), models and meteorological data appropriate to the period of release have also been considered.

The effects of wet and dry deposition have been addressed by the applicant's considerations of plume depletion correction factors. Plume depletion, effects at various distances from the disposal units for ground releases and near-ground release heights under all atmospheric stability classes have been factored into the calculations.

The effects of wet deposition are significant, on the basis of site-specific precipitation data, and have been considered in the airborne pathway analysis. Wet and dry deposition rates and relative deposition per unit area were determined as a function of atmospheric stability and distance from the disposal units.

The analyses of meteorological conditions and atmospheric dispersion and surface deposition factors for short-term and annual average releases have been provided by the applicant. The assumptions, computational procedures, and the probability distribution of these estimates for appropriate time periods are also acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title In, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, Draft Regulatory Guide Task ES 401-4, "Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting," 1985.

---,"Draft Technical Position Paper - Environmental Monitoring of Low-Level Waste Disposal Facilities," Division of Waste Management.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.5.3
TRANSFER MECHANISM - SURFACE WATER

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Hydrologist/Hydrogeologist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR on the ability of the surface water environment to dilute normal or accidental radioactive liquid effluent releases from the low-level waste burial sites, particularly in regard to relating the effects of such releases to existing and known future uses of surface water resources. The staff will review the following areas:

(1) the conceptual model that describes all potential surface water pathways for radionuclide migration

(2) surface water transport models used to analyze the spatial and temporal concentrations of radionuclides at appropriate distances downgradient from the site

(3) source term data used as input parameters to surface water transport models, particularly the release rate and source terms at groundwater interfaces, where applicable

(4) estimates of radionuclide concentrations calculated from surface water transport models

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on surface water pathways in the SAR in accordance with this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply more information or an explanation. The staff may recommend that the application be rejected or accepted for documentation, pending the submittal of the requested information.

If the staff finds that the information furnished by the applicant is adequate, the technical analyses will begin.

3.2 Safety Evaluation

The staff will review the applicant's analyses and make independent conservative calculations for annual average and maximum (for accidental releases) concentrations at points of surface water use. Utilizing the release mechanisms from SRPs 6.1.3 and 6.1.4, the staff will estimate concentrations using the transport models and general guidance given in NUREG-1054, NUREG/CR-3332, and Regulatory Guide 1.113. Conservatism will be used in the selection of coefficients and parameters for use in any of these methods. The staff also will review the analyses to verify that any potential future changes (which might result from variations in precipitation or by the construction of known future wells, reservoirs, and intakes) are reflected in the computations.

For some release scenarios, the surface water pathway analysis may be performed in conjunction with the groundwater pathway analysis; generally, the source term and rate of release of each radionuclide are determined using the procedures given in SRP 6.1.5.1.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

Requirements relating to the adequacy of information and technical analyses of surface water pathways for radionuclide migration are found in the following regulations:

(1) 10 CFR 61.13, "Technical Analyses," (a), which requires information to demonstrate clearly with reasonable assurance that releases of radioactivity from the site will not exceed the dose limits in 10 CFR 61.41

(2) 10 CFR 61.23, "Standards for Issuance of a License," (b), and 10 CFR 61.41, "Protection of General Population From Releases of Radioactivity," which require that the general population be protected from radioactive releases

(3) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(2), which requires information to demonstrate that the site is capable of being characterized, modeled, analyzed, and monitored

4.2 Regulatory Guidance

Transport models suited to the types of analyses needed to estimate concentrations at points of surface water use are described in Regulatory Guide 1.113, NUREG-1054, and NUREG/CR-3332. Use of these models is not required however. In addition, they may not be suitable for all situations.

4.3 Regulatory Evaluation Criteria

Acceptable analyses of radionuclide migration should (1) describe the dispersion characteristics and dilution capability of the surface water environment

with respect to existing and known future users under both normal and accident conditions, (2) provide estimates and bases for annual average and maximum (for accidental releases) concentrations at the locations of existing or known future users under normal and accident conditions, (3) identify potential pathways of contamination to surface water users, and (4) describe and reference sources of data. Information related to the determination of radionuclide release mechanisms and assessment of doses may be found in SRPs 6.1.3, 6.1.4, and 6.1.6. Acceptance of the results of the surface water transport models will be based on a favorable comparison of applicant and staff results.

5. EVALUATION FINDINGS

5.1 Introduction

Documentation of acceptable applicant analyses will state that potential contamination pathways between the site and the nearest water user have been identified and that concentrations of radionuclides (caused by releases from the site) at that user location have been acceptably derived. If the staff predicts substantially more adverse concentrations, it will state the basis for its prediction.

The review should also state that, in determining the distributions and concentration of radionuclides, the applicant has followed appropriate and/or conservative guidelines. The Safety Evaluation Report may also include a brief summary of the concentrations of radionuclides calculated by the staff, reference to the analytical or numerical transport model(s) used, and a comparison of the values computed by the staff and those computed by the applicant.

The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the surface water pathways analyses for [name of facility] low-level waste disposal facility according to Standard Review Plan 6.1.5.3.

The applicant has provided analyses to document the concentrations of radioactive releases that could potentially affect surface water bodies in the site area. The staff has evaluated these analyses independently using the surface water transport models given in NUREG-1054. The staff's analyses indicate that the applicant's estimates and assumptions are conservative and that the annual average and maximum concentrations at the nearest surface water user have been acceptably computed. Final concentrations and dose estimates, for all pathways, may be found in Section 6.1.6.

On the basis of its review of the analyses, the staff concludes that (1) 10 CFR 61.13(a) has been met because adequate analyses and information have been provided in support of surface water pathways identification and (2) 10 CFR 61.50(a)(2) has been met because the site is capable of being characterized and modeled. The ability of the site to meet the requirements of 10 CFR 61.23(b) and 61.41 is stated in Section 6.1.6 of this report.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

---, NUREG-1054, "Simplified Analysis for Liquid Pathway Studies," August 1984.

---, NUREG/CR-3332, "Radiological Assessment - A Textbook on Environmental Dose Analysis," J. E. Till and H. R. Meyer, Oak Ridge National Laboratory, September 1983.

---, Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Liquid Effluents From Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."

General

U.S. Nuclear Regulatory Commission, NUREG-0868, "A Collection of Mathematical Models for Dispersion in Surface Water and Groundwater." June 1982.

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STANDARD REVIEW PLAN 6.1.5.4
OTHER TRANSFER MECHANISMS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Biologist/Health Physicist

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the information in the SAR pertaining to the applicant's assessment of transfer mechanisms other than groundwater, air, or surface water. The transfer mechanisms include attenuation of gamma radiation through air and offsite transfer of radioactivity through biotic pathways.

The findings and conclusions of the review under this SRP will be used, in conjunction with those of the reviews under SRPs 6.1.5.1 through 6.1.5.3, to analyze the input to the applicant's projections of dose rates to individuals (SRP 6.1.6). SRPs 6.1.3 and 6.1.4 provide the source term for this portion of the performance assessment.

The analysis of attenuation of gamma radiation includes analyses of exposure models used by the applicant including the computer codes and source and receptor configurations. The periods of concern are the operational period for offsite individuals and the active institutional control period for the custodial personnel. During the operational period, two likely scenarios are doses to individuals near the disposal site from parked waste delivery vehicles and from such site operations as cranes hoisting liners. During the active institutional control period, the pathway of concern is direct radiation from onsite soil, which is described in Table 6.1.6-2 of SRP 6.1.6, item (7).

The analysis of biotic transfer mechanisms includes the analysis of the consumption of contaminated biota that has migrated off the disposal facility. The pathway of concern is described in Table 6.1.6-2, item (8). The periods of concern range from the startup of operations through the passive institutional control period.

Most other processes involving direct radiation, onsite plant uptake of radionuclides, or the activity of burrowing animals should be considered as subpathways of other major pathways, items (1)-(6) of Table 6.1.6-2. For

instance, if releases can be attributed to disruption of a disposal unit cover by burrowing animals, transfer following such releases should be analyzed as subpathways to groundwater, air, and surface water major pathways (see Sections 4.3.1, 4.3.2, and 4.3.3 of SRP 6.1.3).

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on attenuation of gamma radiation and rates and mechanisms of biotic transfer in the SAR in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending the submittal of additional information.

3.2 Safety Evaluation

The staff will review the information provided by the applicant and verify that it is reasonable. It also will verify that sufficient information has been provided so that it can perform an independent evaluation of radioactivity transfer from the disposal facility.

Specific reviews the staff may perform for the gamma radiation transfer mechanism include the following:

(1) comparison of the mathematical methods for describing buildup, shielding, and absorption effects with acceptable methods found in NUREG/CR-3332, National Council on Radiation Protection and Measurements, Report 50 (NCRP-50), and the Reactor Shielding Design Manual (Rockwell, 1956)

(2) comparison of the model for calculating external exposure to electrons with models presented in NUREG/CR-3332

(3) comparison of the analytical methods of simulating various source geometries such as point, planar, and volume configurations with acceptable methods found in NUREG/CR-3332 and NCRP-50

(4) comparison of the values determined for the site-specific parameters with data published in the Radiological Health Handbook (U.S. Department of Health, Education and Welfare, 1970) and the Reactor Shielding Design Manual

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information reviewed under this SRP will be used, in conjunction with information reviewed under the SRPs of SRP 6.1, to help assess the applicant's compliance with the following regulatory requirements:

(1) 10 CFR 20, "Standards for Protection Against Radiation"

(2) 10 CFR 61.13, "Technical Analyses," (a)

(3) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity"

(4) 10 CFR 61.43, "Protection of Individuals During Operations"

(5) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(6)

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to gamma attenuation or biotic transfer of radioactivity from low-level disposal facility facilities.

4.3 Regulatory Evaluation Criteria

The information in the SAR is acceptable if it is sufficient to ensure a reasonable, yet conservative assessment of gamma attenuation and biotic transfer for each period of concern in the life of the disposal facility. For gamma attenuation, the period of concern is the operational period for offsite individuals and the institutional control period for the onsite custodial personnel. For biotic transfer, the period of concern is from startup of operations through the passive institutional control period. The information should furthermore be sufficient to enable the staff to perform an independent, confirming analysis.

5. EVALUATION FINDINGS

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

If the description of gamma attenuation and biotic transfer satisfies the review procedures and acceptance criteria in Sections 3 and 4 of this SRP, the staff will conclude that the information and results are adequate so that the staff can confirm the applicant's compliance with the regulatory requirements in Section 4.1 of this SRP. However, if the staff should find that the analyses and results are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U. S. Government Printing Office, Washington, DC, revised annually.

National Council on Radiation Protection and Measurements, "Environmental Radiation Measurements," Report 50, Washington, DC, 1976.

Rockwell, T., ed., Reactor Shielding Design Manual, Naval Reactors Branch, Division of Reactor Development, U.S. Atomic Energy Commission, March 1956.

U.S. Department of Health, Education, and Welfare, Radiological Health Handbook, Public Health Service, Food and Drug Administration, Bureau of Radiological Health, Rockville, MD, revised edition, 1970.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.1.6
ASSESSMENT OF IMPACTS AND REGULATORY COMPLIANCE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist

1.2 Secondary - None

1.3 Supporting - Operations Branch (LLOB)

2. AREAS OF REVIEW

The staff will review the information in the SAR pertaining to the applicant's assessment of calculated impacts (dose rates) on individuals and compliance with regulatory criteria.

The findings and conclusions from this SRP form the culmination of the analyses, findings, and conclusions addressed in SRPs 6.1.1 through 6.1.5.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on the assessment of impacts and regulatory compliance in accordance with NUREG-1199 and this SRP. If the information presented by the applicant is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or explanation through the comment process. The staff may recommend at this time that the application be either rejected or accepted for documentation, pending the submittal of additional information.

3.2 Safety Evaluation

The staff will review the information provided by the applicant and verify that it is reasonable. The staff will also verify that sufficient information has been provided to enable an independent evaluation of radiological impacts and compliance with regulations.

3.3 Analytical Results

The staff will review the following areas of the SAR with respect to (1) calculations of radiological impacts on individuals, and (2) compliance with regulatory criteria.

3.3.1 Calculation of Radiological Impacts on Individuals

The overall objective of the staff review is to determine compliance with the regulations listed in Section 4.1 of this SRP. Specific impacts to be calculated include those associated with (1) releases resulting from normal conditions, (2) releases resulting from accidents or unusual operational conditions, and (3) normal activities by the site owner during the active institutional control period.

An acceptable way to organize this review is to first address the overall scope of the applicant's evaluation of impacts and then address the details of this evaluation.

Scoping Review

An acceptable way to organize the scoping review is to first identify and confirm the principal receptor points of concern (i.e., the principal human access locations), then identify and confirm the particular exposure media in which radioactivity is projected to be present, and finally to identify and confirm the principal uptake pathways.

For a scoping review of releases resulting from normal operations, the above three-stage hierarchy is illustrated in Tables 6.1.6-1 through 6.1.6-3. It should be noted, however, that the particular receptor points, exposure media, and uptake pathways that would be considered for a particular facility would be dependent on the proposed design and operation of the facility and site environmental conditions. The examples illustrated in Tables 6.1.6-1 through 6.1.6-3 may be incomplete or inapplicable.

For unusual or accidental operational releases, at least two receptor points may be considered: the site boundary and the nearest surface discharge point (e.g., a stream) for site runoff. The exposure media of concern would, at a minimum, include air for the first receptor point and surface water for the second. It should also be noted that impact assessment models for temporary uptake of radioactivity are somewhat different from those for chronic uptake of radioactivity.

For normal activities by the site owner during the active institutional control period, the receptor point is essentially the surface of the disposal facility. Exposure media of concern would, at a minimum, include contaminated onsite air and direct radiation.

Table 6.1.6-1 Typical receptor points (access locations) and exposure media

Receptor points	Possible exposure media	Comments
Site boundary	Air	a
	Well water	b
	Surface water (possibly)	c
	Gamma radiation	d
Nearest user of groundwater downgradient of site	Air	
	Well water	e
	Surface water (possibly)	e
Nearest community user of groundwater downgradient of site	Air	
	Well water	e
	Surface water (possibly)	e
Nearest surface discharge point (e.g., stream) for groundwater in downgradient direction from site	Air	
	Surface water	
Nearest surface discharge point (e.g., stream) for site runoff	Air	
	Surface water	
Nearest resident[f]	Air	
	Well water (possibly)	
	Surface water (possibly)	
	Contaminated biota	

(a) Determined for each of the 22.5° radial sectors centered on the 16 cardinal compass directions.

(b) Possibly not applicable until active and passive institutional control periods. See comment f.

(c) In the event that a surface water access location is at or near the site boundary.

(d) Determined during operational period at the site boundary near major onsite source of gamma radiation.

(e) Depending on site-specific conditions, the access location could be well water, surface water, or both.

(f) For the active and passive institutional control periods, the nearest resident should be assumed to be at the site boundary. Access locations to be considered should, at a minimum, include air, well water, and contaminated biota. Surface water use depends on site-specific conditions.

Table 6.1. 6-2 Typical uptake pathways considered

Exposure media	Uptake pathways	
	Primary	Secondary
(1) Offsite air*	Inhalation (air) Direct radiation (air)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(2) Offsite air	Inhalation (air) Direct radiation (air) Food (air)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(3) Offsite location	Direct radiation (operations)	
(4) Onsite air	Inhalation (air) Direct radiation (air)	
(5) Well water	Ingestion (water)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(6) Open water	Ingestion (water) Ingestion (fish) Direct radiation (immersion)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(7) Onsite soil during active institutional control period	Direct radiation (volume) Radiation (area)	
(8) Contaminated biota	Ingestion (specific)	

*Note that dose assessment models based on the presence of contaminated air at a human access location would differ somewhat on the basis of whether one is addressing a chronic or a temporary exposure (e.g., as in a puff release of radioactivity).

Table 6.1.6-3 Descriptions of typical uptake pathways

Subpathway	Description
Inhalation (air)	Uptake of radionuclides resulting from breathing contaminated air.
Inhalation (soil)	Uptake of radionuclides resulting from air contaminated from suspension and volatilization of contaminated surfaces.
Direct Radiation (air)	Direct exposure to ionizing radiation based on immersion in a cloud of contaminated air.
Direct Radiation (area)	Direct exposure to ionizing radiation based on standing on a contaminated surface.
Direct Radiation (operations)	Direct exposure to ionizing radiation based on proximity to disposal facility during operations.
Direct Radiation (volume)	Direct exposure to ionizing radiation resulting from disposed waste as attenuated through disposal unit covers.
Direct Radiation (immersion)	Direct exposure to ionizing radiation resulting from immersion in contaminated water.
Ingestion (air)	Uptake of contaminated plant food resulting from deposition of airborne contamination. This pathway could include consumption of deposited contamination (e.g., leafy vegetables) plus consumption of contamination resulting from root uptake pathways. In either case, radionuclide transfer to humans could occur via the following mechanisms: plant-to-human, plant-to-animal-to-human, and plant-to-animal-to-product-to-human.
Ingestion (water)	Uptake of contamination resulting from consumption and use of contaminated water. Water may be consumed directly, used for watering livestock, or used to irrigate plants. Transfer to humans via livestock mechanisms could include the following mechanisms: water-to-animal-to-human and water-to-animal-to-product-to-human. Transfer to humans via plant irrigation could occur by mechanisms similar to those for the above ingestion (air) pathway.
Ingestion (fish)	Uptake of contamination resulting from consumption of fish and shellfish caught in open water.
Ingestion (specific)	Consumption of food in food chain initiated by contaminated biota.

Detailed Review

The review of the details of the applicant's evaluation of radiological impacts should include, at a minimum, the following items:

(1) The conceptual models and scenarios for calculations of dose rates (a) associated with normal scenarios during the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods; (b) resulting from operational accidents or unusual conditions: and (c) received by onsite individuals during the active institutional control period. Review of each of the above conceptual models and scenarios should include identification of the principal receptor points, exposure media, and uptake pathways.

(2) The applicant's computational models and analytical methods for transfer of radioactivity through the uptake pathways, as well as the applicant's choice of specific parameter values.

(3) The applicant's assumed values for occupancy times, exposure periods, growing season, usage parameters, and physiological and metabolic parameters.

(4) The applicant's sets of dose conversion factors used to determine impacts from direct exposures to beta and gamma radiation, as well as dose conversion factors used to determine impacts on internal organs from ingestion or inhalation of radioactivity.

(5) The applicant's computer codes used to calculate impacts.

(6) The applicant's calculations of dose rates to individuals at each of the receptor points identified in item (1) above, as well as the applicant's identification of, and quantification of dose rates to, maximally exposed individuals.

3.3.2 Compliance With Regulatory Criteria

The staff will review the applicant's assessment of compliance, as appropriate, with the regulatory requirements listed in Section 4.1 of this SRP. This review should be documented and cover at least the following areas:

(1) normal impacts on offsite individuals during the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods

(2) impacts on offsite individuals resulting from operational accidents or unusual conditions during the operational period

(3) impacts on onsite individuals during the active institutional control period

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information reviewed under this SRP will be used, in conjunction with information reviewed under the other SRPs of SRP 6.1, to help assess the applicant's compliance with the following regulatory requirements:

(1) 10 CFR 20, "Standards for Protection Against Radiation"

(2) 10 CFR 61.13, "Technical Analyses," (a)

(3) 10 CFR 61.41, "Protection of the General Population From Releases of Radioactivity"

(4) 10 CFR 61.43, "Protection of Individuals During Operations

(5) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(6)

4.2 Regulatory Guidance

There are currently no regulatory guides that specifically address the determination of impacts associated with radioactivity release from a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The staff will determine the acceptability of the applicant's projections of (1) radiological impacts on individuals and (2) compliance with regulatory criteria.

4.3.1 Calculation of Radiological Impacts on Individuals

The staff will determine if, at a minimum, the following information has been provided:

(1) For normal releases of radioactivity, accidental or unusual releases of radioactivity, and exposures to onsite individuals during the active institutional control period, a satisfactory identification of the major receptor points (human access locations) and exposure media of concern in the vicinity of the disposal facility. Acceptable rationale and discussion should also be provided for assumed changes in receptor points and exposure media as a function of time.

(2) For each exposure media at each human access location identified above, a satisfactory identification of the principal radioactivity uptake pathways.

(3) Acceptable computational models and analytical methods for transfer of radioactivity through uptake pathways. Transfer models generally based on the methodology in Regulatory Guide 1.109 are acceptable. However, specific parameters for inclusion in the models should be reviewed and replaced with updated or site-specific parameters as appropriate (note

that Draft Regulatory Guide 1.109 contains parameter values for a number of radionuclides that were not included in Regulatory Guide 1.109).

(4) Acceptable assumptions for occupancy times, exposure periods, growing season, usage parameters, and physiological and metabolic parameters. In this regard, Regulatory Guide 1.109 may be used as a general reference. Updated or site-specific information should be used as appropriate.

(5) To the extent that the above assumptions, models, and parameters are based on more realistic, site-specific conditions rather than on more conservative, generic conditions, sufficient justification for these assumptions, models, and parameters based on comparison with data obtained during the site characterization program (see SRP 2).

(6) Acceptable dose conversion factors for direct exposures to beta and gamma radiation, as well as acceptable dose conversion factors for exposure to internal organs due to ingestion and inhalation pathways. External beta/gamma exposures due to proximity to uniformly contaminated surfaces may be based on the methodology in NUREG/CR-1918, or methodology of equivalent sophistication, as may external beta/gamma exposures due to immersion in contaminated air and water. Exposures to internal organs due to ingestion or inhalation pathways should be based on the methodology in International Commission on Radiological Protection, Publication 30 (ICRP-30), or its equivalent.

(7) Verification of computer codes to determine impacts, including verification of computer output data to ensure that input data were entered properly and that the data output appears complete.

(8) Reasonable assurance that the applicant's analysis includes all significant pathways (i.e., pathways that contribute 5% or more to the total potential dose rate at each receptor point of interest) and provides a bounding estimate of impacts at each receptor point of interest.

(9) Information sufficient to verify determination of projected dose rates to individuals at each of the receptor points of concern. This should be based on the sum of dose rates received at the receptor points from all release/transfer mechanisms that result in a dose rate at that receptor point. The maximally exposed individual should be identified and projected dose rates quantified. For normal releases of radioactivity, this should be performed for each of the five periods of concern. Impacts on individuals, including maximally exposed individuals, should also be determined for offsite releases resulting from accidents or unusual operational conditions, and for exposures to custodial personnel during the active institutional control period.

4.3.2 Compliance With Regulatory Criteria

The applicant's projections of compliance with regulatory criteria are acceptable provided that an independent staff assessment of these projections results in reasonable assurance that the following conditions are met

(1) Potential normal offsite releases will be controlled so that impacts on individuals through the particular combination of pathways inherent at the

access location of concern are within the limits specified in 10 CFR 61.41 and furthermore reduced to levels as low as reasonably achievable.

(2) Potential impacts on offsite individuals resulting from operational accidents and unusual occurrences will be controlled to levels as low as reasonably achievable.

(3) Potential impacts on onsite individuals carrying out routine activities during the active institutional control period will be controlled so that they will not exceed the limits specified in 10 CFR 61.41 and are furthermore reduced to levels as low as reasonably achievable.

The staff's assessment of regulatory compliance is not limited to numerical assessments of potential dose rates but may also include consideration of the applicant's commitments and proposed limiting conditions of operation, the applicant's proposed environmental monitoring and survey program, the ease in which operations can be adjusted to eliminate or mitigate potential releases of radioactivity, past environmental monitoring and disposal history at other disposal facilities, and the applicant's training and experience.

5. EVALUATION FINDINGS

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows. Documentation of conclusions should include a list of the applicant's commitments and/or limiting conditions of operations. These commitments and limiting conditions of operation will form the basis for staff development of disposal facility license conditions.

If the assessment of impacts and regulatory compliance satisfies the review procedures and acceptance criteria in Sections 3 and 4 of this SRP, the staff will conclude that the information and results are adequate so the staff can confirm the applicant's compliance with the regulatory requirements in Section 4.1 of this SRP. However, if the staff should find that the analyses and results are inadequate, it will document the inadequacies, specify the technical basis for the comments, and describe alternative approaches to resolve the inadequacies.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except where the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U. S. Government Printing Office, Washington, DC, revised annually.

International Commission on Radiological Protection, Limits for Intakes of Radionuclides by Workers, Part 1, Publication 30, Pergamon Press, Oxford, England, July 1978.

U. S. Nuclear Regulatory Commission, Draft Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," March 1976.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG/CR-1918, "Dose-Rate Conversion Factors for External Exposure to Photons and Electrons," D. C. Kocher, Oak Ridge National Laboratory, August 1981.

---, Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I."

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.2
INTRUDER PROTECTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - Geologist, Health Physicist

2. AREAS OF REVIEW

The purpose of the intruder protection system is to provide reasonable assurance that individuals will be protected who inadvertently might intrude into the disposal site and occupy the site or contact the waste at any time after active institutional controls over the disposal site are removed. The intruder protection system includes the operations, procedures, and materials designated by the applicant that will provide the protection. The protection system operations may consist of one or both of the following:

(1) Wastes designated as Class C may be disposed of so that the top of the waste is a minimum of 5 m below the top surface of the cover over the waste.

(2) Wastes designated as Class C may be disposed of with an intruder barrier designed to protect against inadvertent intrusion for at least 500 years.

The staff will review the intruder protection system proposed by the applicant and the analyses supporting the design and operation that demonstrate reasonable assurance that an inadvertent intruder will be protected any time after active institutional controls over the site are removed. The staff will review the following areas in accordance with 10 CFR 61:

(1) the proper segregation of wastes so that wastes designated as Class C will be disposed of with acceptable intruder barriers

(2) the analyses presented by the applicant to demonstrate that there is reasonable assurance that an inadvertent intruder will be protected by providing sufficient depth of burial of wastes or an engineered intruder barrier that will be designed to last at least 500 years

3. REVIEW PROCEDURES

The staff will obtain and use such information as is necessary to ensure that the review procedure is complete. The staff will select and emphasize material from this SRP as may be appropriate for a specific case.

3.1 Acceptance Review

The staff will review for completeness information on the intruder protection system in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP and has demonstrated that the applicant's methods will provide the stated performance. The staff will review the areas discussed in the following sections.

3.2.1 Waste Segregation

The staff will review the information on waste segregation especially the procedures that will be used to segregate and dispose of wastes designated as Class C in such a way that protection against inadvertent intrusion is provided. The staff will coordinate its review of waste segregation with the review under SRP 4.2 to determine if the methods for segregating Class C waste are adequate.

3.2.2 Method of Intruder Protection

The staff will review the information on the intruder protection system proposed in the SAR. The review of the potential methods is discussed in the following sections.

3.2.2.1 Minimum Depth of Burial

The staff will review the information on the intruder protection system that is based on the applicant's commitment to provide a minimum depth of burial so that the top of the Class C waste will be at least 5 m below the top surface of the cover over the waste. The staff will coordinate its review of waste emplacement with the review under SRP 4.3 to verify that Class C wastes will be emplaced in this manner. The applicant should clearly describe the specifications, field procedures, and controls that would be required to ensure placement at the minimum depth.

3.2.2.2 Engineered Intruder Barrier

The staff will review the information on the intruder protection system that is based on the design and construction of an engineered intruder barrier that is to be placed over Class C wastes. The information to be provided should address long-term stability considerations in design (material type and properties; shape, thickness, depth, and location in disposal unit excavation; and supporting medium of the engineered barrier) and in construction (methods, features, procedures, and field controls on quality).

3.2 3 Intruder Protection Analysis

The staff will review the analysis presented to provide reasonable assurancet that inadvertent intruders will be protected. The review of the analysis, depending on which type of disposal method will be used by the applicant, is discussed in the following sections.

3.2.3.1 Minimum Depth of Burial

The staff will review the analysis that should demonstrate that the minimum depth of burial would be maintained if abnormal design-basis events (e.g., probable maximum flood or probable maximum precipitation) were to occur.

3.2.3.2 Engineered Intruder Barrier

The staff will review the analysis pertaining to an engineered intruder barrier to determine if the intruder barrier will maintain its function and integrity for at least 500 years after site closure. The staff will review proposed construction and quality control tests and the standard industry practices proposed by the applicant and any historical documentation of material longevity to determine their contribution to a finding that reasonable assurance exists. The staff will verify, if concrete is proposed, that the applicable regulatory guides and pertinent American National Standards Institute and American Concrete Institute standards were incorporated into the analysis. The review will cover the data and assumptions used in any calculational methodology, the methodology itself, and the results and conclusions resulting from the analysis.

3.3 Requests for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are:

(1) 10 CFR 61.12, "Specific Technical Information," (b),(c), and (f), which require descriptions of design features, principal design criteria and construction and operation activities and their relationship to inadvertent intrusion and types of intruder barriers

(2) 10 CFR 61.12, "Specific Technical Information, "(g) and (h) which require a description of disposal site closure plan that would include design features related to inadvertent intrusion, and the identification of known natural resources at the disposal site whose exploitation could result in inadvertent intrusion after removal of active institutional control

(3) 10 CFR 61.13, "Technical Analyses," (b), which requires that analyses of the protection of individuals from inadvertent intrusion include

demonstration that there is reasonable assurance the waste classification and segregation requirements will be met and that adequate barriers to inadvertent intrusion will be provided

(4) 10 CFR 61.23, "Standards for Issuance of a License," (c), which requires that the applicant's proposed disposal site, disposal site design, land disposal facility operations, disposal site closure, and postclosure institutional control are adequate to protect the public health and safety in that they will provide reasonable assurance that individual inadvertent intruders are protected in accordance with the performance objective in 10 CFR 61.42

(5) 10 CFR 61.42, "Protection of Individuals From Inadvertent Intrusion," which requires that design, operation, and closure of the land disposal facility ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed

(6) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," (a)(2), which requires that wastes designated as Class C pursuant to 10 CFR 61.55 be disposed of so that the top of the waste is a minimum of 5 meters below the top surface of the cover or be disposed of with intruder barriers that are designed to protect against an inadvertent intrusion for at least 500 years

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in "Technical Position Paper on Near-Surface Disposal Facility Design and Operation," as it relates to intruder protection

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review in Section 2 of this SRP are given in the following sections.

4.3.1 Waste Segregation

The information on waste segregation is acceptable if the proposed method for segregation will provide for and ensure the segregation of Class C wastes at all times (1) so that the proposed intruder protection system can be implemented without the disruption of Class C waste disposal, which would lead to increased storage time or long periods of having no cover in excavated disposal units, and (2) so that the disposal of Class B and Class A wastes will not disrupt the construction of the intruder protection system.

4.3.2 Method of Intruder Protection

4.3.2.1 Minimum Depth of Burial

The minimum depth-of-burial method for providing intruder protection is acceptable if the wastes designated as Class C will be disposed of at all times so that the top of the Class C waste will be at least 5 m below the top surface

of the cover over the waste. Acceptable methods of accomplishing this are to dispose of Class C waste in a disposal unit with sufficient overburden to provide the minimum depth or to dispose of Class C waste at the bottom of a disposal unit with layers of Class B and stable Class A wastes and sufficient overburden to provide the minimum depth of cover over the Class C wastes.

4.3.2.2 Engineered Intruder Barrier

The engineered intruder barrier method for providing protection is acceptable if the wastes designated as Class C will in all cases be covered entirely with an intruder barrier system that is designed and constructed with a life expectancy of 500 years after site closure.

4.3.3 Intruder Protection Analysis

4.3.3.1 Minimum Depth of Burial

The analysis pertaining to the depth-of-burial method is acceptable if the following conditions have been met:

(1) The analysis appropriately considers and addresses the occurrences of natural and abnormal events that may affect the site and demonstrates that the required 5-m minimum depth will be maintained.

(2) The methodology used to ensure intruder protection is appropriate for the site, the assumptions and data are reasonable, and the specifications, field controls, and procedures to be followed are practical and reasonable.

4.3.3.2 Engineered Intruder Barrier

The analysis pertaining to the intruder barrier is acceptable if the following conditions have been met:

(1) The analysis clearly demonstrates that the intruder barrier is designed and will be constructed to last at least 500 years after site closure and has appropriately considered and addressed the occurrences of natural and abnormal design-basis events.

(2) The provisions of Sections 5.1 and 10 of American National Standards Institute Standard ANSI N101.6-1972 as they apply to such intruder barriers have been followed (where concrete is to be used).

(3) The recommendations of ACI 201.2R-77 as they apply to such intruder barriers have been followed (where concrete is to be used).

(4) A concrete inspection program has been developed and is designed specifically for the intruder barrier system (as recommended by ACI 311.4R-80) using methods recommended in the Manual of Concrete Inspection, SP-2, of the American Concrete Institute (where concrete is to be used).

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the intruder protection system for the [name of facility] low-level waste disposal facility according to Standard Review Plan 6.2. The staff concludes that the intruder protection system is designed to give reasonable assurance that an inadvertent intruder will be adequately protected after active institutional control of the facility is removed. The staff concludes that wastes designated as Class C will be disposed of using methods that will protect the inadvertent intruder. This conclusion is based on [one of the following depending on the information provided in the SAR].

Wastes designated as Class C will be disposed of so that the top of the waste will be a minimum of 5 m below the top surface of the disposal unit cover.

or

Wastes designated as Class C will be disposed of with an engineered intruder barrier that is designed to protect against inadvertent intrusion for at least 500 years after site closure.

The design and construction of the intruder protection system, therefore, meets 10 CFR 61.12(b),(c),(f),(g) and (h), 10 CFR 61.13(b), 10 CFR 61.23 (c), 10 CFR 61.42 and 10 CFR 61.52(a)(2).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

General

American Concrete Institute, ACI 201.2R-77 Reaffirmed 1982, "Guide to Durable Concrete," Manual of Concrete Practice, Detroit, MI, 1985.

---, ACI 311.4R-80, "Guide for Concrete Inspection," Manual of Concrete Practice, Detroit, MI, 1985.

---, ACI 349, "Code Requirements for Nuclear Safety-Related Concrete Structures," Detroit, MI, 1980.

---, Manual of Concrete Inspection, SP-2, Detroit, MI, November 1981.

American National Standards Institute, ANSI N101.6-1972, "Concrete Radiation Shields," New York.

U.S. Nuclear Regulatory Commission, Regulatory Guide 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)."

---, "Technical Position Paper on Near-Surface Disposal Facility Design and Operation," November 1982.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.3
LONG-TERM STABILITY

This SRP consists of the following:

SRP 6.3.1 Surface Drainage and Erosion Protection
SRP 6.3.2 Stability of Slopes
SRP 6.3.3 Settlement and/or Subsidence

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.3.1
SURFACE DRAINAGE AND EROSION PROTECTION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Surface Water Hydrologist

1.2 Secondary - None

1.3 Supporting - Geotechnical Engineer

2. AREAS OF REVIEW

The staff will review those hydrologic analyses and design details that are provided to ensure long-term stability of the disposal site in accordance with the requirements of 10 CFR 61.23(e) and 61.44. The major review areas related to this aspect of the design are described in the following sections.

2.1 Hydrologic Description of Site

The staff will review the general information on site characterization discussed in SRP 2.4.1 regarding the hydrologic characteristics of the local environment. In addition, the staff will review the general information on the proposed location of waste and the principal design features that protect the site against the effects of flooding and erosion, as required by 10 CFR 61.11(c).

The staff also will review (1) the analyses of flooding and erosion effects on the site and on the protective site design features, as required by 10 CFR 61.13(d), and (2) the designs to determine if the long-term stability requirements of 10 CFR 61.23(e) and 61.44 have been met.

2.2 Flooding Determinations

The staff will review the applicant's assessment of the flooding potential for the site. This review will include a determination of the precipitation potential, the precipitation losses, the runoff response characteristics of the watershed, the accumulation of flood runoff through river channels and reservoirs, the magnitude of the probable maximum flood (PMF) or project design flood (if a flood less than the PMF was used) at the site, and the critical water levels and velocity conditions at the site. If a flood less than the PMF was used, the analyses and justification for the use of such a flood will be reviewed. The probable maximum precipitation (PMP) potential, and resulting

runoff, for site drainage and for drainage areas adjacent to the site will also be reviewed.

The staff's assessment of flooding will also include an evaluation of possible geomorphic changes that could affect the potential for flooding and erosion at the site. The staff will consider the following in its review:

(1) types of geomorphic instability

(2) changes to, and effects associated with, flooding and flood velocities resulting from geomorphic changes

(3) mitigative procedures to reduce or control geomorphic instability

Additional information on geomorphic review areas may be found in SRP 2.3.1.

2.3 Dam Failures

The staff will review the applicant's assessment of peak water levels, flood routing procedures, and flood velocities associated with floods resulting from dam failures due to either seismic or hydrologic causes. A conclusion (from an existing analysis) that seismic or hydrologic events will not cause failures of upstream dams that could produce the governing flood at the site may be acceptable if available information supports such a conclusion (e.g., record of contact with dam designers). In general, the staff will review the following specific analyses:

(1) conservatism of modes of assumed dam failure (breach configuration, duration of flow, etc.)

(2) conservatism of downstream flow rates and levels

(3) consideration of storage capacity of flood control reservoirs

(4) flood wave attenuation to downstream dams or to the site

(5) potential for multiple upstream dam failures and resultant flood wave effects

2.4 Erosion Protection Design

The staff will review the applicant' analyses and design details pertinent to the following aspects of erosion protection:

(1) erosion protection against the effects of flooding from nearby large streams

(2) erosion protection for drainage channels

(3) erosion protection for the top and side slopes of earthen mounds, trench caps, etc.

(4) durability of the erosion protection

The peak discharge rates, water levels, and flood velocities, which constitute the design basis for the erosion protection, will be reviewed.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on surface drainage and erosion protection in the SAR in accordance with NUREG-1199 and this SRP. If the information is inadequate or insufficient in detail, the staff may request that the applicant supply additional information or an explanation. The staff at this time may recommend that the application be rejected or accepted for documentation, pending the submittal of the requested information.

If the staff finds that the information furnished by the applicant is adequate, the technical analyses will begin.

3.2 Safety Evaluation

The following sections describe by area of review the procedures that will be used by the staff in its evaluation.

3.2.1 Hydrologic Description of Site

SRP 2.4.1 provides guidance for the staff's review of information and data on the general hydrologic characteristics of the site area. Additionally, the staff will review the information to assess the site designs that protect against flooding and erosion. Acceptable information includes detailed topographic maps showing the locations of natural and engineered hydrologic design features (streams, drainage channels, erosion protection, etc.) and detailed site cross-sections that show the location of buried waste with respect to the locations of these hydrologic features.

3.2.2 Flooding Determinations

The staff's estimate of the maximum flood level may be made independently from basic data, by detailed review and verification of the applicant's analyses, or by a comparison with estimates made by others that have been previously reviewed in detail. The evaluation of the adequacy of the flood estimates is generally a matter of engineering judgment and is based on the confidence in the flood level estimate, the degree of conservatism in each parameter used in the estimate, and the relative sensitivity of each parameter as it affects the flood level or flood velocity.

The evaluation of flooding potential is, for review purposes, separated into two parts: flooding of large adjacent streams and flooding of local drainage channels and protective features. The review procedure for evaluating the effects of a PMF on a large stream is outlined in American National Standards Institute/American Nuclear Society Standard ANSI/ANS 2.8-1981. The review procedure for evaluating a local PMP/PMF event is outlined in Draft Regulatory Guide, "Design of Long-Term Erosion Protection Covers for Reclamation of Uranium Mill Sites." PMF estimates approved by the Chief of Engineers, Corps of Engineers, and contained in published or unpublished reports of that agency, or generalized estimates (such as those found in Regulatory Guide 1.59) may be

used instead of independent staff-developed estimates. In the absence of such estimates, the staff will use techniques such as Corps of Engineers runoff, impoundment, and river routing models to estimate PMF discharge and water levels at the site. When detailed independent estimates are necessary, the applicant will be requested to provide all necessary basic data not already included in the supporting documents.

On the basis of the analysis of geomorphic considerations under SRP 2.3.1, the staff will evaluate the potential for geomorphic changes that may have a significant effect on the ability of the site and its protective features to prevent flood intrusion and erosion over a long period. Following a determination of geomorphic instability, the effects of that instability on the potential for flooding and erosion will be analyzed using procedures similar to those given below, particularly with regard to estimates of flood levels and flood velocities.

3.2.3 Dam Failures

The staff will review the acceptability and conservatism of the applicant's estimate of flood potential and water levels as a result of dam failures. In general, depending on the potential for flooding, the staff will use the following step-by-step analysis procedure to verify that aspects of the applicant's dam failure analyses are either realistic or conservative:

(1) Determine locations and sizes of upstream dams.

(2) Assume an instantaneous failure (complete removal) of the dam embankment and compute the peak outflow rate in accordance with methods such as those given by Henderson (1971). If this outflow rate is less than the design flood rate, no additional analyses will be performed.

(3) If this simplified analysis indicates a potential flooding problem, repeat the analysis using more refined techniques. Detailed failure models (such as those of the National Weather Service) may be used to identify the outflows, various failure modes, and resultant water levels at the site.

3.2.4 Erosion Protection Design

The staff will verify the applicant's analyses or perform independent analyses of floods, flood velocities, and rock durability in general accordance with the guidelines in Draft Regulatory Guide, "Design of Long-Term Erosion of Protection Covers for Reclamation of Uranium Mill Sites." The staff will review the design assumptions and calculations to verify that the long-term stability criteria of 10 CFR 61.44 are met with respect to erosion protection and other surface water hydrology aspects.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

Requirements relating to the adequacy of information and technical evaluations are found in 10 CFR 61.11(c) and 61.12. The basic acceptance criteria pertinent to the erosion protection aspects of these reviews are provided in 10 CFR 61.13(d), 61.23(e), and 61.44, which require that the designs provide

reasonable assurance of site stability following closure, without the need for active maintenance.

4.2 Regulatory Guidance

Acceptable methods for designing erosion protection features to provide reasonable assurance of effective long-term stability can be found in Draft Regulatory Guide, "Design of Long-Term Erosion Protection Covers for Reclamation of Uranium Mill Sites."

4.3 Regulatory Evaluation Criteria

A thorough evaluation of the surface water flooding and erosion protection aspects of the site design and the basic data supporting all conclusions are necessary. Criteria for the assessment of information, data, and analyses submitted by the applicant pertinent to each area of review are given in the following sections.

4.3.1 Hydrologic Description of Site

Acceptance of the information is based on a qualitative evaluation of the completeness and quality of information, data, and maps. The description of structures, facilities, and erosion protection designs are sufficiently complete if they allow an independent evaluation of the effects of flooding and intense rainfall, particularly with regard to the long-term stability of the buried waste. Site topographic maps are acceptable if they are of good quality and of sufficient scale to allow independent staff analysis of pre-and postconstruction drainage patterns.

4.3.2 Flooding Determinations

In providing engineering designs for long-term performance, the selection of the design flood event is very critical, because one of the most disruptive natural phenomena affecting long-term stability is likely to be erosion caused by flooding. The selection of the flood event for the design of the protective cover usually should not be based on the statistical extrapolation of limited data bases because of the unreliability of such estimates. Rather, the staff concludes that, because the PMF and the PMP are based on site-specific physical meteorological limitations that eliminate the uncertainties associated with extensive extrapolation of limited data bases, the use of these deterministically-derived phenomena for long-term design provides an acceptable design basis.

Although use of the PMF is clearly acceptable for design of low-level waste facilities, its use is not required. On a case-by-case basis, the staff will review site designs that are based on floods less than a PMF. The acceptability of using such floods must be documented by the applicant. Staff acceptance of the analyses depends primarily on the ability of the site design to meet applicable long-term stability requirements and the sensitivity of the site design to small increases in the peak flood magnitude (as the magnitude of the PMF is approached). The analyses must conclusively document the long-term integrity of the site, particularly in light of the uncertainties associated with the magnitude and occurrence of rare floods.

The probable maximum precipitation is given in various hydrometeorological reports of the U.S. Weather Service and is used to develop the probable maximum flood. The probable maximum flood is defined in ANSI/ANS 2.8-1981 and should be estimated for all adjacent streams, rivers, and site drainage channels. The following two conditions should be considered for flood designs at a site:

(1) The elevation and velocity attained by flooding on a large adjacent stream establish a required protection level and the necessary flood protection.

(2) The elevation and velocity attained by flooding on site and in onsite drainage channels establish the design-basis flood protection.

Information pertinent to the identification of the design-basis flood magnitudes, levels, and velocities is considered acceptable if it is provided in sufficient detail to enable the staff to perform independent flood estimates. Acceptance of the analysis is based on general agreement of the staff's and the applicant's estimates of static flood level and peak discharges and the adequacy of the computational methods used for such estimates.

The effects of flooding caused by geomorphic changes will depend to a great extent on the flow of the river, the velocities associated with those flows (particularly at the site), the extent to which significant erosion can occur causing release of wastes, and the mitigative procedures provided to control or reduce erosion. Information on the acceptability of geomorphic analyses may be found in SRP 2.3.1. On the basis of the results of the geomorphic analyses, it may be necessary to compute water surface profiles and flood velocities for the revised flow regimes created by the geomorphic changes. Acceptance is based principally on the conservatisms in the analysis and the sensitivity of the various parameters in the analysis. It should be recognized that considerable judgment must be used in the determination of long-term geomorphic instability and the effects of such instability on the site design.

4.3.3 Dam Failures

In general accordance with the procedures outlined in ANSI/ANS 2.8-1981, the staff will review the analyses provided in the application or will independently estimate the coincident river flows at the site and at the dams being analyzed. The acceptable "worst conditions" that should be postulated in the analysis of upstream dam failures are (1) an approximate 25-year flood on a normal operating reservoir pool level coincident with the dam-site equivalent of the earthquake for which the project is designed, (2) a flood of about one-half the severity of a PMF on a normal reservoir pool level coincident with the dam-site equivalent of one-half of the earthquake for which the project is designed, and (3) a PMF on a normal reservoir pool.

Conditions (1) and (2) are applied when the dam is not designed with adequate seismic resistance; condition (3) is applied when the dam is not designed to safely store or pass the design flood. In many cases, it may be much easier to perform simplified flood analyses assuming a dam failure, rather than detailed analyses of the seismic resistance of a dam. In such cases, the staff will review those simplified flood analyses in accordance with the procedures outlined above.

If applicable, the staff will assess the location of upstream dams, potentially "likely" or severe modes of failure, potential for multiple dam failures (of closely spaced dams), and the domino failure of a series of dams. Results of analytical hydraulic failure models should be accompanied by complete model descriptions and documentation. A determination of the peak flow rate and water level at the site for the most critical combination of dam failures will be reviewed along with a description of all computations, coefficients, and methods used. Acceptance is based principally on the conservatisms used in the analyses and the sensitivity of the analyses to small changes in the model input parameters.

As stated previously, a dam failure flood resulting from a flood less severe than the PMF may be acceptable in those cases where it can be documented that applicable requirements are met by a lesser design flood. Additionally, if it can be documented that the reservoir has been or will be designed for the damsite equivalent of the site design earthquake and the PMF, no dam failure and flooding analyses need be performed.

4.3.4 Erosion Protection Design

The erosion protection designs must be capable of meeting applicable long-term stability requirements. In general, durable erosion protection that is designed to resist an occurrence of the PMP or PMF provides an acceptable design. Additional details and acceptable methods of analysis of floods, flood velocities, and rock durability may be found in Draft Regulatory Guide, "Design of Long-Term Erosion Protection Covers for Reclamation of Uranium Mill Sites." If the design assumptions and calculations are reasonable and accurate and/or compare favorably with independent staff estimates, the designs are found acceptable.

5. EVALUATION FINDINGS

5.1 Introduction

If the staff's evaluation, based on a complete review of the hydraulic engineering aspects of the site design, confirms that regulatory guidelines have been met, documentation of the review will state:

(1) In accordance with 10 CFR 61.13(d), the flood analyses and investigations adequately characterize the flood potential at the site, are appropriately documented, and employ an acceptable level of conservatism.

(2) In accordance with 10 CFR 61.23(e) and 61.44, the long-term stability design with respect to surface water hydrology and erosion considerations represents a feasible plan for ensuring long-term stability without the need for ongoing, active maintenance.

The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the erosion and flood control system for [name of facility] low-level waste disposal facility according to Standard Review Plan 6.3.1. The staff's analysis is presented below:

Determination of Flood Flows

To determine site effects from flooding, the applicant analyzed various floods to evaluate the flood levels and the need for erosion protection features. The calculations were performed to determine flows in XYZ Creek and in the onsite drainage channels.

(1) XYZ Creek

Using detailed computational procedures, the applicant estimated that the probable maximum flood (PMF) in XYZ Creek would have a magnitude of 131,000 ft^3/sec, resulting from an occurrence of the probable maximum precipitation (PMP) over the 91-mi^2 drainage area. This estimate was compared with enveloped values of historical maximum flood flows and regional flood estimates. These PMF estimates were found to be similar to the PMF estimates computed by the applicant. On the basis of these comparisons, the staff concludes that the PMF estimate of 131,000 ft^3/sec is conservative.

(2) Onsite Drainage Channels

Peak flood flows were calculated by the applicant for the onsite drainage channels using standard computational techniques. The staff's independent review indicates that the PMP, infiltration losses, times of concentration, rainfall distribution, and PMF computations were acceptably derived in accordance with standard, referenced procedures, and that the resulting peak PMF flow is conservative.

Design of Erosion Protection for XYZ Creek

Water surface profiles and velocities were developed using standard computational models. On the basis of its review of these analyses, the staff concludes that appropriate estimates for channel and overbank velocities have been computed.

Because the channel velocities are very high, significant erosion of the channel banks can be expected to occur during major floods. To prevent longterm meander and migration of the channel bank toward the site area, the applicant proposes to install a riprap layer along the right channel bank. These riprap sizes were computed using Corps of Engineers techniques, which the staff finds acceptable.

Design of Erosion Protection for Perimeter Ditches

The peak flows in the perimeter ditches will be produced by runoff from a local PMP on the small drainage areas. The applicant estimated the maximum shear stress in these ditches and concluded that rock riprap with a D50 (median average diameter) of 8.5 in. would be adequate. These calculations were checked by the staff to determine their accuracy. On the basis of these evaluations, the staff concludes that the methods used and design assumptions are conservative and the proposed 8.5-in. rock (which will be placed in all of the ditch segments) provides adequate erosion protection.

Design of Erosion Protection for Top Cover of Trench

The rock cover that will be used to protect the trench cover from wind and water erosion is designed to resist an occurrence of the local PMP. For the top of the cover (maximum 2% slopes), the applicant proposes to provide an 18-in. layer of rock with a D_{50} of 1.5 in.

The applicant estimated that the PMP would produce a peak sheetflow rate of 0.3 ft^3/sec/ft. The applicant estimated that an average 1.5-in. rock size would be necessary to resist the shear forces produced by this rate of flow. The rock size requirements were independently evaluated by the staff. On the basis of these independent evaluations, the staff concludes that the computed rock sizes are acceptable.

Upstream Dam Failures

The applicant identified two impoundments located approximately 10 miles upstream of Waste City, whose failures could potentially affect the site. The dams are located on separate tributaries to XYZ Creek and are owned by the Western Water Company.

Various worst-case scenarios were projected by the applicant for possible failures of these two impoundments. The applicant assumed that the largest dam failed and that the reservoir completely drained in 30 min, resulting in a peak outflow of 125,000 ft^3/sec. Because the peak flow rate at the site for the PMF was calculated to be 131,000 ft^3/sec, the effects from the failure of this dam impoundment are considered to be less than those from the PMF.

The staff has analyzed the method of computation and assumptions used by the applicant in the dam failure analysis and finds them to be conservative. Overall, the staff's review of the calculations and staff experience with attenuation of flood peaks indicate that dam failures pose a much less severe threat to the integrity of the site area than the PMF.

Conclusion

The staff's review indicates that sufficient information and technical analyses were provided to enable the staff to independently review and analyze the details of the site erosion protection design. The staff, therefore, concludes that 10 CFR 61.12 has been met.

Overall, on the basis of its review of the applicant's flood analyses as detailed above, the staff concludes that the site and the flood protection designs provide adequate assurance that 10 CFR 61.23(e) and 61.44 are met. On the basis of its review of the applicant's analyses and its independent analyses, the staff concludes that the site, in conjunction with the engineered erosion protection features provided, will provide reasonable assurance of long-term stability without the need for active maintenance.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition,

it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

American National Standards Institute/American Nuclear Society, ANSI/ANS 2.8-1981, "Standards for Determining Design Basis Flooding at Power Reactor Sites," Hinsdale, IL.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

Fread, D. L., "DAMBRK: The NWS Dam-Break Flood Forecasting Model," National Weather Service, Silver Spring, MD, continuously updated.

Henderson, F. M., Open Channel Flow, MacMillan Co., New York, 1971.

U.S. Nuclear Regulatory Commission, Draft Regulatory Guide, "Design of Long Term Erosion Protection Covers for Reclamation of Uranium Mill Sites."

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.3.2
STABILITY OF SLOPES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

This section of the SAR addresses the long-term stability aspects of the slopes of the proposed low-level waste disposal facility (LLWDF) design in accordance with the requirements of 10 CFR 61.12(b) and (d), 61.13(a) and (d), 61.23(e), 61.44, 61.50(a)(9) and (a)(10), and 61.50(a)(1), (a)(2) and (a)(5). The staff will review the long-term stability of all earth and rock slopes both natural and engineered (excavations, fills, embankments, etc., within or in the immediate vicinity of the site), whose failure under any of the conditions and design-basis events to which they could be exposed and could adversely affect the facility's meeting the performance objectives in 10 CFR 61, Subpart C. The objective of this review is to ensure that (1) the slopes whose instability or failure could adversely affect the LLWDF at the disposal site have been identified for evaluation, (2) the information on the geotechnical characteristics of the slope area is adequate, (3) the slope characteristics have been described in appropriate detail, (4) the design and analysis of the slopes have been presented in appropriate detail, (5) there are provisions for quality control during construction of fill and excavation slopes, and (6) the information in the SAR meets the guidance and acceptance criteria of this SRP. Information that will provide reasonable assurance that these objectives are met, including analyses and substantiation, must be presented in the SAR. The staff will review the following items using the data in the SAR and information from other sources: (1) the results of investigations for slope area characterization including data obtained from borings, test pits, trenches, and laboratory tests; properties of borrow materials; compaction criteria and provisions for quality control; and (2) slope characteristics, design criteria, and slope stability analyses and results.

The staff will use the staff's evaluation of the following information that is relevant to the slope stability aspects of the site: (1) the geologic information cited by the applicant to characterize the site and to support conclusions concerning the suitability of the site for an LLWDF; (2) the

applicant's conclusions on the stability of the earth and rock slopes at the site as controlled by mass wasting and erosion phenomena; (3) the seismological and geological investigations carried out to establish the ground motion environment for seismic design of the LLWDF and the procedures and analyses used by the applicant in establishing the seismic design criteria; (4) the groundwater and surface water aspects of the site, including information on the fluctuations of the groundwater levels and the adequacy of the flood data provided to assess the erosional environment at the site; (5) the geochemical aspects of the long-term effects of the disposal site environment and rain water on the properties of the soils and rocks at the LLWDF.

For those areas of review identified above the acceptance criteria necessary for review and their methods of application are given in SRPs 2.3, 2.4, and 2.6.

The staff will coordinate its evaluation of slope stability with evaluations under other appropriate SRPs, namely, the engineering and geotechnical aspects of (1) principal design criteria adopted in the stability studies for normal and abnormal design-basis events (SRP 3.2), (2) construction considerations used to ensure long-term stability (SRP 3.3.1), (3) the accurate and acceptable representation of design information on the engineering drawings and in the construction specifications (SRP 3.3.1), and (4) the quality assurance program during the construction and operations phases (SRP 9).

3. REVIEW PROCEDURES

NRC publications and other publications that will be used in this review are listed in Section 7 of this SRP. In addition to the review of the information provided, site visits may be an integral part of the review process.

3.1 Acceptance Review

The staff will review for completeness the information on the long-term stability of slopes in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine whether the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP by comparing the applicant's submittal and methods with the regulations and guides and by verifying the applicant's reference to such guides or to proposed alternatives. The staff will verify that the alternatives are either equivalent to or improvements on the methods cited in the referenced regulatory guides. Otherwise, alternatives are likely to be disapproved.

3.2.1 Site/Slope Area Characterization

3.2.1.1 Geology of Site

The staff will review the information on the geologic aspects of the site according to SRP 2.3. The staff will use the geologic information such as geologic stratigraphy, structural and engineering geology, and history of deposition and erosion in assessing the geotechnical characteristics of the slope area at the LLWDF. The staff will also determine if the applicant has

evaluated the potential for solutioning and/or subsidence within the bedrock and if there are any weak joints/planes/zones within the bedrock that might initiate a landslide under the design conditions at or in the vicinity of the proposed LLWDF. The staff's evaluation of the geochemical effects of rain water on the physical and strength characteristics of the soil and rocks at the site (under SRP 2.6) will be considered in the review.

3.2.1.2 Field Investigations

The staff will review the geotechnical and geophysical investigations conducted at the disposal site and borrow area according to SRP 2.5. However, the geotechnical investigations performed in the vicinity of the slopes that are designated for stability analyses will again be reviewed under this SRP. The scope of the review will be similar to that under SRP 2.5. The staff will use Regulatory Guide 1.132 as a general guide and other pertinent references listed in Section 7 of this SRP. The staff will consider the adequacy of the applicant's information in response to the following questions in its review of the field investigations for the slope area:

(1) Are the exploratory techniques used by the applicant representative of current accepted engineering practice? Do the samples represent the in situ soil conditions?

(2) Do the investigations adequately cover the slope areas and in sufficient detail to define the specific subsurface conditions and their physical characteristics with a high degree of confidence?

If the staff finds that the investigations are inappropriate or insufficient to characterize the slope area with a high degree of confidence, it will ask the applicant to conduct additional investigations. The final conclusion will be based in part on professional judgment, depending on the complexity of the site subsurface conditions. As a part of the review, the staff has to ascertain that appropriate equipment and techniques currently used in the geotechnical engineering profession (cited in American Society of Civil Engineers and American Society for Testing and Materials publications) were used in the field investigations.

3.2.1.3 Testing and Soil Parameters

The scope, methodology, and determination of soil parameters from various field and laboratory tests performed to characterize the site and borrow areas will be reviewed under SRP 2.5. However, the testing of samples from the slope area and determining the soil parameters to be used in the stability analysis will be reviewed under this SRP. In its review, the staff will consider the adequacy of the applicant's information in response to the following questions:

(1) Was the sampling program adequate in quantity (numbers) and quality (disturbed, undisturbed, etc.) to ensure that all materials critical for slope stability evaluation have been adequately sampled?

(2) Were the investigations (sampling and testing) to determine the properties of the various materials underlying the slope area sufficient? Regulatory Guide 1.138 presents a detailed list of laboratory tests and parameters to be determined in connection with a nuclear power plant. This may be used

as a general guide in evaluating this phase of characterizing the LLWDF site, keeping in mind that the scope of investigations should match the design requirements of the slope and the complexities of the site.

(3) Were the properties of materials needed for slope stability evaluations determined by performing appropriate laboratory and field tests? If borrow material is used in the slope to be evaluated, the material's design parameters to be used in the stability analyses should be determined by appropriate testing on samples representative of in situ conditions in the slope. The staff will determine whether the test data have been conservatively interpreted in establishing the design parameters for the various materials at the site. These parameters should be presented in tabular or graphic form to readily demonstrate the conservativeness of the selected design values.

If the staff finds that the investigations (sampling and testing) are inappropriate or insufficient to establish the design parameters needed for slope stability analyses with a high degree of confidence, it will ask the applicant to conduct additional investigations. The final conclusion will be based in part on professional judgment, depending on the complexity of the slope area.

3.2.1.4 Groundwater Conditions

The staff will review the groundwater aspects of the site characterization studies according to SRP 2.4. The staff will use the evaluation of the following information in its review of the stability of slopes at the LLWDF

(1) the location of the groundwater table and the elevation range of its seasonal fluctuation in the vicinity of the slope area

(2) the presence of perched, artesian, and aquifer conditions, groundwater movement, etc. at the site location of the slopes being analyzed

(3) design water level in the vicinity of the slope area as determined by design-basis events such as the probable maximum flood

3.2.1.5 Borrow Materials

The fill borrow material exploration program and testing will be reviewed under SRP 2.5 if borrow material is used in the slope to be analyzed. Provisions for the restoration of the borrow area will be reviewed to determine its effect on the performance of the LLWDF, particularly its effect on the site drainage, groundwater table, and overall long-term stability of the LLWDF.

3.2.1.6 Compaction and Quality Control

The staff will review the proposed compaction criteria for both the excavated in situ materials when they are to be used as fill, and borrow materials to ensure that it is feasible to compact the materials to the compaction specifications. The strength properties of the compacted material should be determined from tests performed on samples representative of the as-compacted, in situ condition. Provisions for the inspection and quality control of borrow material, moisture content, and compaction during construction will be reviewed

to ensure that the material will be placed and compacted according to approved specifications.

3.2.2 Slope Stability

3.2.2.1 Slope Characteristics

The staff will review and compare plot plans, cross-sections, and profiles of all cut and/or fill slopes and all nearby slopes (the failure of which could adversely affect the facility's compliance with the performance objectives) with exploratory records to ascertain that the most critical stability conditions have been addressed and that the physical characteristics of the slopes have been properly defined. The staff will review the soil and rock test data to determine if there are sufficient relevant test data to support the design parameters selected for the particular slope being analyzed. The staff also will consider whether soil and rock characteristics derived from the investigations have been completely and conservatively incorporated into the design. If clearly unconservative soil properties and profiles were used, the staff will ask the applicant to supply additional data to justify the design assumptions.

3.2.2.2 Stability Analyses

Static Stability

The staff will review the criteria and method of analysis used to determine static stability to ascertain that they represent the current accepted industry practice for projects similar in scope to that of an LLWDF. The method of slope stability analysis (e.g., circular arc, wedge, finite element) should be appropriate for the stratigraphy (homogeneous, stratified) that constitutes the slope. If a computer code is used that is commercially available and generally accepted in the profession, the staff will accept the validity of the code without a request for further documentation. If a new code or a proprietary code is used, then documentation supporting the validity of the code for the problem at hand will be required and will be reviewed by the staff. The staff will review slope analyses to determine if a conservative analysis has been performed and if all adverse conditions to which the slope might be subjected have been considered. Analyzed potential failure surfaces with the lowest factor of safety for the various loading conditions will be reviewed taking into consideration the slope characteristics, groundwater conditions, and design properties used in the analysis. Evaluation of both short-term and long-term static stability of the slopes will be reviewed.

Dynamic Stability

The staff will review the dynamic stability analyses of slopes, taking into consideration the effects of the design-basis earthquake including potential site amplification of ground motions. The soil parameters used in the analyses will be reviewed to ensure that their values are appropriate for the level of strain and/or deformation expected during the design-basis seismic event. No single method of analysis is entirely acceptable for all stability assessments; thus, no single method of analysis can be recommended. Relevant manuals issued by public agencies (such as the U.S. Department of the Navy, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation) are often used in staff reviews to

ascertain whether the analyses performed are reasonable (see Section 7). Many of the important interaction effects cannot be included in current analyses and must be treated in some approximate fashion. Procedures for the review of static stability are also applicable for the review of dynamic stability. Engineering judgment is an important factor in the staff's review of the analyses and in assessing the adequacy of the resulting safety factors.

If the staff review indicates that questionable assumptions have been made or some nonstandard or inappropriate method of analysis has been used, then the staff may model the slope in a manner consistent with the data, and perform an independent analysis.

Liquefaction Potential

The staff will review liquefaction potential by studying the results of geotechnical investigations including boring logs, laboratory classification test data, and soil profiles to determine if any of the site soil could be susceptible to liquefaction. The results of in situ tests such as the standard penetration tests along with the density and strength tests on undisturbed samples obtained in exploration borings will be examined and, when appropriate, related to the liquefaction potential of the in situ soils. The staff also will review groundwater conditions and the analysis of the expected maximum ground acceleration considering the potential for soil amplification.

If the staff determines that there may be liquefaction-susceptible soils beneath the site, the applicant should perform and submit for staff review an appropriate liquefaction analysis. The liquefaction potential analysis will be reviewed in detail and may be compared to an independent study performed by the staff.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) and (d), which require description of design features including disposal site closure and stabilization and of the design basis natural events and their relationship to the principal design criteria

(2) 10 CFR 61.13, "Technical Analyses," (a), which requires analyses to clearly identify and differentiate between the roles performed by the natural disposal site characteristics and design features in isolating and segregating the wastes

(3) 10 CFR 61.13, "Technical Analyses," (d), which requires that (a) the analyses of the long-term stability of the disposal site and the need for ongoing active maintenance after closure be based on analyses of active natural process such as erosion, mass wasting, slope failure, settlement of waste and backfill, infiltration through covers over disposal areas and adjacent soils, and surface drainage of the disposal site and (b) the analyses provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure

(4) 10 CFR 61.23, "Standards for Issuance of a License," (e), which requires that the proposed disposal site, disposal site design, disposal site closure, and postclosure institutional controls are adequate to provide reasonable assurance that long-term stability of the disposal site will be achieved and will eliminate to the extent practicable the need for ongoing active maintenance of the disposal site

(5) 10 CFR 61.44, "Stability of the Disposal Site After Closure," which requires that the disposal site be sited, designed, used, operated, and closed to achieve long-term stability of the site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure.

(6) 10 CFR 61.50, "Disposal Site Suitability Requirements for Land Disposal," (a)(9), and (a)(10), which requires that areas be avoided where tectonic processes such as faulting, folding, seismic activity, or vulcanism and surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of Subpart C, 10 CFR 61

(7) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(1) and (a)(2), which require that the disposal site design features be directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure and lead to disposal site closure that provides reasonable assurance that the performance objectives of Subpart C, 10 CFR 61, will be met

(8) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(5), which requires surface features (that would involve slopes) to direct surface water drainage away from disposal units at velocities and gradients which will not result in erosion that will require ongoing active maintenance in the future.

Portions of the regulations cited above require that all the slopes at the disposal site should be stable in the long term and should not require to the extent practicable any ongoing active maintenance.

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to the geotechnical engineering aspects of the low-level waste disposal program. However, the following guides provide recommendations and guidance generally applicable to a geotechnical review of this type, although the required level of detail and the extent of investigation and analyses would vary on a case-by-case basis:

(1) Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," which (a) describes programs of geotechnical engineering site investigations that would normally meet the needs for evaluating the performance of earthworks under anticipated static and dynamic loading conditions and (b) provides general guidance and recommendations for developing site-specific investigation programs as well as specific guidance on conducting subsurface investigations, the spacing and depth of borings, and sampling

(2) Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants," which describes laboratory investigations and testing practices acceptable for determining soil and rock properties and characteristics needed for geotechnical engineering analysis and design

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 3.2 of this SRP are given in the following sections.

4.3.1 Site/Slope Area Characterization

SRP 2.5 presents acceptance criteria for the geotechnical characterization of the site, which also would include the slope area. However, for completeness, acceptance criteria for the geotechnical characterization of the slope area are given in the following sections.

4.3.1.1 Geology of Site

The section defining geologic features is acceptable if the discussions, geologic maps, profiles of the site stratigraphy, structural geology, geologic history, and engineering geology are complete and are supported by investigations sufficiently detailed to obtain an unambiguous representation of the site geology. The geochemical effects of rain water on the physical and strength characteristics of the soil and rocks at the site should be discussed. See SRPs 2.3 and 2.6 for the acceptance criteria to be used by the staff in its evaluation of the geology and geochemistry of the site.

4.3.1.2 Field Investigations

The scope of the field investigations should be adequate to establish with a high degree of confidence the geotechnical characteristics of the slope areas whose failure could adversely affect the LLWDF. Regulatory Guide 1.132 describes the geotechnical investigations required for a nuclear power plant. However, it can be used as a general guide because the scope of the field investigations depends on the complexity of the slopes and subsurface conditions at the site. The investigation program is acceptable if it includes the following:

(1) plot plan(s) clearly showing the outline of the LLWDF and the locations of all site explorations, such as borings, probes, pits, trenches, seismic lines, piezometers, and geologic profiles, and the location of the proposed slope areas selected for stability investigation

(2) profiles and adequate number of cross-sections of the slopes showing the stratigraphy

(3) logs of borings, probes, pits, trenches, and geophysical investigations from the slope areas in sufficient detail as described in Regulatory Guide 1.132

4.3.1.3 Testing and Soil Parameters

In keeping with the general regulatory positions of Regulatory Guides 1.132 and 1.138, the description of and test results for materials underlying the slope area and proposed borrow materials are acceptable if the methods and procedures currently accepted in the geotechnical engineering profession are used to determine their engineering properties. Widely accepted index and engineering properties tests for soils are listed below:

- Water content
- Unit weights
- Void ratio
- Porosity
- Saturation
- Atterberg limits
- Specific gravity
- Grain size analysis
- Compaction
- Permeability
- Consolidation
- Direct shear test
- Triaxial compression tests
- Unconfined compression tests
- Relative density
- Tests to determine dynamic soil properties

Acceptable test methods are described, for example, in the Journal of Geotechnical Engineering Division published by the American Society of Civil Engineers; applicable standards published by the American Society for Testing and Materials; Geotechnique published by the Institution of Civil Engineers; Engineering Manual EM 1110-2-1906 published by the U.S. Army Corps of Engineers; various research reports prepared by universities such as the University of California, Earthquake Engineering Research Center; and other publications mentioned in Section 7. The properties of these materials must be supported by field and laboratory test records.

A detailed discussion of the preparation of laboratory samples for testing should be given when applicable. For strength tests conducted in the laboratory, full details must be given, for example, how saturation of the sample was determined and maintained during testing and how the pore pressures changed. Strength tests on compacted materials should be performed on samples representative of as-compacted conditions.

For slopes that are underlaid by saturated cohesionless soils and sensitive clays, the applicant should show that all zones that could become unstable because of liquefaction or strain-softening phenomena have been sampled and tested to evaluate their liquefaction potential. The applicant must also define the static and dynamic engineering properties of the soils, such as unconfined compressive strength, and must demonstrate that shear strength parameters for total and effective stress conditions, dynamic modulus values, and dynamic strength parameters from cyclic triaxial tests were properly determined and that reasonable and conservative values were used in the design. The applicant should explain how the developed data were used in the analyses, how the test data are enveloped for design, and why the design envelope is conservative. A table indicating the values of the parameters used in the analyses should be provided.

4.3.1.4 Groundwater Conditions

The information on the groundwater conditions is acceptable if the following items are included and if the effects of groundwater on slope stability are adequately accounted for in the design:

(1) discussion of critical cases of groundwater conditions relative to the stability of the slopes of the proposed LLWDF

(2) analyses and evaluation of the potential for piping conditions during construction

(c) history of groundwater fluctuations

4.3.1.5 Borrow Materials

The information on the proposed borrow material for the slope area is acceptable if it includes (1) data supporting the suitability of the material for the intended use, (2) adequate demonstration that the physical and strength parameters recommended to be used in the analyses were based on appropriate tests performed on samples representative of the in situ as-compacted condition, and (3) plans for the restoration of the borrow area to be reviewed to assess any potential for adversely affecting the long-term performance of the slopes of the LLWDF.

4.3.1.6 Compaction and Quality Control

The information on compaction and quality control is acceptable if it includes detailed specifications on material selection, compaction criteria, moisture content of the material when it is placed, gradation of the material, and the frequency of quality control tests.

4.3.2 Slope Stability

The discussion of slope stability is acceptable if the information (slope characteristics, design criteria, and design analyses) is sufficient and appropriate to demonstrate the long-term stability of the slopes of the LLWDF and, any other slopes at the site whose failure could adversely affect the long-term effectiveness of the disposal facility in meeting the performance objectives in 10 CFR 61, Subpart C.

4.3.2.1 Slope Characteristics

The discussion of the slope characterization aspects of the slope stability studies should include the following:

(1) a discussion of the characteristics of excavation slopes, natural slopes, and embankment slopes, if any, including cross-sections and profiles of the slopes at critical locations and details on slope and foundation conditions

(2) a summary and description of the appropriate static and dynamic properties of the soil and rock constituting the slope and a discussion of the

procedures used to establish, from the available field and laboratory data, soil properties to be used in the analyses

(3) a description of the groundwater and seepage conditions at the slope

4.3.2.2 Stability Analyses

The design criteria and analyses of the short-term and long-term stability of the slopes are acceptable if valid static and dynamic analyses have been presented to demonstrate that the factor of safety is adequate. Slopes, whose instability during the construction/operation phase may have an adverse effect on the disposal facility meeting the 10 CFR 61 performance objectives, should be analyzed for short-term stability under both static and appropriate dynamic loading conditions. A number of different methods of analyses such as Bishop's method of slices, Morgenstern's method, the sliding wedge method, and the finite element method are available for static analysis. Other methods such as the pseudostatic method, Newmark's deformation method, and the finite element method are available in the literature for the dynamic analysis.

Static Stability

To be acceptable, the static stability analyses should assess the following factors:

(1) the uncertainties with regard to the boundaries and properties of the several types of soil in the foundation and within the slope, the forces acting on the slope, and the pore pressures acting within the slope

(2) failure surfaces (slip circle, sliding wedge, etc.) corresponding to the lowest factor of safety for the anticipated conditions of loading (e.g., long-term, seismic, and flooding)

(3) the effect of the assumptions inherent in the method of analysis on the resulting margin of safety

The lowest factor of safety from the short-term and long-term static stability analyses under the worst combination of water levels and pore pressures should be 1.30 and 1.50, respectively.

Dynamic Stability

To be acceptable, the dynamic analyses must account for the effect of cyclic motion of the earthquake on soil strength properties. Just as the static analyses, the dynamic stability analysis should demonstrate that the factor of safety is adequate. A sophisticated dynamic analysis such as the finite element method using earthquake parameters such as acceleration, velocity, and duration with adequate supporting investigations and testing may be appropriate under certain conditions such as where the soil in the slopes would develop high pore pressures and experience loss of strength during an earthquake. However, the need for such an analysis should be decided on a case-by-case basis depending on the level of earthquake shaking, type of soil in the slopes, and consequences of a seismically induced failure of the slope. The analysis should consider the amplification of the earthquake resulting from the soil conditions at the site. Pseudostatic analysis in lieu of the dynamic analysis

is acceptable if the strength parameters used in the analysis are based on a conservative interpretation of the test data, the materials are not subject to significant loss of strength and development of high pore pressures under dynamic loads, and the resulting lowest factor of safety is greater than 1.0, preferably greater than 1.05.

Liquefaction Potential

If the foundation materials and/or materials in the slope at the site of the LLWDF are saturated, loose, cohesionless soils, then an analysis of the liquefaction potential of the saturated soils at the site is required for long-term stability considerations. The need for a detailed analysis is determined on the basis of the level of earthquake shaking, a case-by-case study of the site stratigraphy, critical soil parameters (relative density, standard penetration test (SPT), percent fines, etc.), and the consequence of a liquefaction-induced failure. The SPT, undisturbed samples obtained at the site, and appropriate laboratory tests may be required to show if the soils are likely to liquefy. When the need for an indepth analysis is indicated, an assessment of the potential adverse effects that complete or partial liquefaction could have on the stability of the slope should be based on cyclic triaxial test data obtained from undisturbed soil samples taken from the critical zones in the site area

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the long-term stability of the slopes at [name of facility] low-level waste disposal facility according to Standard Review Plan 6.3.2. The objectives of the review were to ensure that (1) critical slopes at the disposal site have been identified for evaluation, (2) the information on the geotechnical characterization of the slope area and borrow material is adequate, (3) slope characteristics have been described in appropriate detail, (4) the design and analysis of slope stability were presented in appropriate detail, (5) there are provisions for quality control during construction, and (6) information in the SAR meets SRP 6.3.2.

In its review, the staff

(1) identified both engineered and natural slopes at/or in the general vicinity of the disposal facility that should satisfy the long-term stability requirement of the regulations

(2) determined that the information in Section 2.5 is adequate to enable the staff to independently judge the applicant's interpretation of the stratigraphy and design parameters used in the slope stability analyses

(3) determined that the applicant's description of the slope characteristics, cross-sections, the soil and foundation conditions at the slope, the summary and description of both the static and dynamic properties of the soil and rock, and the phreatic surface and seepage forces used in the analysis are a reasonable and conservative interpretation of the available data

(4) determined that, in the static and dynamic analyses performed by the applicant, reasonable and conservative design assumptions were used and uncertainties were considered with regard to the shape of the slope, the boundaries of several types of soil within the slope, forces acting on the slope, pore water pressure within the slope, failure surface corresponding to the lowest factor of safety, the effect of assumptions inherent in the method of analyses, and adverse environmental conditions

(5) determined that the applicant has definite plans for applicable quality control actions pertaining to both the selection and excavation of borrow materials and the compaction phase of earthwork

The information on both short-term and long-term slope stability in the SAR is adequate to satisfy the objectives of the staff review. On the basis of its review of the data and the analyses supplied, the staff concurs with the applicant that the factors of safety against short-term and long-term failure of engineered slopes and natural slopes at the site are greater than the acceptable minimum of 1.30 for short-term and 1.50 for long-term static stability and greater than 1.0 for dynamic stability for both cases. Therefore, there is reasonable assurance that the slopes at the disposal facility are stable in the long term and that the slope stability requirements of 10 CFR 61.12(b) and (d), 10 CFR 61.13(a) and (d), 61.23(e), 61.44, 61.50(a)(10), and 61.51(a)(1), (a)(2), and (a)(5) are met.

On the basis of its review, the staff concludes that the long-term slope stability aspects meet all the requirements of the applicable regulations.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

American Society for Testing and Materials, Annual Book of ASTM Standards, Philadelphia, PA, revised annually.

Shannon & Wilson, Inc., and Agbabian-Jacobsen Associates, "Soil Behavior Under Earthquake Loading Conditions - State-of-the-Art Evaluation of Characteristics for Seismic Responses Analyses," U.S. Atomic Energy Commission Contract W-7405-eng-26, January 1972.

Terzaghi K., and R. B. Peck, Soil Mechanics in Engineering Practice, 2nd edition, John Wiley & Sons, New York, 1967.

U.S. Army Corps of Engineers, Engineering Manual EM 1110-2-1902, "Engineering and Design Stability of Earth and Rock-Fill Dams," Office of the Chief of Engineers, Department of the Army, Washington, DC, 1970.

---, Engineering Manual EM 1110-2-1906, "Laboratory Soil Testing," Office of the Chief of Engineers, Department of the Army, Washington, DC, November 1970.

---, Engineering Manual EM 1110-2-1907, "Soil Sampling," Office of the Chief of Engineers, Department of the Army, Washington DC, March 1972.

---, Engineering Manual EM 1110-2-1908, "Instrumentation of Earth and Rockfill Dams," Office of the Chief of Engineers, Department of the Army, Washington DC, August 1971.

U.S. Department of the Interior, Bureau of Reclamation, Earth Manual, Denver, CO, 1968.

U.S. Department of the Navy, "Soil Mechanics, Foundations, and Earth Structures," NAVFAC DM 7-1, DM 7-2, and DM 7-3, Alexandria, VA, May 1982.

U.S. Nuclear Regulatory Commission, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. J. Tucker, U.S. Department of the Army, Army Engineers Waterways Experiment Station, February 1983.

---, NUREG/CR-3356, "Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities," H. V. Johnson, S. J. Spigolon, and R. J. Lutton, U.S. Department of the Army, Army Engineer Waterways Experiment Station, June 1983.

---, Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants."

---, 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 6.3.3
SETTLEMENT AND SUBSIDENCE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Civil Engineer

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will evaluate the long-term settlement and/or subsidence aspects of the proposed low-level waste disposal facility design to determine compliance with the requirements of 10 CFR 61.12(b) and (d), 61.13(a) and (d), 61.23(e), 61.44, 61.50(a)(9) and (a)(10), and 61.51(a)(1) and (a)(2). The staff will review the settlement and/or subsidence of the individual disposal unit excavation covers and the disposal site to determine if settlement would adversely affect the facility's meeting the performance objectives of Subpart C, 10 CFR 61. The objective of this review is to ensure that: (1) the information on site characteristics, construction of the disposal facility, waste disposal operations, and disposal unit excavation covers is adequate to enable the staff to perform a settlement and/or subsidence evaluation; (2) areas that are potentially susceptible to long-term settlement are identified and are modeled (representative sections and design parameters) reasonably and conservatively; (3) the uncertainties are considered and addressed appropriately in the settlement analyses; (4) the applicant has committed to monitor settlement and/or subsidence and to perform remedial actions if long-term settlement should be a potential problem that would adversely affect the facility's meeting its performance objectives; and (5) the information meets the guidance and acceptance criteria in this SRP. Information, including analyses and substantiation, that will provide reasonable assurance that these objectives are met must be presented in the SAR. The staff will review the following items using the data in the SAR and information from other sources: (1) results of site characterization, details of excavation and waste emplacement in the disposal unit excavation and their backfilling during the operations phase, and details of disposal unit excavation cover design and construction; (2) identification of areas potentially susceptible to long-term settlement and their modeling in the analyses; (3) settlement analyses; and (4) proposals for settlement and/or subsidence monitoring and remedial actions if they should be necessary.

The staff will use the evaluation of the following items as they pertain to the assessment of the settlement and/or subsidence aspects of the site: (1) the geologic and seismologic information provided by the applicant to characterize the site and to support conclusions concerning the suitability of the site for a low-level waste disposal facility; (2) the seismologic and geologic investigations performed to establish the ground motion environment for seismic design of the facility and the procedures and analyses used by the applicant to establish the seismic design criteria; (3) the groundwater and surface water aspects of the site, including information on the fluctuation of the groundwater level and the adequacy of the flood data provided to assess the erosional environment at the site; and (4) the geochemical aspects of the long-term effects of environment (weather and rain water) on the properties of the soils and rocks at the facility. For the areas of review identified above the acceptance criteria and their methods of application are given in SRPs 2.3, 2.4, and 2.6.

The staff will coordinate its evaluation of settlement and/or subsidence at the facility with evaluations under other appropriate SRPs, namely, the engineering and geotechnical aspects of (1) the geotechnical characteristics of the site (SRP 2.5), (2) the design criteria adopted for normal and extreme conditions (SRP 3.2), (3) the construction considerations used to ensure long-term stability of the disposal unit excavation cover (SRPs 3.3 and 3.3A), (4) the accurate and acceptable representation of design information on the engineering drawings and in the construction specifications (SRP 3.3), (5) waste disposal operations (SRP 4.3), (6) site stabilization considerations (SRPs 5.1.A and 5.1.2), and (7) the quality assurance program during the construction and operations phases (SRP 9).

3. REVIEW PROCEDURES

NRC and other publications that will be used in this review are listed in Section 7 of this SRP. In addition to the review of the information provided by the applicant, site visits are an integral part of the review process.

3.1 Acceptance Review

The staff will review for completeness the information on the long-term settlement and/or subsidence aspects of the facility design in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will determine if the applicant has followed the regulations, regulatory guides, and industry standards referenced in this SRP by comparing the applicant's submittal and methods with the regulations and guides and by verifying the applicant's reference to such guides or to proposed alternative. The staff will verify that the alternatives are either equivalent to or improvements on the methods cited in the referenced regulatory guides. Otherwise, alternatives are likely to be disapproved.

3.2.1 Site Data

Site Characteristics

The staff will review the geological, seismological, groundwater, geotechnical, and geochemical aspects of the disposal site in accordance with SRPs 2.3, 2.4, 2.5, and 2.6. Information on the above items that is relevant for the settlement and/or subsidence analyses and the staff's findings on these items will be used to assess the settlement and/or subsidence aspects of the design. If the applicant's information in response to the following questions is adequate, the staff will use the information in its review of the site characteristics of the areas designated for settlement evaluation:

(1) Is there any potential for subsidence caused by solution cavities within the bedrock?

(2) Were the groundwater parameters such as location of groundwater table, range of its fluctuation, and any other significant hydrological conditions determined by adequate investigations?

(3) Were the investigations (sampling and testing) adequate to determine the properties of various materials underlying the disposal site and disposal excavations?

(4) Were the properties of materials needed for settlement and/or subsidence evaluations determined by appropriate laboratory and field tests? Were the test data conservatively interpreted to determine the design parameters recommended for various materials at the site? These parameters should be presented in tabular or graphic form to readily demonstrate the conservativeness of the selected design values.

If the investigations are inappropriate or insufficient, the staff will ask the applicant to conduct additional investigations. The final conclusion will be based, in part, on professional judgment, depending on the complexity of the subsurface conditions at the site.

Construction and Operations Phase Data

The staff will review the construction and operations phase data that are relevant to the settlement and/or subsidence evaluation of the facility to verify that the site condition used in the settlement analyses is a reasonable and conservative interpretation of the actual conditions. Information on the construction phase will be reviewed according to SRPs 3.1, 3.2, and 3.3. Information on the operations phase including backfill placement will be reviewed according to SRP 4.3. Information on the construction and operations phases that is relevant to the settlement and/or subsidence analyses and the staff's findings on this information will be used to assess the settlement and/or subsidence aspects of the facility design. If the applicant's information in response to the following questions is adequate, the staff will use the information in its assessment of the settlement and/or subsidence aspects of the facility design:

(1) What is the location and elevation of subsurface water in relation to the disposal excavation ? What measures are planned to control surface and subsurface drainage?

(2) What are the plans for storage or disposal of the material excavated from the disposal excavation? If it is stored in the vicinity of an open disposal excavation, has its effect on the stability of the disposal excavation slopes been evaluated? Has the settlement caused by the material stored at the site been evaluated?

(3) What is the proposed method of disposing of the waste containers in the disposal unit excavations - e.g., arranging to minimize the intercontainer voids? What is the estimated volume of voids between the containers?

(4) What is the specification of the intercontainer backfill material, and how does the applicant plan to fill the intercontainer voids to comply with specifications? What are the provisions for quality controlling and testing the intercontainer backfill material?

(5) Are there any proposals for placing backfill material between layers of stacked containers? If so, is the construction information on placing and compacting this backfill material adequately detailed? Has the information on placing the final soil cover and disposal unit excavation cover (material specifications, compaction specification, placement moisture content, provisions for quality control testing all the materials used, etc.) been provided?

(6) Have the pertinent details (engineering, construction, and specification) on earthwork at the site (such as filling and grading the site, drainage ditches, and embankments or dikes related to surface water control) been provided to enable the staff to determine their effects on settlement at the facility?

If the information is insufficient, the staff will ask the applicant to supply additional information to enable it to perform an independent evaluation, if necessary.

3.2.2 Modeling

The staff will review the applicant's evaluation of the settlement and/or subsidence estimated for the disposal unit excavation covers and the general area within the disposal site. The settlement and/or subsidence resulting from the change in volume of various materials at the site caused by both the weight of the materials and the weight of the materials above them and by dynamic loading during a design-basis seismic event should be evaluated by methods currently used and accepted in the profession. The various materials that would contribute to the settlement are (1) soils and rock beneath the disposal excavations, (2) disposed waste containers and backfill material in the disposal unit excavations, (3) disposal unit excavation cover, and (4) site cover placed in connection with the final grading of the site.

The staff will review the applicant's modeling (characterization of the problem), parameters used in the analysis, method of analysis, and conclusions on the long-term consequences of settlement. If the applicant's information in

response to the following questions is adequate, the staff will use the information in its review of the settlement and/or subsidence evaluations:

(1) Have the areas within the site that are critical with regard to settlement been identified? The best, average, and worst conditions (from the point of view of settlement) at the site should be considered to enable an evaluation of the total and differential settlements at the selected locations, which should include both the disposal unit excavation cover and the general area within the disposal site.

(2) Do the typical cross-sections modeled in the analyses reflect the in situ stratigraphy, appropriate groundwater conditions, and sequence of loading?

(3) Are the design parameters for various materials (soil, rock, waste containers, backfill, disposal unit excavation covers and site fill) used in the settlement analyses a reasonable and conservative representation of the in situ conditions? How are items such as intercontainer backfill, disposed waste containers (degrading with time), partially saturated backfill (caused by migration of water through the sides of the disposal excavation and/or through the disposal unit cap), and layered disposal unit excavation cover (made up of layers of various materials), considered in determining the values of the design parameters? The design parameters include physical properties and deformation properties such as modulus of elasticity, Poisson's ratio, bulk modulus, modulus of subgrade reaction, coefficient of consolidation, coefficient of recompression, and coefficient of secondary compression and other parameters depending on the method of settlement analysis used. Has the applicant justified the values of the design parameters? Characterization and modeling of a heterogeneous material in a settlement analysis are difficult, and if the applicant makes simplified assumptions, these simplified assumptions should be conservative and adequately justified.

If the modeling of the site characteristics and the values of the design parameters used are inappropriate, the staff will ask the applicant to provide additional justification. The final conclusion will be based, in part, on professional judgment, depending on the complexity of the conditions at the site.

3.2.3 Settlement Evaluation

In its review of the settlement evaluation for both the general site and disposal unit excavation covers, the staff will determine if: (1) the methods of settlement analyses are appropriate for the site conditions and are commonly used in the profession; (2) the long-term effects and applicable severe environmental conditions have been considered; (3) the total and differential settlements have been evaluated at all the critical locations; and (4) the potential for infiltration into the disposal unit excavation as a result of cracking of its cover caused by differential settlement has been adequately investigated.

If the applicant's information in response to the following questions is adequate, the staff will use the information in its review of the settlement aspects of the facility's design:

(1) Have the sequence of construction (loading) and severe environmental conditions (seismic event, drought, probable maximum flood, and probable maximum precipitation, etc.) been considered in the settlement analyses? What is the settlement resulting from the design-basis seismic event? The applicant may calculate settlement induced by changes in volume caused by expulsion of either air or water in the voids of soils using either conventional calculations or a computer code. If the computer code used is commercially available and generally accepted in the profession, the staff will accept the validity of the code without a request for further documentation. If a new code or a proprietary code is used, then documentation supporting the validity of the code for the problem at hand will be required and will be reviewed by the staff.

(2) How are the computed long-term settlements, total and differential, used to estimate the potential for cracking of the disposal excavation caps? Are there any areas of subsidence caused by total settlement instead of areas of cracking caused by differential settlement? Is there a potential for cracking of the disposal unit excavation cover in the long term? If so, is there any estimate of the probable openings or pathways in the cover that would inhibit flow and/or infiltration of rain water into the disposal unit excavation? The applicant should strive to determine the potential for and the quantity of long-term infiltration into the disposal unit excavation. The staff will review the conservatism of the analyses and how uncertainties of various parameters are addressed.

If the applicant's evaluation of the settlement is inappropriate, the staff will ask the applicant to provide additional justification. If necessary, the staff will perform independent analyses to verify the applicant's conclusions. The final conclusion will be based, in part, on professional judgment, depending on the complexities of the subsurface conditions at the facility.

3.2.4 Remedial Actions

Because the facility has to satisfy the long-term stability and performance objectives, it may be necessary for the applicant to undertake remedial action before or during the site closure phase, so that any adverse consequences of excessive settlement and/or subsidence will be mitigated. The staff will ask for a commitment by the applicant to monitor the settlement and/or subsidence and to perform the remedial action, if necessary. The review of this aspect is covered under SRP 5.1.2. It would first be necessary to determine the cause or reason for the excessive settlement and/or subsidence. The remedial measures may range from a simple remedy of regrading and/or filling the areas of subsidence to promote surface drainage to a complex remedy of dewatering the disposal unit excavation treating the contaminated water, and rectifying the cause of this migration of water into the disposal unit excavation.

The staff will review the applicant's commitment to monitor the settlement and the proposed remedial actions if any are necessary.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (b) and (d), which require description of design features including disposal site closure and stabilization and of the design basis natural events and their relationship to the principal design criteria.

(2) 10 CFR 61.13, "Technical Analyses," (a), which requires analyses to clearly identify and differentiate between the roles performed by the natural disposal site characteristics and design features in isolating and segregating the wastes

(3) 10 CFR 61.13, "Technical Analyses," (d), which requires that (a) the analyses of the long-term stability of the disposal site and the need for ongoing active maintenance after the closure be based on analyses of active natural processes such as...settlement of wastes and backfill,...and (b) the analyses provide reasonable assurance that there will not be a need for ongoing active maintenance of the disposal site following closure

(4) 10 CFR 61.23, "Standards for Issuance of a License," (e), which requires that the proposed disposal site, disposal site design, disposal site closure, and postclosure institutional controls be adequate to provide reasonable assurance that long-term stability of the disposal site will be achieved and will eliminate to the extent practicable the need for ongoing active maintenance of the disposal site

(5) 10 CFR 61.44, "Stability of the Disposal Site After Closure," which requires that the disposal site be sited, designed, and closed to achieve long-term stability of the site and to eliminate to the extent practicable the need for ongoing active maintenance of the site following closure

(6) 10 CFR 61.50, "Disposal Site Suitabilitiy Requirements for Land Disposal," (a)(9) and (a)(10), which require that areas be avoided where tectonic processes, such as faulting, folding, seismic activity, or vulcanism and surface geologic processes such as mass wasting, erosion, slumping, landsliding or weathering occur with such frequency and extent to significantly affect the abilitiy of the disposal site to meet the performance objectives of Subpart C, 10 CFR 61

(7) 10 CFR 61.51, "Disposal Site Design for Land Disposal," (a)(1) and (a)(2), which require that the disposal site design features be directed toward long-term isolation and avoidance of the need for continuing active maintenance after site closure and provide reasonable assurance that the performance objectives of Subpart C of this part will be met

Portions of the regulations cited above entail a determination of the settlement aspects of the facility to evaluate conformance to the regulatory requirement to achieve long-term stability and to eliminate to the extent practicable the need for any ongoing active maintenance of the disposal site.

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to the settlement and/or subsidence of a low-level waste disposal facility. However, the references in

Section 7 of this SRP and other technical publications such as Geotechnique (published by the Institution of Civil Engineers, London) and the Journal of Geotechnical Engineering Division (published by the American Society of Civil Engineers) and those prepared at the Earthquake Engineering Research Center, University of California, provide recommendations and guidance generally applicable to a review of this type, although the required level of detail and the extent of analyses would vary on a case-by-case basis.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review listed in Section 3.2 of this SRP are given in the following sections.

4.3.1 Site Data

Site Characteristics

The site investigations (geological, groundwater, geotechnical, geophysical, and geochemical investigations) must be adequate in scope and technique to provide the site characteristics data needed to evaluate the settlement and/or subsidence aspects of the facility. (See SRPs 2.3, 2.4, 2.5, and 2.6 for the criteria that apply to a review of the above areas of investigation.)

The information on the site characteristics is acceptable if the following conditions have been met:

(1) The applicant has submitted a plot plan(s) clearly showing the outline of the facility and the locations of all site explorations and the areas selected for the settlement evaluation.

(2) The applicant has provided profiles and cross-sections of the areas selected for settlement evaluation illustrating in appropriate detail the relationship of the proposed facility to the subsurface materials.

(3) The applicant has submitted logs of borings, probes, pits, and trenches considered in developing the stratigraphy used in the settlement evaluation.

(4) The applicant has described the engineering properties of materials underlying the site and has provided test results. These properties should be determined using methods and procedures currently accepted in the geotechnical engineering profession.

Widely accepted index and engineering properties tests for soils are

Water content	Compaction
Unit weights	Permeability
Void ratio	Consolidation
Porosity	Unconfined compression tests
Saturation	Relative density
Atterberg limits	Triaxial compression tests
Specific gravity	Cyclic triaxial tests
Grain size analysis	Other tests

Acceptable test methods are described in the publications listed in Section 7 of this SRP. The properties of these materials must be supported by field and laboratory test records. A detailed discussion of the preparation of laboratory samples for testing should be given when appropriate. The applicant should demonstrate that the design parameters were properly determined and that reasonable and conservative values were used in the design and should explain how the developed data were used in the analyses, how the test data are enveloped for design, and why the design envelope is conservative. A table indicating the values of the parameters used in the settlement analyses should be provided.

(5) The information on groundwater conditions, as they relate to the settlement aspects of the proposed facility, includes the following and the effects of groundwater on the settlement have been adequately accounted for in the design:

(a) discussion of critical cases of groundwater conditions and the groundwater's range of fluctuation at the proposed facility

(b) discussion of any other significant hydrological conditions

The information on site characteristics provided in the sections of the SAR reviewed under SRPs 2.3, 2.4, 2.5, and 2.6 need not be repeated in the section, reviewed under this SRP, but the sections should be appropriately referenced.

Construction and Operations Phase Data

Construction and operations phase data that are relevant to settlement evaluation are acceptable if they include the following:

(1) information and analyses to justify whether construction dewatering would be required and, if needed, information on the dewatering criteria (level of water, pore pressures, and monitoring details)

(2) information on using the excavated material either as a backfill in the disposal unit excavations or as a general fill at the site and information on where the material will be stockpiled

(3) information on the proposed method of placing the waste containers in the disposal unit excavation and an estimation of the intercontainer voids

(4) specifications for the backfill material and its placement in the intercontainer voids and information on how the backfill material will be placed to comply with the approved specifications

(5) design and construction information on the soil backfill and the disposal unit excavation cover to be placed above the waste containers and detailed specifications for the soil backfill and disposal unit excavation cover and the technique for their placement

4.3.2 Modeling

Information on modeling (characterization of the problem) for the evaluation of settlement is acceptable if it includes the following:

(1) information on areas or locations (disposal unit excavation cover and general area within the disposal site) selected for settlement evaluations, including the best, average, and worst conditions (from the point of view of settlement) at the site to enable an evaluation of total and differential settlements at locations that should be selected on the basis of site data (reviewed according to SRP 2.5)

(2) typical cross-sections, stratigraphy, groundwater conditions, and sequence of loading (construction or placement of fill) used in the analyses that are representative of the in situ conditions

(3) proper justification to show that the design parameters for various materials (soil, rock, waste containers, backfill, disposal unit excavation cover materials, site fill, etc.) used in the settlement analyses are a reasonable and conservative representation of the in situ conditions and justification of the analytical representation or modeling of items such as disposed waste (waste and containers degraded with time), partially saturated backfill (caused by infiltration from the sides and top of the disposal unit excavation and leachate), and layered disposal unit excavation cover

4.3.3 Settlement Evaluation

Information on the evaluation of settlement is acceptable if it includes the following:

(1) Discussions on the method of analysis should include formulation of the problem, assumptions, and appropriate details of the method of analysis so that the staff can judge whether the method is applicable and commonly used in the engineering profession. The sequence of loading and severe environmental conditions such as seismic event, drought, and probable maximum flood should be considered in the settlement evaluation. If a commercially marketed computer code is used, the staff will accept its validity. If a new code or a proprietary code is used, the documentation supporting the validity of the code should be presented for staff review. The analyses should determine both instantaneous and time-dependent deformations to enable a determination of both total and differential settlements with time at various locations of the facility.

(2) A detailed discussion should be included on how the magnitudes of settlements calculated at various locations have been used to estimate the magnitudes of differential settlement (on both a short- and long-term basis) and the potential for cracking of the disposal unit excavation cover. Estimation of the magnitude of the cracking or the area of openings or pathways for flow and/or infiltration of water should be presented with adequate justification. If the differential settlement is not severe enough to result in cracking of the cover, then an estimation of the extent of subsidence of the cover, if any, should be presented. The conservatism in the analyses and how the uncertainties in the various parameters are considered should be discussed. The settlement evaluation should provide the necessary information to estimate the extent of long-term infiltration into the disposal unit excavation, and the applicant should provide definitive statements with adequate justification.

4.3.4 Remedial Actions

Any proposal for future remedial actions at the facility to rectify the problems associated with excessive settlement, if necessary, is appropriate if it includes a commitment (1) to monitor the settlement and (2) if excessive settlement (more than that predicted or assumed in the design) is observed, to conduct a study to determine the causes for the excessive settlement and to delineate remedial actions. The scope of the remedial action depends on the seriousness of the cause of the excessive settlement. The remedial action may range from a simple task of regrading or filling the area of subsidence to a complex task of dewatering the disposal units excavations, treating the contaminated water, and rectifying the problem of infiltration into the excavation. In the SAR a commitment by the applicant to determine the causes of the settlement and to carry out the required remedial action, if necessary, is acceptable.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the long-term settlement and/or subsidence aspects for [name of facility] low-level waste disposal facility according to Standard Review Plan (SRP) 6.3.3. The objective of the review was to ensure that (1) information on the site characteristics, construction of the facility, waste disposal operations, and disposal unit excavation cover is adequate; (2) the areas that are potentially susceptible to long-term settlement have been identified and their modeling (characterization of the problem) is reasonable and conservative; (3) the uncertainties have been considered and addressed appropriately in the settlement analyses; (4) the applicant had committed to perform remedial actions if long-term settlement should be a potential problem; and (5) the information presented meets the guidance and acceptance criteria in SRP 6.3.3.

In its review, the staff

(1) determined if the information on site characteristics, the excavation and backfilling of disposal unit excavations during the operations phase, and disposal unit excavation cover design and construction was adequate to justify the applicant's interpretation of stratigraphy, the typical section of disposal units excavations, and the parameters used in the settlement analyses

(2) identified both the general areas within the disposal site and the disposal unit excavation cover areas that are potentially susceptible to long-term settlement, and determined if the applicant's description of the typical sections, the long-term condition of the backfill and buried

waste within the disposal unit excavation, the parameters used in estimating the settlement, and the assumptions on groundwater conditions were a reasonable and conservative interpretation of the available data

(3) determined if the uncertainties such as severe events or conditions resulting in settlement, the extent and boundaries of the various materials within the sections being analyzed, and the effect of assumptions inherent in the method of analysis were considered by the applicant in the settlement analyses

(4) determined if the applicant had provided definite proposals for remedial actions if excessive settlement and/or settlement-induced cracks should occur in the disposal excavation cover, and evaluated the scope and feasibility of such proposals

The information on long-term settlement and its safety implications is adequate to satisfy the objectives of the staff review except for the long-term characterization of degraded waste and its container and backfill within the disposal unit excavation. The applicant has made reasonable assumptions concerning this item in estimating the long-term settlement and has evaluated the potential for cracking of the disposal unit excavation cover. Because of the uncertainties involved in characterizing the deformational behavior of a heterogenous mass such as degraded waste with its container and backfill, the staff cannot determine the validity of the applicant's assumptions. However, if excessive settlement should occur during the operational phase and the initial 5 years of the institutional control phase, the applicant has proposed remedial action to mitigate the adverse effect of long-term settlement. The remedial action includes filling the areas of subsidence to mitigate the adverse effects of ponding and maintaining the surface drainage characteristics of the disposal site. A detailed plan of the remedial action, if necessary, will be filed with the application for site closure and stabilization for the site. On the basis of its review of the information provided by the applicant and the commitment for remedial action during the operational phase and initial 5 years or longer, if necessary, of the institutional control phase, the staff concurs with the applicant that the potential for long-term settlement and/or cracking of the disposal unit excavation cover is minimal and thereby the settlement and/or subsidence aspects related to 10 CFR 61.12(b) and (d), 61.13(d), 61.23(e), 61.44, 61.50(a)(9) and (a)(10), and 61.51(a)(1) and (a)(2) are satisfied.

On the basis of its review, the staff concludes that the potential adverse effect of long-term settlement and/or subsidence on the performance of the disposal facility is minimal and the information on the settlement and/or subsidence aspects meets all the applicable regulations, contingent on the commitment by the applicant to perform remedial actions, if necessary, to mitigate the adverse effects of settlement and/or subsidence on the performance of the disposal facility.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commissions's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

General

American Society for Testing and Materials, Annual Book of ASTM Standards, Philadelphia, PA, revised annually.

Shannon & Wilson, Inc., and Agbabian-Jacobsen Associates, "Soil Behavior Under Earthquake Loading Conditions - State-of-the-Art Evaluation of Characteristics for Seismic Responses Analyses," U.S. Atomic Energy Commission Contract W-7405-eng-26, January 1972.

Terzaghi, K., and R. B. Peck, Soil Mechanics in Engineering Practice, 2nd edition, John Wiley & Sons, New York, 1967.

U.S. Army Corps of Engineers, Engineering Manual EM 1110-2-1902, "Engineering and Design Stability of Earth and Rock-Fill Dams," Office of the Chief of Engineers, Department of the Army, Washington, DC, 1970.

---, Engineering Manual EM 1110-2-1906, "Laboratory Soil Testing," Office of the Chief of Engineers, Department of the Army, Washington, DC, November 1970.

---, Engineering Manual EM 1110-2-1907, "Soil Sampling," Office of the Chief of Engineers, Department of the Army, Washington, DC, March 1972.

---, Engineering Manual EM 1110-2-1908, "Instrumentation of Earth and Rockfill Dams," Office of the Chief of Engineers, Department of the Army, Washington, DC, August 1971.

U.S. Department of the Interior, Bureau of Reclamation, "Earth Manual," Denver, CO, 1968.

U.S. Department of the Navy, "Soil Mechanics, Foundations and Earth Structures," NAVFAC DM 7-1, DM 7-2, and DM 7-3, Alexandria, VA, May 1982.

U.S. Nuclear Regulatory Commission, NUREG/CR-3144, "Trench Design and Construction Techniques for Low-Level Radioactive Waste Disposal," P. J. Tucker, U.S. Department of the Army, Army Engineers Waterways Experiment Station, February 1983.

---, NUREG/CR-3356, "Geotechnical Quality Control: Low-Level Radioactive Waste and Uranium Mill Tailings Disposal Facilities," H. V. Johnson, S. J. Spigolon and R. J. Lutton, U.S. Department of the Army, Army Engineer Waterways Experiment Station, June 1983.

---, Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants."

---, Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants."

Winterkorn, H. F., and H. Y. Fang, Foundation Engineering Handbook, Van Nostrand Reinhold, New York, 1975.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 7.1
OCCUPATIONAL RADIATION EXPOSURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist (HP)

1.2 Secondary - None

2. AREAS OF REVIEW

The staff will review the safety analysis report (SAR) and the applicant's facility procedures according to this SRP to determine if the applicant has adequate procedures and policies in place to ensure that occupational radiation exposures will be within the limits of 10 CFR §§ 20.1201, 20.1207, 20.1208, and will be maintained as low as is reasonably achievable (ALARA) in accordance with 10 CFR 61.43 and 10 CFR 20.1101. The staff should coordinate the review of the procedures under this SRP with the review of the applicant's procedures under SRP 7.3.

The staff should review the management policy as it relates to the commitment to integrate the ALARA process into all activities related to exposures of personnel. The staff should determine if the organizational structure and personnel responsibilities and activities of the applicant are adequate to ensure that ALARA policy and procedures will not be compromised because of pressures from operational activities. The staff should also determine if the ALARA policy for facility operations, training, development of radiation protection procedures, and design reviews is adequate. The staff will coordinate this review with the review for SRPs 8.1, 8.2, 8.3, and 8.6 of the organizational structure, qualifications, and training, and operating procedures.

The staff should use detailed design and operational information provided by the applicant in SRPs 3.1 (section 4.3.9), 4, 8, and 7.3 to determine if the ALARA policy is adequately applied.

The staff should also review the radiation protection plan in coordination with SRP 7.4 to determine if the ALARA policy has been incorporated into the

program. The review should include a determination of the qualifications of the radiation protection staff as described in NUREG/CR-3343 and RGs 1.8, 8.8, and 8.10. The radiation protection program should provide for the incorporation of radiation protection audit findings into ALARA procedures as specified in RG 8.29.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff should review the information on occupational radiation exposures for completeness in relation to NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff should review the applicant's ALARA policy and proposed procedures as they relate to policy, design, and operations.

The staff should review the management policy on ALARA and the planned organizational structure proposed by the applicant to determine if the ALARA program is adequate in scope and detail to ensure that occupational exposures will be maintained ALARA. The staff should also determine if the program is adequate to ensure that the applicant will continue to review and improve the ALARA program and that the appropriate mechanisms are in place to implement required changes in operational procedures. Section 2 of NUREG/CR-3343 provides guidance for a LLW ALARA program. In RGs 1.8, 8.8, 8.10, 8.29, 8.34, and 8.35, the staff provides further guidance for the ALARA program related to personnel selection and training, information for developing an ALARA program, and operating philosophy for maintaining exposures ALARA.

In NUREG/CR-3343, the staff recommends that the following elements be included in an ALARA program for LLW disposal facilities:

(1) written management policy statement

(2) organizational structure separating the radiation protection group from the operational groups

(3) designation of a specific individual responsible for the coordinating the ALARA program efforts

(4) training of employees in ALARA principles

(5) incorporation of ALARA principles in the design features of the facility and equipment

(6) incorporation of ALARA principles into operational procedures

(7) development of administrative controls on exposure below regulatory limits

(8) use of preplanning and mock-up training

(9) establishment of periodic reviews to determine the effectiveness of the ALARA program

(10) trend analysis of radiological parameters

(11) radiation protection program audits

The staff should review the SAR to determine that the recommended elements of NUREG/CR-3343 have been adequately addressed and incorporated into the ALARA policy and procedures. The staff should determine if the ALARA policy includes a communication network between the management and the staff to ensure full staff participation. The ALARA policy should be based on the following criteria as a minimum:

- No practice should be adopted unless the introduction produces a net benefit.
- All exposures should be kept as low as reasonably achievable; technological, economic and social factors.
- The exposure to individuals should not exceed the limits recommended for the appropriate circumstances.

The staff should review the ALARA policy and procedures submitted by the applicant to determine the adequacy of the organizational structure and personnel responsibilities. The organizational structure should maintain a separation between the radiation protection organization and operational groups, allow the independent implementation of the ALARA policy, and allow the radiation protection management to have direct access to facility management as outlined in NUREG/CR-3343, and in RGs 8.8 and 8.10. The staff should also determine the adequacy of the applicant's staff qualifications and training program. The qualifications and training program for ALARA should include the elements in Section 3 of NUREG/CR-3343 and in RGs 1.8, 8.8, and 8.10. The staff should coordinate this review with the review for SRPs 8.1, 8.2, and 8.3.

The staff should evaluate the information in the SAR in accordance with Section 2.4 of NUREG/CR-3343 and RG 8.8 to determine if the organizational structure provides a mechanism for the radiation protection manager and the radiation protection organization to interact with design review groups in a way that methods and techniques for reducing occupational radiation exposures can be incorporated into the design of the facility. If the radiation protection manager has not yet been selected, the staff should conduct the

design review in accordance with the guidance of RG 8.8 unless acceptable alternatives are proposed.

The staff should determine if design personnel are adequately trained in ALARA principles as described in Section 2.4 of NUREG/CR-3343.

The staff should determine if appropriate personnel with operating facility experience have reviewed the proposed design and if the applicant has incorporated previously accepted design features. The applicant should consider operating experience to improve the design of the facility to ensure that occupational radiation exposures will be ALARA. The staff will coordinate this review with the reviews for SRPs 3.1, and 7.3.

The staff should review the SAR submitted by the applicant to determine the manner in which the detailed operational plans and procedures will be developed. The staff should review the operational plans and procedures for receipt and inspection of waste, waste handling and interim storage, waste disposal operations, and decontamination and decommissioning described in SRPs 4.1, 4.2, 4.3, and 5.2 to determine if the applicant has incorporated the ALARA policy into the operational plans and procedures. In preparing the SAR for this section, the applicant should provide an estimate of the expected occupational exposures. The staff should evaluate these exposure estimates, the basis of their derivation, and all related assumptions to determine if the requirements of 10 CFR Part 20 and the ALARA provision of 10 CFR 61.43 are met. The staff will coordinate this review with the reviews for SRPs 4 and 8.

The staff should also review the radiation protection program in coordination with the review for SRP 7.4 to determine if the ALARA policy has been incorporated into the program. The review should include a determination of the qualifications of the radiation protection staff in accordance with NUREG/CR-3343 and with RGs 1.8 (parts A, B, and C as they can be applied to radiation protection and design criteria at LLW disposal facilities), 8.8 (parts A and B as they can be applied to ensuring ALARA at LLW disposal facilities), 8.10, and 8.29 (all parts as applied to the radiation exposure knowledge of the radiation protection staff). The radiation protection program should provide for incorporating radiation protection audit findings into ALARA procedures. Design and operation considerations will be commensurate with the facility size and activities, including anticipated waste inventories.

3.3 Request for Additional Information

On the basis of its review, the staff may request that the applicant supply additional information or modify its submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if it meets the requirements of 10 CFR 61.11(b)(1) and (b)(2), 10 CFR 61.12(k), 10 CFR 61.13(c), 10 CFR 61.43, 10 CFR 61.52(a)(6), 10 CFR 19.12, and 10 CFR 20.1101 and if it includes the required information as delineated in Section 7.1 of NUREG-1199.

The regulations applicable to the areas of review of this SRP are:

(1) 10 CFR 61.11 (b)(1) and (b)(2), as related to the applicant providing an organizational structure and the qualifications of members of the staff involved in proposed activities, including ALARA

(2) 10 CFR 61.12 (k), as related to the applicant providing a description of the radiation protection program which ensures that occupational radiation exposures will comply with 10 CFR Part 20

(3) 10 CFR 61.13 (c), as related to the applicant preparing an assessment of expected radiation exposures due to routine operations and accidents during the handling, storage, and disposal of waste

(4) 10 CFR 61.23 (d), as related to the applicant providing sufficient material in the license application on occupational exposures

(5) 10 CFR 61.43, as related to the applicant conducting operations in compliance with 10 CFR Part 20 and maintaining radiation exposures as low as is reasonably achievable

(6) 10 CFR 61.52(a)(6), as related to maintaining exposures ALARA during facility operations

(7) 10 CFR 19.12, as related to the applicant ensuring that workers entering restricted areas are kept informed about the storage, transfer, or use of radioactive materials or radiation in such areas and instructed as to the risk associated with occupational radiation exposure, precautions and procedures to reduce exposures, and the purpose and function of protective devices

(8) 10 CFR 20.1101, as related to the applicant involved in licensed activities making every effort to maintain radiation exposures ALARA

(9) 10 CFR 20.1001

(10) 10 CFR 20.1201

(11) 10 CFR 20.1202

(12) 10 CFR 20.1203

(13) 10 CFR 20.1207

(14) 10 CFR 20.1208

4.2 Regulatory Guidance

The staff included regulatory guidance in the following documents to aid the applicant in meeting the requirements in Section 4.1 for LLW disposal sites:

(1) NUREG/CR-3343, "Recommended Radiation Protection Practices for Low-Level Waste Disposal Sites," as related to the development of an ALARA program, content of a radiation protection plan, and the elements to be included in a comprehensive radiation protection program, as well as procedural details

(2) Regulatory Guide 1.8, "Personnel Selection and Training," as related to the qualifications of radiation protection personnel

(3) Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable," as related to radiation protection information pertaining to actions taken during the design, construction, operation, decommissioning, and site closure to ensure that occupational radiation exposures are kept ALARA in order to meet 10 CFR 61.43 and 10 CFR 20.1101.

(4) Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," as related to the responsibilities of the ALARA personnel and also the commitment by the applicant's management, radiation protection manager, and the radiation protection staff to maintain occupational exposures ALARA in order to meet 10 CFR 61.43 and 10 CFR 20.1101.

(5) Regulatory Guide 8.29, "Instructions Concerning Risk from Occupational Radiation Exposure," as related to the occupational exposures assessed by radiation protection personnel and in accordance with 10 CFR 20 and 10 CFR 61.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review of this SRP are given in the following sections.

Acceptability should be based on evidence that a policy for ensuring that occupational radiation exposures will be ALARA has been formulated in accordance with the training requirements in 10 CFR 19.12, the ALARA provisions of 10 CFR 60.43 and 10 CFR 20.1101, the organizational structure and qualifications of ALARA management personnel of 10 CFR 61.11(b)(1) and (b)(2) and the qualification specifications in RG 1.8 (all parts as they can be applied to personnel training at LLW disposal sites). The policy should include the ALARA elements provided in Section 2 of NUREG/CR-3343 and the ALARA personnel responsibilities outlined in RGs 8.8 (parts A and b as they can be applied to LLW disposal facilities) and 8.10.

The organizational structure should maintain the independence between operational groups and radiation protection groups to ensure the implementation of the ALARA policy. As a minimum, a specific individual will be designated and assigned responsibility and authority for implementing and coordinating the ALARA policy in Section 2 of NUREG/CR-3343 and in RGs 8.10 and 8.29.

The ALARA policy should include provisions for an audit of the radiation protection program conducted at least once each year by a qualified person or persons who are independent of those responsible for implementing and coordinating the radiation protection program. The information from the audit will ensure that the management provides continual attention and support for ALARA efforts. The staff will evaluate alternative proposed policies by comparing them with the above regulatory guides and Section 2 of NUREG/CR-3343. The staff should evaluate information provided in SRPs 8.1, 8.2, 8.3 and 8.6 for acceptability as related to the SAR ALARA policy.

To determine if the applicant's ALARA policy is acceptable, the staff should review the evidence that the design methods, approach, and interactions are in accordance with the ALARA provisions of 10 CFR 61.43, 10 CFR 20.1001, 20.1101, 20.1701, and the design review guidance in RG 8.8. The applicant should provide for direct interaction between the radiation protection group and the facility and equipment design groups as outlined in Section 2.4 of NUREG/CR-3343 and in Parts A and B of RG 8.8, as they can be applied by LLW disposal sites in the design of the facility to ensure ALARA. The staff should verify that

(1) measures will be incorporated into designs for reducing exposures and the time spent in radiation areas

(2) measures for ensuring that occupational radiation protection during decommissioning will be ALARA

(3) competent radiation protection personnel review the design

(4) instructions to designers and engineers regarding ALARA design are incorporated

(5) experience from operating facilities and with past designs are considered

(6) competent radiation protection professionals continue performing design reviews of the facility

The staff should review alternative proposed design policies against the design guidance in Section 2.4 of NUREG/CR-3343 and in RG 8.8. The staff should coordinate this review with information from the reviews for SRPs 3.1 (section 4.3.9) and SRP 7.3 as related to design review.

The applicant has an acceptable radiation protection plan if it can demonstrate that it prepared this plan in accordance with the occupational exposure provisions of 10 CFR 61.12(k). The staff should evaluate information for evidence that the applicant plans to develop a radiation protection program and procedures in accordance with 10 CFR 61.43 and 10 CFR 20.1101 and RG 8.29 to ensure that occupational exposures will be maintained ALARA. The staff should determine if the radiation protection program will be managed by appropriately trained and qualified personnel as stated in Section 2 of NUREG/CR-3343, and RGs 8.8 and 8.10 to the extent that each part of these RGs can be applied to LLW disposal facilities. The applicant will have developed procedures and policy to ensure that an effective and efficient feedback mechanism is in place for an ALARA review of occupational monitoring and dose assessment. The staff should review information in SRPs 4.1, 4.2, 4.3 and 5.2 to determine if the applicant has evaluated the potential occupational exposures as required in 10 CFR 61.13(c) and to verify that the exposures meet the requirements of 10 CFR 20 and 10 CFR 61.43.

The staff should determine if the guidelines of NUREG/CR-3343, including the criteria, concepts, and implementation schemes, are included in the operational radiation protection programs for the waste disposal facility. The staff will coordinate this review with the review of information for SRP 7.4.

5. EVALUATION FINDINGS

5.1 Introduction

The staff should verify that the license application and amendments contains sufficient information to satisfy the requirements of 10 CFR 61.11, 10 CFR 61.12(k), 10 CFR 61.13(c), 10 CFR 61.43, 10 CFR 20.1, and 10 CFR 19.12. The staff can document the review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the information on occupational radiation exposure in relation to the as low as is reasonably achievable (ALARA) principle for [name of facility] low-level waste disposal facility according to Standard Review Plan 7.1.

The staff concludes that the ALARA policy, facility design, operational considerations, and radiation protection considerations are acceptable because the applicant has met the training requirements of 10 CFR 19.12, the ALARA provisions of 10 CFR 20.1101 and 10 CFR 61.43, the ALARA organizational structure and responsibilities of 10 CFR 61.11 (b)(1) and (b)(2), NUREG/CR-3343, and RG 1.8. The applicant has included in the SAR assurances that it will comply with the dose limits in 10 CFR Part 20 as required by 10 CFR 61.12(k), assess the expected radiation exposures required by 10 CFR 61.13(c), and implement the guidance in RGs 8.8, 8.10, and 8.29.

The applicant has provided a management commitment to ensure that [name of facility] will be designed, constructed, and operated in a manner consistent with the above criteria. The [title of person or group, e.g., facility health physicist and staff] periodically will review, update, and modify, as appropriate, facility design features and changes, as well as all operating and maintenance features, using exposure data and experience gained from operating facilities, to ensure that occupational exposures will be kept ALARA in accordance with 10 CFR 61.43, 10 CFR 61.52, 10 CFR 20.1101, NUREG/CR-3343, and RG 8.8.

The objective of the facility radiation protection design is to maintain individual doses and total person-rem doses to facility workers and to members of the general public ALARA, and to maintain individual doses within the limits of 10 CFR 20. Within restricted areas all facility sources of direct radiation and airborne radioactive contamination were considered in the staff review.

The applicant will incorporate the following facility and equipment design considerations at [name of facility] to satisfy the above-listed radiation protection design objectives. [List several design considerations used.] These design considerations conform with RG 8.8 and the guidance in NUREG/CR-3343 and are acceptable.

Facility personnel should follow specific plans and procedures to ensure that ALARA goals are achieved in the operation of the facility. Engineering controls for the protection of personnel have been made as effective as possible. Operations involving high person-rem exposures have been carefully planned and will be carried out by personnel well trained in radiation protection and the use of proper equipment. During such activities, the applicant will monitor personnel for exposure to radiation and contamination.

Their radiation exposures will be reviewed and used to make changes in future job procedures and techniques.

Provisions have been made so that the management will review radiation exposure trends periodically to determine major changes in problem areas and to note which groups of workers are accumulating the highest exposures. The staff should use these reports to recommend design modifications or changes in procedures. These practices conform with those in RG 8.8 and 8.10 [SECTIONS] and the guidance in Section 2 of NUREG/CR-3343 and are acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in the technical review of an SAR for a near-surface, low-level, radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding NRC plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Revision 2, January 1991.

---, Regulatory Guide 1.8, "Personnel Selection and Training."

---, Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Plants Will Be As Low As Is Reasonably Achievable."

---, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable."

---, Regulatory Guide 8.29, "Instructions Concerning Risks from Occupational Radiation Exposure."

---, Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses."

---, Regulatory Guide 8.35, "Planned Special Exposures."

General

---, NUREG/CR-3343, "Recommended Radiation Protection Practices for Low-Level Waste Disposal Sites," December 1983.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 7.2
RADIONUCLIDE INVENTORIES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist (HP)

1.2 Secondary - None

2. AREAS OF REVIEW

The staff should review the areas of the SAR for Sections 2.1 and 2.2 of this SRP to determine if the applicant has adequate procedures and policies in place to define radiation sources in accordance with 10 CFR 61.55, and 10 CFR 61.56. Upon determining the sources of radiation, the staff should review areas addressed in Sections 2.1 and 2.2 of this SRP to determine if the applicant has proposed adequate procedures and policies to ensure radiation protection for the involved inventories during normal operations, anticipated operational occurrences, and accident conditions according to 10 CFR 61, Subpart C. The staff should coordinate its review of procedures under this section with the review of procedures under SRP 7.3.

2.1 Waste Inventories

The description and location of radioactive waste inventories during normal operations and under accident conditions in the facility should be used as the basis for designing the radiation protection program. The applicant should post radiation areas according to the requirements in 10 CFR 20 Subpart J. The applicant should determine the concentration and quantities of radionuclides for the purpose of posting areas and should describe the process for posting areas in its radiation protection plan. The applicant should specify the operational location of sources which result in radiation exposures. The applicant should identify the radionuclides by their material type such as source, byproduct, or special nuclear material.

The applicant should provide arrangements for the disposal of waste inventories in accordance with 10 CFR 20, Subpart K; and the temporary storage

of waste inventories.

2.2 Airborne Radioactive Material Sources

The type and concentration of airborne radioactive material sources at the facility are among the determinant factors in the design of the ventilation systems and the procedures for monitoring and protecting against personnel exposures. The staff should verify that the applicant assessed the contribution to effluent releases according to 10 CFR 61.53. Upon conducting this assessment, the applicant should write a description of airborne radioactive sources, which should include: (1) a classification by physical type of airborne radioactive material (e.g., gas or particulate); (2) a table of the calculated concentrations expected during normal operations, operational occurrences, and accident conditions; (3) the models and corresponding parameters used in the calculations for the scenarios described above; and (4) the actual dose calculations for inventories in geometries expected during storage and disposal operations. The radiation protection program for airborne radionuclides should follow 10 CFR 20.1203,"Determination of External Dose from Airborne radioactive material," and 20.1204, "Determination of internal exposure."

The evaluation of exposures from airborne radioactive material is one of the most important parts of the application. The applicant should submit dose calculations and assessment assumptions from expected airborne radioactive material sources for operational activities performed under differing source scenarios. The staff should review the calculations and assumptions using the standard models available.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff should verify the completeness of the information on radiation sources in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff should determine if the criteria for waste inventories that will be stored and disposed meet the acceptance criteria. The staff should also determine if the model assumptions and resulting calculation methods used by the applicant are appropriate for the described quantitative source and airborne concentrations. The staff should determine if the administrative inventory control levels are adequate.

The staff should evaluate the description of the construction and operation of the facility, as outlined in 10 CFR 61.12, paragraphs (b) and (f), with SRP

7.1 to discern if the ALARA principle has been used in all situations for the described waste and stored inventories. In Section 7.1.3 of NUREG/CR-3343, the staff stated

> Control and isolation of contamination should be considered in the design and construction of an LLW disposal site and supporting facilities. A well-planned and constructed site can aid in contamination control by minimizing human and equipment contact with the waste once it is on site.

The staff should closely coordinate its safety evaluation review with that for SRP 4 to ensure that radiation protection is provided appropriately for the anticipated inventories and waste forms, as identified on incoming waste manifests. The review should include an evaluation of operational details such as (1) operating procedures in accordance with 10 CFR 61, (2) anticipated inventories classified by the applicant as described above, and (3) calculations of doses based on occupancy times in radiation areas in accordance with 10 CFR Part 20. The staff should tailor its review criteria according to the type of disposal facility and the methods of emplacing waste.

3.3 Request for Additional Information

The staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if it meets the requirements in 10 CFR Parts 61 and 20, and if it includes the information required in Section 7.2 of NUREG-1199.

The specific parts of the regulations applicable to the areas of review for this SRP are as follows:

(1) 10 CFR 20.1201, as related to limiting radiation doses to protect individuals in restricted areas from whole- or partial-body exposures

(2) 10 CFR 20.102, as related to limiting the radiation doses to protect individuals in restricted areas by somming external and internal doses.

(3) 10 CFR 20.1203, as related to limiting the average concentrations of airborne radioactive materials to protect idnividuals in restricted areas from external doses.

(4) 10 CFR 20.1204, as related to limiting the internal exposure of individuals in restricted areas.

(5) 10 CFR 20.1206, as related to limiting and identifying planned special exposures to individuals in restricted areas and keeping exposures ALARA.

(6) 10 CFR 20.1207, as related to limiting dose to minors.

(7) 10 CFR 20.1208, as related to limiting does to the embryolfetus.

(8) 10 CFR 20.Subpart G, as related to the control of exposure from external sources to individuals in restricted areas.

(9) 10 CFR 20, Subpart J, as related to labelling radiation sources in order to maintain expsoures to individuals ALARA.

(10) 10 CFR 20, Subpart K, as related to control, disposal and tranfser of radioactive waste to minimize exposure to individuals in restricted areas.

(11) 10 CFR 61.12(b), (c), (f), (h), (j), (k), (l), and (m), as related to the evaluation of facility construction and storage of radioactive materials to discern if the ALARA principle has been employed in all situations

(12) 10 CFR 61.13(c) as related to assessments of expected exposures to individuals during routine operations and accident conditions

(13) 10 CFR 61.23(j) as related to providing sufficient license application information regarding radioactive waste material

(14) 10 CFR Sections 61.40 through 43, as related to the protection of individuals from exposures that exceed established limits

(15) 10 CFR 61.52(a)(6), as related to limiting the dose rate from radioactive materials stored at the site

(16) 10 CFR 61.55(a)(1), (a)(2), (a)(3), (a)(4), and (a)(5), as related to the classification of wastes

(17) 10 CFR 61.56(8)(b), as related to limiting exposure and ensuring stability of the wastes

4.2 Regulatory Guidance

Regulatory guidance to help the applicant meet the requirements in Section 4.1

is provided in the following documents:

(1) NUREG/CR-3343, as related to defining, characterizing, and classifying radiation sources and controlling contamination to limit exposure to individuals.

(2) RG 8.8, as related to parameters for determining the characteristics and intensity of the radiation fields and the length of time of exposure to ensure that the ALARA principle is used in all situations.

4.3 Regulatory Evaluation Criteria

The licensee has an acceptable policy for considering radionuclide inventories during the construction and operation of the facility if it can demonstrate that this policy meets the requirements in 10 CFR 61.12, paragraphs (b) and (f). The policy should ensure that occupational radiation exposures will be ALARA in all situations. A radiation protection program for normal operations and under accident conditions should be commensurate with the proposed radionuclide inventories accepted for disposal. The primary consideration in developing the radiation protection program is the description of the type and strength of the radiation sources (including isotopes, curie content, and geometry).

The disposal methods will be deemed effective if they limit exposure to individuals. To limit exposures, the applicant should monitor the time individuals spend exposed to the radiation sources and the distance between the radiation sources and individuals. The adequacy of radionuclide descriptions will be based on the applicant's ability to provide information including isotope, curie content, and geometry of waste packages before, during, and after disposal. If the facility includes waste that is emplaced above grade and in storage locations, the source descriptions should include accessible waste packages in areas of active disposal. The applicant should describe the radionuclides for which it performs the dose assessment.

An acceptable description includes the expected inventories that require shielding, ventilation systems, special storage locations and conditions, traffic or access control, special plans or procedures, or monitoring equipment to ensure that the "Performance Objectives" in 10 CFR 61.40-44 are met. In Chapter 7 of NUREG/CR-3343, the staff provides recommendations for a well planned and well constructed disposal site that limits the contact of individuals and equipment with the radiation sources. The description submitted by the applicant should include all necessary information pertaining to shielding codes used in the design process and related design features (10 CFR 61.52 (6)). Waste and storage inventory limits will be strongly dependent upon the type of facility and the method of disposal. The staff should coordinate the review with the review of source term analysis for the

Performance Assessment review in SRP 6.

The description is acceptable if the applicant has described all waste inventories, stored inventories, and airborne sources. The description of waste inventories should include plan drawings in which all sources of potential exposures are located accurately to the scale of the facility (10 CFR 61.52 (7)). The approximate size and shape of the sources of radiation exposures should be indicated on the drawings. The inventories should be easily correlated to tables containing pertinent quantitative parameters.

The applicant should include the description of airborne sources on drawings to facilitate the design of ventilation and monitoring systems, to identify any intigate airborne sources which may be attributed to leakage from containers or opening closed containers. Airborne radioactivity concentrations in frequently occupied areas will be a small fraction of the concentrations specified in 10 CFR 20.1201(d), Appendix B. The applicant should also specify all assumptions made during the calculation of quantitative values of the appropriate sources.

The source parameters are acceptable if the accompanying text specifically explains the values used in the radiation protection calculations and in the ventilation designs. The applicant can place the source parameter tables in SRP 6 or reference them in other sections.

5. EVALUATION FINDINGS

5.1 Introduction

The staff should verify that sufficient information has been provided in the license application and amendments to satisfy the requirements set forth in 10 CFR 61.12 (b, c, f, h, j, k, l, m), 10 CFR 61.40-44, 10 CFR 61.52 (6)(a), 10 CFR 20.1101, and 10 CFR 20, Subpart C. The staff can document the review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the information regarding the radiation sources for [name of facility] low-level waste disposal facility according to the Standard Review Plan 7.2.

The staff concludes that the information submitted by the applicant regarding radiation sources including the identification of radiation sources (10 CFR 61.55), proper labelling procedures (10 CFR 20, Subpart J), and assessment of airborne radioactive materials (10 CFR 61.53) is acceptable and meets the NRC requirements.

The applicant submitted a thorough description of the evaluation of source terms for the facility according to 10 CFR 20.1101, and 10 CFR 20, Subpart C.

The applicant has described the type and concentration of airborne and contained radioactivity sources. The applicant has used the appropriate radioactive source concentrations for determining the dose assessment, shielding requirements, and proper ventilation system design. The assumptions used by the applicant in determining the quantitative values for the contained and airborne sources are described according to 10 CFR 20.1101.

The most important factors influencing personnel radiation exposure during operation of the facility are (list according to the staff evaluation). The parameters used, a complete description of the routine source term development, and the description of the accident source terms are contained in (list parts of application). The source terms presented by the applicant are comparable to estimates by other applicants with similar designs approved facility designs (reference other facilities).

The airborne radioactivity within the facility is mostly due to leakage from waste packages. The applicant has provided evaluation and tabulation of the maximum concentration expected during routine and accident condition operations (10 CFR 61.53). The basic calculations for determining radiation protection for personnel and for designing the required ventilation systems to minimize airborne radioactivity are (describe from applicant's submittal). The source terms used are acceptable according to estimates by other applicants with similar facility designs (reference other facilities).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in the technical review of an SAR for a near-surface, low-level, radioactive waste disposal facility. In addition, this SRP may be used by applicants and licensees in preparation for performance of the technical review by the NRC staff.

The staff should use the method described herein except when the applicant proposes an acceptable alternative method dictated by variances in facility design for complying with NRC regulations.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be As Low As Is Reasonably Achievable," Rev. 3, June 1978.

General

---, NUREG/CR-3343, "Recommended Radiation Protection Practices for Low-Level Waste Disposal Sites," December 1983.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 7.3
RADIATION PROTECTION DESIGN FEATURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Technical Branch (LLTB)

1.2 Secondary - None

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the areas of the SAR given in the following sections as they relate to radiation protection design features, taking into account design dose rates, anticipated operational occurrences, and accident conditions.

2.1 Facility Design Features

(1) the equipment and facility design features used for ensuring that occupational radiation exposures will be as low as is reasonably achievable (ALARA)

(2) the radiation zone designations, including zone boundaries for normal operations and accident conditions

(3) the illustrative examples of facility design features of the equipment, components, and systems listed in Sections 7.1 and 7.3 of NUREG-1199, including clearly readable, scaled layout and arrangement drawings of the facility showing all source locations and the other design details requested in Section 7.3 of NUREG-1199; wall thicknesses for shielded spaces should be specified on the drawings or provided in separate tables

(4) implementation of Regulatory Guide (RG) 8.8 guidelines on facility and equipment design and layout and information on proposed alternatives

2.2 Shielding

(1) the shielding to be provided for radiation sources reviewed under SRP 7.2, including the design criteria and the shielding material to be used

20.1101 as guidance to ensure that the ALARA principle is followed in facility design.[1]

2.2 Shielding

The use of shielding is one of the most important operational controls to ensure the risk of exposure is ALARA at LLW disposal sites. The use of permanent and temporary shielding is listed in Section 2.6 of NUREG/CR-3343. Upon characterizing the sources of potential exposures as reviewed for SRP 7.2, the applicant should determine the design criteria for shielding and the shielding material to be used. The staff should review the methods by which the shield parameters were determined, including pertinent codes, assumptions, and techniques used in the calculations of the applicant. The assumptions should address requirements in 10 CFR 61.12. The applicant should determine any special protective features that use shielding, geometric arrangement, or remote handling to ensure that occupational exposures are kept ALARA. The staff should review these features.

The applicant should discuss in the SAR its method for implementing RGs 1.69, 8.8, and 8.29, as related to design features, special protective features, and proposed alternatives.

The staff should review the radiation and shielding design considerations proposed by the applicant to determine the areas where personnel occupancy may be limited during operations following an accident and to determine the corrective actions needed (NUREG/CR-3343, Section 2.6). For example, the applicant may propose to install portable or temporary shielding devices to ensure adequate access to areas of interest.

2.3 Ventilation

In 10 CFR 20.1701, the NRC stated that

> "The licensee shall use, to the extent practicable, process or other engineering controls (e.g., containment or ventilation) to control the concentrations of radioactive material in air."

The applicant should determine the personnel protection features incorporated in the ventilation system designs designated in NUREG-1199, Section 3. The applicant should observe the guidance in RG 8.8 and 8.29 and should incorporate any proposed alternative. The applicant should also include examples of the personnel radiation protection features of any air cleaning system design.

2.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

In 10 CFR 61.50 (2), the NRC listed the capabilities of the disposal site including the ability to be monitored. Guidance for the applicant is provided

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[1] Note: Occupational dose assessment calculations will be significantly affected by the nature of the disposal unit. Therefore, the staff should verify that the applicant has provided the appropriate dose calculations for the specific method of disposal used. The staff issued guidance to the applicant in NUREG/CR-3343.

in RG 8.2, and American National Standards Institute document, ANSI-N13.1 1969. Descriptions in the SAR should include the fixed area radiation and continuous airborne radioactivity monitoring instrumentation for normal operation, anticipated operational occurrences, and accident conditions. The criteria and additional details for placing monitoring devices are found in Section 7.3 of NUREG-1199. The ALARA principle should apply to monitoring under the guidance in RG 8.8 (all parts as they can be applied to LLW disposal facilities). The applicant can use as guidance the information in ANSI/ANS HPSSC-6.8.1-1981 for the locations of the fixed radiation monitors as applicable to the specific LLW disposal facility.

The staff should evaluate the criteria and method for obtaining representative samples of airborne radioactivity concentrations in work areas. The SAR should include procedures for locating suspected high-radiation areas and areas of suspected high concentrations of airborne radioactivity. The radiation monitoring capability during and after accident conditions should also be included and reviewed by the staff according to Section 2, NUREG/CR 3343, with emphasis on part 2.6.

2.5 Operational Procedures

The staff should review the methods used to develop detailed operational plans and procedures to determine if the applicant adequately addressed the ALARA management policy when it developed these plans and procedures. The staff should determine if the operational plans and procedures reflect information from past experience and other design features and operations. The staff should review the descriptions of criteria and conditions under which various operating procedures are implemented for specific operations. The staff should determine if the applicant has addressed how operating procedures are reviewed and updated as a result of ALARA audits. The staff should determine if the applicant has implemented the management policy on ALARA in the radiation protection program. The staff will coordinate this review with the review of information for SRP 7.4 and SRPs 4.1, 4.2, 4.3, and 5.2. In SRP 7.4, the staff discusses the radiation protection program and procedures, while in SRPs 4.1, 4.2, and 4.3, the staff reviews the procedures for the receiving, inspecting, temporarily storing, and disposing of waste. In SRP 5.2, the staff describes the review for the applicant's decontamination and decommissioning program. In SRP 8, the staff addresses operational concerns that will have a significant effect on this review.

2.6 Dose Assessment

The radiation dose standards are set forth in 10 CFR 61.43. The applicant should conduct the dose assessment using detailed information on the expected occupancy of site radiation areas for each radiation zone and the estimated annual person-rem doses associated with major functions such as operations, waste handling, maintenance, and inspections. The applicant should indicate any additional methods for reducing doses that it develops upon conducting the dose assessment process for specific features. The applicant should provide occupational dose assessments to facility personnel for each job category, with which to demonstrate that design features and operational procedures

result in acceptable levels of occupational exposure. The applicant should assess the exposure for a variety of personnel other than disposal operators.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff should verify the completeness of the information on design features in the SAR in accordance with NUREG-1199 and this SRP.

The staff should review the applicant's use of its past design and operational experience to determine if the facility was designed to reduce the potential for radiation exposures. The staff should review information on how the design is directed toward reducing the occupational radiation exposures. The applicant should provide calculated occupational exposures for each disposal method used. The staff should review the information describing the manner in which the design process is directed toward reducing occupational exposures during maintenance and operational activities. The staff should also determine if the applicant provides adequate mechanisms for appropriate competent professionals in radiation protection to use in reviewing the design.

The staff should evaluate for safety by reviewing the text and related scaled layout drawings of the facility contained in the SAR. The staff should concentrate its safety review on the sources (as described in Section 7.2), appropriate shielding requirements (RG 1.69, all parts and especially Part C in reference to ANSI N101.6-1972, "Concrete Radiation Shields" as can be applied to LLW disposal facilities and activities), and building layouts including decontamination facilities, offices, access control areas, lockers and shower rooms, and laboratory facilities. To ensure the ALARA principle, the applicant should describe the personnel decontamination areas as detailed in RG 8.2. Radiation protection design features will be evaluated using the guidelines RG 8.10, to the extent it applies to all licensees.

The staff should review access control plans to verify they conform with 10 CFR 20, Subpart G and Subpart I. The plans should provide for proper controls in limited access areas and restricted access areas (high radiation areas). The staff should determine any unsatisfactory arrangements, areas in which the design should be improved, unusual shielding thicknesses, and unusual assumptions in the calculations. The staff should also evaluate the procedures for calculating the shielding thickness and the placement of radiation monitors. The majority of codes used by shield designers are contained in the code description file of the Radiation Shielding Information Center at Oak Ridge National Laboratory (ORNL). These codes have been tested and verified for operation.

The staff should evaluate the adequacy of the shielding design using acceptable radiation shielding codes. The staff may verify calculations with appropriate computer programs such as SDC, G3, QAD, or MORSE.

The staff should consider recommending changes in any design features and procedures necessitated by the rearrangement of radiation zones or the relocation of equipment.

The staff should determine whether the applicant has followed the guidance in RGs 1.69, 8.2, 8.8, and 8.29 (as described above), and the design feature safety procedures in Sections 2.0 and 6.0 of NUREG/CR 3343 to meet the requirements of 10 CFR 20. The staff should compare these design features and procedures with current industry standards and should verify the applicant's references to guides and regulations. The staff should validate the alternatives described by the applicant by comparing them with those alternatives described in the cited regulatory guides.

The staff should review the SAR to determine that the applicant has adequately addressed the recommendations made in Chapter 7 of NUREG/CR 3343. The staff should evaluate procedures for receiving and inspecting waste to ensure that the applicant will maintain adequate protection from radiation exposures resulting from damaged or opened packages. The staff should evaluate the classification of sources identified as long-lived and short-lived, and the concentrations of the expected inventories. The staff should coordinate this review with the review for SRP 4 and its operational considerations.

3.3 Request for Additional Information

The staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if the applicant meets the requirements in 10 CFR Parts 61 and 20, and provides the required information delineated in NUREG-1199.

The specific parts of the regulations applicable to the areas of review in this SRP are as follows:

(1) 10 CFR 20.1101, as related to persons involved with licensed activities making every reasonable effort to maintain radiation exposures ALARA

(2) 10 CFR 20.1201, as related to design features, shielding, ventilation systems, monitoring, and dose assessment for the purpose of controlling occupational radiation exposures

(3) 10 CFR 20.1203, as related to design features, engineering controls, ventilation systems, monitoring, and dose assessment for the purpose of controlling occupational radiation exposures in air

(4) 10 CFR 20.1207, as related to control of exposure to minors to radiation or radioactive materials in restricted areas

(5) 10 CFR 20.1208 as related to controlling the exposure to an embryolfetus

(6) 10 CFR 20.1906 as related to the design features associated with accepting and monitoring radioactive materials

(7) 10 CFR 20, Subpart J, as related to: 1) the posting of radiation areas, high radiation areas, or airborne radioactivity areas; and 2) other indicators to identify, quantify, and label radioactive materials in an area of the facility

(8) 10 CFR 20, Subpart I, as related to securing licensed material against unauthorized removal from storage

(9) 10 CFR 61.7 (a)(2), and (b), as related to the design of the facility and the design features such as shielding and buffer zones which dictate dependent waste classification

(10) 10 CFR 61.12 (b), (c), (d), (e), (f), (i), (k), and (l), as related to the design of the facility to ensure the ALARA principle and the respective monitoring programs

(11) 10 CFR 61.23 (d) and (e), as related to design features and disposal facility operations

(12) 10 CFR 61.24 (9), as related to the requirements for license conditions for design features and mitigation systems

(13) 10 CFR 61.43

(14) 10 CFR 61.51, as related to the design features that ensure long-term isolation of radioactive materials from persons and the environment

(15) 10 CFR 61.52 (a)(6), (a)(7), and (a)(8), as related to placement and containment of waste in the design features and location of waste on maps

(16) 10 CFR 70.24, as related to procedures and criteria for criticality accident monitoring.

4.2 Regulatory Guidance

Regulatory guidance to help the applicant meet the requirements in Section 4.1 is provided in the following documents:

NRC Regulatory Documents

(1) RG 1.69, as related to the requirements and recommended practices in ANSI N101.6-1972, "Concrete Radiation Shields," that are acceptable and applicable for the construction of disposal facilities and appropriate radiation protection shielding structures.

(2) RG 8.2, as related to radiation-monitoring programs influencing design criteria.

(3) RG 8.8, as related to compliance with 10 CFR 20.1101 concerning actions taken during design, construction, operation, and decommissioning to ensure that occupational exposures ALARA.

(4) RG 8.10, as related to compliance with 10 CFR 20.1101 in maintaining occupational exposures ALARA and influencing the design features.

(5) NUREG/CR-3343, as related to facility design requirements to ensure exposures ALARA.

Industry Standards

(1) American National Standards Institute, ANSI N13.1-1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities," as related to facility design applications, and the use of principles in obtaining valid samples of airborne radioactivity, and acceptable methods and materials for obtaining gas and particle samples.

(2) American National Standards Institute, ANSI N16.2-1969, "Criticality Accident Alarm Systems," as related to the prevention of criticality accidents while handling, storing, processing, and transporting fissionable materials for consideration in facility design features.

(3) American National Standards Institute, ANSI N101.6-1972, "Concrete Radiation Shields," as related to the design and construction of concrete radiation shielding structures.

(4) American National Standards Institute/American Nuclear Society, ANSI/ANS-HPSSC6.8.1-1981, "Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Nuclear Reactors," as related to criteria for establishing locations of fixed continuous area gamma radiation monitors, and for design features and ranges of measurements, as applicable to low-level radioactive waste.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review of this SRP are given in the following sections.

4.3.1 Facility Design Features

The applicant should provide a discussion of the approach to meet the requirements of the design concept selected. The discussion should include design bases and criteria. In this discussion, the applicant should demonstrate that the design concept is technically feasible (10 CFR Part 61, Subpart D. The technical feasibility statement should show that the design is within the state of the art and that reasonable assurance exists that all requirements will be implemented before the facility is constructed, the waste is accepted, and the radioactive materials are disposed.

The design is acceptable if it meets the following requirements:

(1) the design features submitted by the applicant comply with the dose requirements in 10 CFR 20, Subpart C and 10 CFR 61.12.

(2) the major exposure-accumulating functions including receiving, handling, processing, inspecting, storing, and disposing of radioactive wastes, are considered in the facility design.

(3) the design facilitates that the potential radiation exposure caused by operational activities is ALARA in accordance with 10 CFR 20.1101.

(4) the parts of RGs 8.8 and 8.10 that can be applied to LLW facilities for the radiation protection features incorporated in the design.

Examples of such design features are

(1) the ease of accessibility to work stations, inspections, and sampling areas

(2) the ability to reduce source intensity

(3) the design measures to reduce the production, distribution, and retention of contamination

(4) the ability to reduce time spent in radiation fields, and

(5) the provisions for portable shielding devices and remote handling tools

The staff should evaluate the access controls in accordance with the requirements of 10 CFR 20, Subpart I. Other alternatives can be considered if the applicant proves reasonable assurance of compliance with the performance objectives in Subpart C of 10 CFR 61.

The applicant should subdivide the areas in the general facility site and the areas inside of the structures into radiation zones and label the zones according to 10 CFR 20, Subpart I. The radiation zones are identified according to the design dose rates and the criteria used in selecting maximum dose rates. The applicant should define the maximum zone dose rate for each zone according to anticipated occupancy and access control. The areas that are to be occupied at predictable intervals during both normal operations and anticipated operational occurrences should be zoned so that the occupancy results in an individual annual dose and total person-rem dose that maintains the ALARA principle and is within the limits set forth in 10 CFR 20.

The bases for the dose rates are the number of persons occupying a zone and their exposure times while occupying or passing through the zone. The anticipated operational occurrences include receiving, handling, processing, storing, and emplacing the waste for disposal; performing routine operational surveillance and inspections; and performing normal maintenance. The facility

can be zoned and sufficient radiation protection can be incorporated in the design features so that individuals receive a fraction of the 10 CFR Part 20 dose limits on the basis of experience from operating facilities and predictions made for new designs.

The staff should thoroughly evaluate the applicant's procedures that have a significant effect on occupational exposures to ensure that they include adequate ALARA provisions. The staff should also review all other procedures submitted by the applicant and reviewed under SRPs 3, 4, and 8 to determine if these procedures cover all significant potential doses. The staff should evaluate these procedures against the criteria in the proposed radiation protection program as described in SRP 7.4.

4.3.2 Shielding Design

The staff should evaluate the assumptions used to calculate shield thickness, the calculational methods used, and the chosen parameters. Numerous acceptable shielding calculational codes are effective for determining appropriate shielding thicknesses for gamma ray sources. The NRC staff should use codes that it is familiar with to perform shielding calculations to ensure reliability and accuracy.

The applicant can follow the guidance in ANSI N101.6-1972, "Concrete Radiation Shields," on fabricating and installing concrete shields for occupational radiation protection when that guidance applies to LLW disposal facilities. The shield construction is acceptable if it meets the guidance in the document mentioned above (ANSI N101.6-1972) or in an alternative proposal deemed acceptable by the staff. In RG 8.8, the staff provides additional acceptance criteria regarding shielding and isolation in the radiation protection design that can be applied to LLW disposal facilities in specific instances.

4.3.3 Ventilation Systems

To determine if the ventilation systems are acceptable, the staff should evaluate them against the criteria for ventilation rates that ensure the radioactivity in the airflow remains ALARA from low to high potential airborne radioactivity areas and through filters and vents. The ventilation systems are acceptable if the applicant has proven that the concentrations of airborne radioactive material in areas normally occupied can be maintained in accordance with 10 CFR 20.1203. The system should have the capability to reduce concentrations of airborne radioactivity in areas used only for maintenance or inservice inspections in accordance with 10 CFR 20.1203. The system should be designed so that the filters containing radioactivity can be easily maintained without creating an additional radiation hazard to maintenance personnel or personnel in adjacent areas. The applicant should follow the guidance in RG 8.8 on radioactive gases and particles. The applicant may propose alternatives, which the staff should evaluate for acceptability.

Although the staff wrote RG 1.52, particularly Sections 6.4 and 6.5, to provide guidance for mitigating accidents involving airborne radioactivity, it can be used in the review of ventilation systems. This guidance can apply to

normal operating conditions since releases during normalcy differ only in intensity from those under accident conditions.

4.3.4 Area Radiation and Airborne Radioactivity Monitoring Systems

Area Radiation Monitoring Systems

To determine if the area radiation-monitoring systems are acceptable, the staff should evaluate evidence that the applicant meets the requirements in 10 CFR 20.1001, and the guidance in Sections C. 4 and 5 of RG 8.15 and in RG 8.2, regarding LLW disposal facilities. The monitoring system designs should also meet the following criteria:

(1) Engineering controls give the principal protection against personnel intake of radioactive materials.

(2) The monitors are located in areas that are normally occupied without restricted access and that have a potential for radiation fields in excess of the designations discussed in NUREG-1199, Section 7.3. The monitors should be located in the areas in accordance with ANSI/ANS-HPSSC-6.8.1-1981.

(3) The monitors show onscale readings of dose rate including the maximum dose rate for the location-specific design. The monitors also include the maximum dose rate for anticipated accidents.

(4) The monitors are calibrated at described intervals, and after maintenance activities.

(5) Each monitor has a local audible alarm and variable alarm set points. Monitors in high-noise areas also include a visual alarm.

(6) Monitor readout and annunciation are provided in a staffed central location.

Airborne Radioactivity Monitoring Systems

ANSI N13.1-1969 provides detailed guidance on sampling airborne radioactive materials in nuclear facilities. The staff can use this document in evaluating the sampling process proposed by the applicant and the techniques involved in the sampling. The staff discussed air sampling procedures in detail in NUREG/CR 3343, Section 6.11. Acceptability of the airborne radioactivity-monitoring system is based on the following criteria:

(1) The applicant provides a description of the radionuclides likely to be present and the potential maximum concentration of radionuclides in accordance with 10 CFR 20, Appendix B, Table 1, as described in Section 6.11 of NUREG/CR 3343.

(2) The applicant samples air at normally occupied locations that could have airborne radioactivity. According to NUREG/CR-3343, Section 6.11, "the sample should be representative of worker breathing zone

air." Continuous monitoring of air being exhausted from locations within the facility during normal operations is acceptable.

(3) The monitoring system is capable of detecting the derived air concentration (DAC) of particulate radioactivity from any normally occupied area that may contain airborne radioactivity. Dilution in the ventilation system should be taken into account. In NUREG/CR-3343, Section 6.11, the staff states that "The minimum amount of air which must be sampled in order to provide valid results is dependent upon the sensitivity and accuracy of the analytical or counting system to be used."

(4) Representative air concentrations are measured by the monitors, and the monitors are located reasonably close to the sampler intake structures.

(5) Ventilation monitors are upstream of high-efficiency particulate air filters. The staff provided guidance for the choice of air filters in NUREG/CR-3343, Section 6.11.

(6) The air monitors are calibrated routinely at described intervals, and are calibrated after maintenance or repair.

(7) Each monitor has an audible alarm and variable alarm set points. Monitors in high-noise areas should also have visual alarms.

(8) The applicant provides displays and annunciators in a centrally staffed location.

(9) The applicant provides for changes in air sample characteristics that are anticipated with changes in operations (NUREG/CR-3343).

(10) In taking air samples the applicant considers physical characteristics, such as particle size, to assist in determining intake and exposure pathways or mechanisms.

Accident Radiation-Monitoring Systems

The following regulatory guides provide guidelines that can be partially applied to LLW disposal facilities and can be used by the applicant where appropriate. In RG 8.2, the staff provides guidance on surveys to evaluate radiation hazards. Instrumentation to monitor for accidental criticality is acceptable when in accordance with 10 CFR 70.24 (a)(1), RG 8.12, and ANSI N16.2-1969. The accident radiation-monitoring systems are acceptable if they meet the following criteria:

(1) The monitors are equipped with indicators such that personnel can assess the radiation hazard in areas that may have to be entered during or after an accident.

(2) Portable instruments to be used during an accident are placed in a readily accessible location for personnel responding to an emergency.

(3) Emergency power should be provided for installed accident monitoring systems.

(4) The accident-monitoring system should have ranges that include the maximum calculated accident radiation levels. These systems should be designed to operate properly in the environment caused by the accident.

4.3.5 Dose Assessment

The dose assessment is acceptable if it meets the objectives described in RG 8.19. The applicant should document the assumptions made, the calculations used, the results obtained for each radiation zone, exceptional dose rate, and the projected individual dose pertaining to the dose assessments. The applicant should justify the occupational exposure action levels against operational and design considerations. The results for the expected radiation zones should include the numbers and types of workers estimated for each zone.

5. EVALUATION FINDINGS

5.1 Introduction

The staff should verify that the applicant provided sufficient information in the license application and amendments to satisfy the requirements set forth in 10 CFR 20, Subpart B and Subpart C, 10 CFR 61.12, 10 CFR 61.42, 10 CFR 61.51, 10 CFR 61.52, and 10 CFR 70.24. The staff can document the review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the information regarding the design features for the [name of facility] low-level waste disposal facility according to the Standard Review Plan 7.3.

The staff concludes that the information provided by the applicant regarding design features including a description of the principle design criteria and performance objectives (10 CFR 61.12) and the manner in which the waste is stored to ensure the exposure is as low as reasonably achievable (ALARA) during storage (10 CFR 61.52) is acceptable and meets the requirements.

The applicant has provided appropriate radiation protection design features to maintain occupational radiation exposures within regulatory limits and ALARA, consistent with 10 CFR 20, Subpart B, and the dose-limiting provisions of 10 CFR 20, Subpart C. The applicant has considered the guidance provided in RGs 8.8 and 8.10. The design features incorporated on the basis of experience gained in radiation exposure during the operation of other waste disposal facilities are [list the specific design features]. [The staff should include examples of design features that could limit exposure to workers during

operations, provide remote operational capability, and reduce the time required for work in radiation fields.] These design features are consistent with RG 8.8 and are acceptable to the staff.

Access control is in accordance with 10 CFR 20, Subpart G and is acceptable.

The applicant has described the [number] zones contained within the restricted area. The applicant derived the dose rate criteria for each of the zones from expected occupancy and access restrictions. The applicant used these criteria as the basis for the radiation shielding design and for selecting equipment in accordance with RG 8.8. During facility operations, the applicant provided for the health physics staff to re-evaluate area access classifications and to monitor area entry for the purpose of updating zone posting and entry requirements in accordance with 10 CFR 20, Subpart J.

The radiation sources, as reviewed according to SRP 7.2, capable of producing radiation levels in excess of 100 rads an hour are shielded and clearly marked (10 CFR 20, Subpart G), indicating that potentially lethal radiation fields are possible.

The applicant has made provisions for administrative controls which will be initiated when temporary shielding is used (RG 8.2). The applicant will install local audible and visual alarming monitors to alert personnel when temporary shielding is removed.

The applicant has designed radiation shielding that provides protection against radiation, both inside and outside the facility, for operational personnel and the general public in accordance with RG 8.8. The following shielding design features have been incorporated into the facility design: [list the shielding features]. These shielding techniques are designed to maintain personnel radiation exposures ALARA in accordance with RG 8.10 and are acceptable.

The general shielding design methodologies and source term inventories for the [name the facility] are similar to operating facilities.

The basic radiation transport analysis used by the applicant for the shielding design is based on the following codes and is acceptable: [list the appropriate computer codes].

The applicant will construct all concrete shielding in the facility in general compliance with RG 1.69. The staff finds the shielding design and associated methodologies in the application acceptable.

The ventilation system designed by the applicant ensures that personnel are not inadvertently exposed to airborne contaminants exceeding the limits in 10 CFR 20, Subpart C. The exposure reduction features are [list features], which comply with the design criteria in RG 8.8.

The staff reviewed the ventilation system design and the applicant intends to maintain personnel exposure ALARA in accordance with the policies outlined in NUREG/CR-3343, Section 2.0. The applicant will maintain personnel exposures

ALARA by (1) maintaining circulation of air flow from areas of potentially low airborne contamination to areas of potentially higher concentrations, (2) ensuring negative or positive pressures to prevent exhaust or infiltration of potential contaminants, and (3) locating the ventilation system intake structures so that the intake of potentially contaminated air from other building exhaust points is minimized.

The objectives and location criteria of the area and airborne radiation-monitoring systems comply with applicable parts of 10 CFR Part 20, 10 CFR Part 61, 10 CFR 70.24, RG 8.2, RG 8.8, and ANSI N13.1-1969. The applicant indicated that it will periodically calibrate all area and airborne radioactivity monitors.

The applicant has designed the radiation monitoring system in compliance with 10 CFR 61.12 to

(1) monitor radiation levels by using [supply number] such monitors in areas where radiation levels could exceed limits and where personnel are present

(2) provide audible alarm systems and visual alarm systems in high noise areas to detect radiation in excess of preset levels by using [supply number] such monitors

(3) provide a continuous record of radiation levels at key locations throughout the facility. [List examples of other area monitoring system features.]

The applicant has used airborne radioactivity-monitoring design objectives to assist in maintaining occupational exposure to airborne contaminants ALARA in accordance with 10 CFR Part 20, to verify the integrity of systems containing radioactivity in accordance with 10 CFR 61.51, and to warn of unexpected release of airborne radioactivity to prevent inadvertent overexposure of personnel according to 10 CFR Part 20.

The applicant made provisions for installing airborne radioactivity monitors in areas that could contain airborne radioactivity. These airborne radioactivity monitors can detect the derived air concentrations (DACs) (10 CFR 20, Appendix B) in air of the most restrictive particulate radionuclides [by name] in the specific areas of lowest ventilation flow rates within [supply number] hour(s) [denoted as 10 DACs]. The applicant has also made provisions for portable continuous air monitors in work areas not covered by fixed monitors. [List examples of other airborne radioactivity monitoring features.]

The applicant designed its accident radiation-monitoring systems to provide the capability to assess the radiation hazards in areas that may be occupied during an accident. The instruments installed have emergency power supplies. The portable instruments are readily accessible to personnel responding to an emergency. These systems are designed according to the operating range of the instruments provided and the environment in which the instruments will perform

properly. Instrumentation to monitor for accidental criticality is acceptable and complies with 10 CFR 70.24 (a)(1), RG 8.12, and ANSI N16.2-1969.

The dose assessment provided by the applicant complies with RG 8.19 and is acceptable. The dose assessment includes a summary table of occupational radiation exposure estimates and a detailed explanation of the dose assessment process. The applicant has made provisions for a systematic, continuing review of the design features and facility operations. The applicant described these review procedures. This continuing review includes recording procedures documenting requirements, and determining the ALARA-related changes that it will make upon conducting the dose assessment.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in the technical review of an SAR for a near-surface, low-level radioactive waste disposal facility. In addition, this SRP may be used by applicants and licensees in preparation for performance of the technical review by the NRC staff.

The staff should use the method described herein except when the applicant proposes an acceptable alternative method for complying with NRC regulations dictated by variances in facility design.

7. REFERENCES

Essential

American National Standards Institute (ANSI), ANSI N13.1-1969, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities," New York.

---, ANSI N16.2-1969, Criticality Accident Alarm Systems," New York.

---, ANSI N101.6-1972, "Concrete Radiation Shields," New York.

American National Standards Institute/American Nuclear Society, ANSI/ANS-HPSSC-6.8.1-1981, "Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Nuclear Reactors," New York.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Atomic Energy Commission, Regulatory Guide 1.69, "Concrete Radiation Shields for Nuclear Power Plants," December 1973.

---, Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring," February 1973.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Revision 2, January 1991.

---, NUREG/CR-3343, "Recommended Radiation Protection Practices for Low-Level Waste Disposal Sites," December 1983.

---, Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," July 1976.

---, Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable," Revision 3, June 1978.

---, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," Revision 1, September 1975.

---, Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," October 1976.

---, Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure."

---, Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses."

General

---, Regulatory Guide 8.19, "Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants Design Stage Man-Rem Estimates," Revision 1, June 1979.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 7.4
RADIATION PROTECTION PROGRAM

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist (HP)

1.2 Secondary - None

2. AREAS OF REVIEW

The staff should review the areas of the SAR described in the following sections to determine if the applicant has adequate procedures and policies in place to minimize occupational radiation exposures by conducting a radiation protection program. The staff should closely coordinate its review of procedures for this section with the review of procedures for SRP 7.3, placing particular emphasis on reviewing administrative procedures in the application when evaluating the radiation protection program. The factors influencing the radiation protection program are as follows: ALARA programs, training programs, external and internal exposure control, respiratory protection, surveillance, radioactive waste management, the selection of facilities and equipment, and external dose analysis (NUREG/CR-3343).

2.1 Organization

The staff provided guidance for the responsibility and authority for the radiation protection program in NUREG/CR-3343, Section 2.2. The applicant should include in the description of the program the administrative organization, including the authority and responsibility of the individual occupying each position. The applicant should indicate the experience and qualifications of the personnel responsible for the radiation protection program referencing the section of the SAR reviewed under SRP 8.2 as appropriate. The applicant should also indicate the personnel responsible for supervising the handling and monitoring of radioactive material. The applicant's program should include a feedback mechanism, which the staff will evaluate.

The NRC staff should coordinate the review of the organization, experience, and qualifications with the review of the organizational aspects under SRP 8.2.

2.2 Equipment, Instrumentation, and Facilities

In Section 6 of NUREG/CR-3343, the staff provided guidance for selecting and implementing equipment, instrumentation, and operations. The applicant should describe the criteria for selecting portable and laboratory equipment and instrumentation for performing radiation and contamination surveys. The applicant should use the equipment and instrumentation for monitoring and sampling airborne radioactivity, monitoring area radiation, and monitoring the exposure of personnel during normal operations, anticipated operational occurrences, and accident conditions. The applicant should indicate the quantity of each type of instrument to be available, since some instruments will be unavailable periodically because of calibration, maintenance, and repair.

The staff should review the procedures for storing, calibrating and maintaining instruments. The radiation protection facilities include locker and shower rooms, personnel decontamination areas, respiratory protective equipment, and other contamination control equipment. Such facilities and services should allow for male and female workers to receive separate necessary protection against radioactive contamination. The description of the location of instruments, equipment, and radiation protection facilities should include the types, sensitivity, range, and frequency of detectors and monitors, and should include the calibration methods (10 CFR 61.12 (k)).

The applicant should provide information on any proposed alternatives and should implement the following regulatory guides as they can be applied to LLW disposal facilities: 1.8, 8.2, 8.7, 8.8, 8.9, 8.10, 8.26, 8.27, and 8.29.

2.3 Administrative Radiation Protection Procedures

The staff should review the applicant's administrative and programmatic procedures to assist in determining the acceptability of the radiation protection program. The staff should pay particular attention to the level of management involvement committed to the facility and should carefully review the process for developing additional procedures and policies.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff should review the information in the SAR regarding the radiation protection program to ensure it is complete and is in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff should review the areas described in Section 2 by comparing the applicant's submittal with the regulations, regulatory guides, and industry standards referenced in Section 4.

The applicant should provide the description of the organizational position,

functional responsibilities, experience, and qualifications of personnel responsible for the radiation protection program. The qualifications and training of personnel should be commensurate with the assigned or projected duties. The staff should review these functions and qualifications to verify that the work assignments and subsequent occupational assessments are appropriate for the facility. The staff should verify that the applicant is considering all radiological aspects of the facility, based on the design and operations at the facility.

The applicant should justify that the equipment necessary to measure radioactivity, radiation fields, and exposures are adequate. The applicant should describe the number, type, range, sensitivity, calibration method and frequency, availability, and planned uses of the equipment. The applicant should also describe the planned uses of portable, fixed, laboratory, and personnel-monitoring instrumentation. The staff should verify that the planned uses of equipment are adequate as dictated by the disposal facility design.

The applicant should specify the health physics facilities and associated protective equipment for controlling occupational radiation protection and radioactive contamination. The reviewer should verify that the applicant accounted for the training and indoctrination program and the radiation protection instruction manuals or the methods for ensuring their development. The reviewer should verify that the applicant has formulated procedures to control the storage and movement of radioactive material, to control exposures, and to control contamination. The applicant should show that procedures are in place whereby both the management and the radiation protection staff will review all current and planned activities in which personnel could receive exposures that exceed previously specified levels.

The staff will coordinate its review of the plant organization, the functional responsibilities, and the qualifications of personnel with the review for SRP 8.2. The staff will review the radiation protection organization, functions, and personnel qualifications using the criteria that can be applied to LLW disposal facilities in RGs 1.8 and 8.8, and in accordance with Subpart C of 10 CFR Part 61.

3.3 Requests for Additional Information

The staff may request that the applicant supply additional information or modify the submittal to meet the acceptance criteria in Section 4.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if it meets the requirements in 10 CFR Parts 20 and 61 and if the applicant provided the information required in NUREG-1199.

The specific parts of the regulations that apply to the areas of review in this SRP are as follows:

(1) 10 CFR 19.12, as related to informing workers entering restricted areas about the storage, transfer, or use of radioactive materials or radiation in such areas; instructing the workers in the risk associated with occupational radiation exposure, precautions, and procedures to reduce exposures; and the purpose and function of protection devices.

(2) 10 CFR 20.1101 as related to personnel involved in licensed activities maintaining radiation exposures ALARA.

(3) 10 CFR 20, Subpart C as related to design features, ventilation, monitoring, and dose assessment for the purpose of controlling occupational radiation exposures to individuals in restricted areas.

(4) 10 CFR 20, Subpart F, as related to: 1) performing surveys to assess the location of contaminated materials and equipment; 2) measuring levels of radiation and concentrations of radioactive materials; and 3) providing appropriate personnel monitoring equipment to individuals entering restricted areas.

(5) 10 CFR 20, Subpart J, as related to: 1) the posting of radiation areas, high-radiation areas, and airborne radioactivity areas; and 2) other indicators identifying and quantifying radioactive materials.

(6) 10 CFR 20.1906, as related to the appropriate handling of packages containing specified quantities of radioactive materials.

(7) 10 CFR 20, Subpart I, as related to securing licensed materials against unauthorized removal from storage.

(8) 10 CFR 20, Subpart L, as related to maintaining records both for individuals provided with personnel monitoring equipment and for those exposed to radiation in restricted areas.

(9) 10 CFR 20.2201, as related to reports to the NRC required from licensees immediately upon becoming aware of any loss or theft of licensed material resulting in significant hazard to persons in unrestricted areas.

(10) 10 CFR 20, Subpart M, as related to written reports to the NRC on individual exposures in excess of regulatory limits, incidents requiring notification, and levels of radiation or concentrations of radioactive materials in excess of specified limits.

(11) 10 CFR 61.7, as related to the protection of individuals during operations.

(12) 10 CFR 61.11, as related to the organizational structure and authority and the training requirements for key personnel.

(13) 10 CFR 61.12, as related to maintaining occupational exposures ALARA.

(14) 10 CFR 61.13, as related to assessments of expected exposures during routine operations and under accident conditions.

(15) 10 CFR 61.23, as related to providing reasonable assurance that the standards for radiation protection will be met.

(16) 10 CFR 61.24, as related to the requirement to maintain reports and records.

(17) 10 CFR 61, as related to maintaining occupational exposures ALARA.

(18) 10 CFR 61, as related to the capability of the facility design to be adequately monitored.

(19) 10 CFR 61.52, as related to the placement, characterization, and accurate location of waste to maintain occupational exposures ALARA.

(20) 10 CFR 61.55, as related to the classification of waste for the purpose of informing personnel of potential exposure to radioactive material.

4.2 Regulatory Guidance

Regulatory guidance to help the applicant meet the requirements in Section 4.1 is provided in the following documents:

NRC Regulatory Guidance

(1) NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials," as related to the provision of technical information to licensees on the appropriate application of respiratory protection devices for protection against airborne radioactive materials, including selection and maintenance of equipment, and training of personnel.

(2) NUREG/CR-3343, "Recommended Radiation Protection Practices for Low-Level Waste Disposal Sites," as related to the development of a radiation protection program.

(3) Regulatory Guide 1.8, "Personnel Selection and Training," as related to the qualification and training of facility personnel.

(4) Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring," as related to radiation monitoring programs for administrative personnel.

(5) Regulatory Guide 8.3, "Film Badge Performance Criteria," as related to film badge performance criteria for the categories of radiation after exposure under specific conditions.

(6) Regulatory Guide 8.4, "Direct-Reading and Indirect-Reading Pocket Dosimeters," as related to standards for direct- and indirect-

reading pocket dosimeters used for personnel dose or dose rate measurements.

(7) Regulatory Guide 8.6, "Standard Test Procedure for Geiger-Muller Counters," as related to testing the operating characteristics of Geiger-Muller counters before making calibrations and measurements, and to formulating procedures for calibration of and measurements by other instruments.

(8) Regulatory Guide 8.7, "Occupational Radiation Exposure Records Systems," as related to the specification of records necessary to describe the occupational radiation exposure of individuals and the conditions under which the exposure may occur.

(9) Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable," as related to meeting requirements in 10 CFR 20.1101 by providing information on actions taken during the design, construction, operation, and closure to ensure that occupational radiation exposures are maintained ALARA.

(10) Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program," as related to determining the extent of an individual exposure to concentrations of radioactive materials.

(11) Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," as related to the commitment by the facility management and vigilance by the radiation protection manager and the radiation protection staff to maintain occupational radiation exposures ALARA.

(12) Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure," as related to instruction provided to personnel on biological risks to embryos or fetuses resulting from prenatal occupational radiation exposure.

(13) Regulatory Guide 8.14, "Personnel Neutron Dosimeters," as related to the use of personnel neutron dosimeters where possible exposure to neutrons can occur.

(14) Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," as related to the formulation of acceptable respiratory protection programs.

(15) Regulatory Guide 8.26, "Applications of Bioassay for Fission and Activation Products," as related to the necessity to include bioassay programs in the license provisions where personnel may be receive internal radiation exposure from the inhalation or ingestion of fission or neutron activation products.

(16) Regulatory Guide 8.27, "Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants," as related to a radiation protection training program consistent with ALARA objectives in accordance with the training requirements of 10 CFR 19.

(17) Regulatory Guide 8.28, "Audible-Alarm Dosimeters," as related to the appropriate use of audible-alarm dosimeters and conditions under which malfunction may occur.

(18) Regulatory Guide 8.29, "Instruction Concerning Risks From Occupational Radiation Exposure," as related to providing appropriate instruction to personnel on the risks of occupational radiation exposure in accordance with the training requirements of 10 CFR 19.

(19) Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses."

Industry Standards

(1) American National Standards Institute, ANSI N13.2-1969, "Guide for Administrative Practices in Radiation Monitoring," as related to guidance on administrative practices associated with monitoring of ionizing radiation in and around facilities with potential for radiation exposure.

(2) American National Standards Institute, ANSI N13.5 1972, "Performance Specifications for Direct-Reading and Indirect-Reading Pocket Dosimeters for X- and Gamma Radiation," as related to the essential performance characteristics of direct- and indirect-reading pocket-type radiation detectors for personnel use on the facility.

(3) American National Standards Institute, ANSI N13.6-1972, "Practice for Occupational Radiation Exposure Record Systems," as related to guidance for the management of the facility on the systematic generation and retention of records pertaining to occupational radiation exposures.

(4) American National Standards Institute, ANSI N13.7-1972, "Criteria for Film Badge Performance," as related to film badge performance criteria for detailed categories of radiation following exposure of workers under specified conditions.

(5) American National Standards Institute, ANSI N42.3-1969, "Test Procedure for Geiger-Muller Counters," as related to test conditions for instrumentation to ensure that operating characteristics can be appropriately evaluated, such as associated electronic circuitry, environment, and counting rate.

(6) American National Standards Institute/American Nuclear Society, ANSI/ANS 3.1 1978, "Selection and Training of Nuclear Power Plant Personnel," as related to criteria for the selection, qualifications, responsibilities,

and training of personnel in operating and support organizations appropriate for the safe and efficient operation of facilities.

4.3 Regulatory Evaluation Criteria

The staff will apply evaluation criteria to the results from dose assessment calculations demonstrating that the occupational doses will remain consistently below action levels and will not exceed regulatory limits for all operational and design conditions. The following sections provide the evaluation criteria for the areas of review for this SRP.

4.3.1 Organization

The radiation protection program is acceptable if it includes a description of the organization in accordance with 10 CFR 19.12, 10 CFR 20, Subpart B, RG 1.8 (all parts as they can be applied to LLW disposal facilities), RG 8.2 (all parts as they can be applied to LLW disposal facilities), RG 8.8 (all parts as they can be applied to LLW disposal facilities), RG 8.10 (all parts as this RG applies to all licensees as stated in paragraph 2), and NUREG/CR-3343. The organization is structured so that occupational exposures can be maintained ALARA. The duties, qualifications, and training of the specific individuals in the organization are described in the SAR. The staff should evaluate alternatives by comparing them with the regulatory guides referenced.

4.3.2 Equipment, Instrumentation, and Facilities

Acceptability of the radiation protection program should be based on the following requirements:

(1) The radiochemistry laboratory is equipped to perform routine analyses required for personnel protection, surveys, and related radiation protection functions in accordance with 10 CFR 20.1101, 10 CFR 61.55, and NUREG/CR-3343. The low background counting room has the instrumentation to perform routine counting on all radioactivity samples including air, water, and swipes as follows:

(a) multichannel gamma pulse height analyzer

(b) low background alpha-beta proportional counter

(c) gamma and alpha-beta scintillation counters

(d) end window Geiger-Muller (G-M) type counter.

(2) Portable instruments used for measuring radiation or radioactivity in accordance with 10 CFR 20.1101 and 10 CFR 61.55 are as follows:

(a) low- and high-range ion chamber rate meters

(b) portable G-M counters

(c) alpha scintillation or proportional counter rate meters

(d) neutron dose equivalent rate meters

(e) air samplers for use with particulate filters and iodine collection devices such as charcoal cartridges, and airborne radioactivity monitors

(f) high-range instruments

(3) Equipment for personnel monitoring and provisions for bioassay and whole-body counting, in accordance with 10 CFR 20.1101, NUREG/CR-3343, RG 8.9 (all parts as this RG applies to licensees in general with references to International Commission on Radiological Protection (ICRP) publications), and RGs 8.26 and 8.28 (all parts as they can be applied to LLW disposal facilities) are as follows:

(a) friskers for detecting radioactive contamination

(b) self-reading low- and intermediate-range pocket dosimeters including audible alarm dosimeters for early evaluation of individual doses (RG 8.4)

(c) count rate meters or personnel air samplers to be worn on protective clothing

(d) film badges or thermoluminescent dosimeters (TLDs) in conformance with RG 8.3.

(4) Respiratory protection equipment should conform to 10 CFR 20, Subpart H. Facility-provided personnel protection equipment should include

(a) anti-contamination clothing

(b) chemically-resistant plastic suits for liquid contamination control

(c) head covers, shoe covers, gloves, and safety-related items

(d) Pressure demand full-face piece air line respirators

(e) pressure demand full-face piece self-contained breathing apparatus (SCBA)

(f) full-face mechanical filter respirators.

(5) Acceptability of the facility design should be based on the guidance of RG 8.8 (all parts as they apply to licensees). The facility design should include the minimum radiation protection support facilities and areas as follows:

(a) portable instrument calibration areas and easily accessible storage areas

(b) a specific use area designed for personnel decontamination, equipped with necessary monitors, and located to expedite separate decontamination of male and female personnel

(c) equipment maintenance facilities used specifically for cleaning, sanitizing, repairing, and decontaminating personnel protective equipment

(d) change room located between labelled clean and contaminated areas

(e) entrance and exit control points designated for restricted areas that include caution signs, labels, and signals in accordance with 10 CFR 20, Subpart I.

(f) storage and control capability for licensed materials in unrestricted areas in accordance with 10 CFR 20.205 and 10 CFR 20.207

(g) at least one readily accessible radiation protection station used for storing radiation survey equipment, respiratory protective equipment, personnel-monitoring equipment, and contamination control supplies, located so as to facilitate communication throughout the facility.

4.3.3 Radiation Protection Procedures

The radiation protection procedures are acceptable if they meet the access control criteria in accordance with 10 CFR 20, Subpart I, 10 CFR 61.12, NUREG/CR- 3343, and the following regulatory guides as applicable to licensees: 1.8, 8.8, and 8.10. The staff may consider appropriate alternatives if applicable.

The staff should review the radiation protection program to verify that procedures are in place to if whether the regulations governing disposal activities are adequately addressed.

The applicant has developed special control procedures for designated zoned areas, including requiring a special survey of the area before entering and beginning a work permit program. The work permit program should include data on radiation levels, allowable working time, protective clothing and respiratory protective equipment required, special tools, portable shielding, and specialized personnel-monitoring devices.

In Section 2.5 of NUREG/CR-3343, the staff states that "Procedures and the procedure development process should be used to ensure that ALARA considerations are included in work activities." The staff should review procedures and methods that the applicant is considering for operation, maintenance, repair, and surveillance. The staff should verify that using these procedures and methods will keep occupational radiation exposures ALARA in accordance with 10 CFR 61.12 and RG 8.8. The staff should conduct a post-operational review for major dose accumulating functions to evaluate the effectiveness of the work permit program for ALARA considerations in future

operations. The applicant should maintain ALARA occupational exposures through the quality assurance program. The applicant should also make provisions to supervise and control the handling and movement of radioactive material throughout the facility. The spread of radioactive material should be controlled.

The staff should review the procedures for personnel-monitoring, bioassay, record-keeping, and the reporting of personnel radiation doses in accordance with 10 CFR 20, Subpart B, Subpart C, Subpart L, Subpart G of 10 CFR Part 61, and the applicable parts of RGs 8.2, 8.3, 8.7, 8.8, 8.9, and 8.10, 8.34 and 8.35. The staff should evaluate proposed action levels and procedures to verify that the applicant can resolve operational deficiencies that may lead to exposure limits being exceeded.

The radiation protection program is acceptable if the applicant has provided sufficient training and indoctrinating for personnel. The staff provided guidance for training in NUREG/CR-3343 and applicable parts of RGs 8.10, 8.13, 8.27, and 8.29. In 10 CFR 19.12, the NRC requires that the applicant instruct personnel in radiation protection and conduct systematic reviews of the radiation protection program. The periodic reviews should include improving procedures, equipment, and facilities where possible to incorporate advances in the state of the art. The program should include regular audits to determine when occupational radiation exposures occur and to review possible methods for mitigating the exposures.

5. EVALUATION FINDINGS

5.1 Introduction

The staff should verify that the applicant provided sufficient information in the license application and amendments to satisfy the requirements in 10 CFR 20, Subpart B and Subpart C, 10 CFR 61.12, 10 CFR 61.42, 10 CFR 61.55, 10 CFR 61.80 and 10 CFR 19.12. The staff can document the review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the radiation protection program for the [name of facility] low-level waste disposal facility according to Standard Review Plan 7.4.

On the basis of the following findings, the staff concludes that the program is acceptable and complies with 10 CFR 19.12, 10 CFR Part 20, and 10 CFR Part 61.

The objectives of the radiation protection program are to provide reasonable assurance that the limits set forth of 10 CFR 20.1101, and 10 CFR 61.55 will not be exceeded. The radiation protection program has been developed in accordance with guidance given in Regulatory Guides 8.2, 8.8, and 8.10. The main objectives of the radiation protection program are to reduce unavoidable exposures and maintain occupational exposures and person-rem doses ALARA.

The duties of the facility radiation protection manager include [list duties]. The radiation protection organization and implementation of the program are acceptable and complies with 10 CFR 19.12, 10 CFR 20.1101, and Regulatory Guides 1.8, 8.2, 8.8, 8.10, and 8.13. The applicant has made provisions qualifications descriptions and for the training of personnel in accordance with the regulations.

The radiation features are acceptable and include [list facilities, areas, control points, laboratories, offices, laundry, decontamination areas, changing rooms and showers, and any other applicable area or facility]. These facilities are sufficient to maintain occupational radiation exposures ALARA and comply with guidance given in Regulatory Guide 8.8.

Both permanent and temporary facility personnel should be assigned betagamma thermoluminescent dosimeter badges or equivalent film badges to be worn in restricted areas at all times. The badges should be processed regularly in accordance with Regulatory Guide 8.3. The badges may be processed more frequently if significant exposures are suspected, at the discretion of the radiation protection program manager. For controlled areas, personnel are also required to wear direct- or indirect-reading dosimeters. The readings from these badges should be used to prepare a cumulative total exposure prior to badge processing. Visitors to the facility should wear self-reading dosimeters to document exposure or should be escorted by a person wearing a dosimeter.

The applicant has made provisions for caution signs, labels, and signals in accordance with 10 CFR 20, Subpart J, and the procedures are acceptable. Audible dosimeters should also be provided in high-noise areas in accordance with Regulatory Guide 8.14 and guidance in NUREG/CR-3343.

All radiation exposure information should be recorded in accordance with 10 CFR 20, 10 CFR 61, "Subpart G---Records, Tests, and Inspections," and Regulatory Guide 8.7. The procedures described by the applicant are acceptable. Provisions for maintenance of records of surveys, personnel monitoring, and bioassay have been made by the applicant and are acceptable. Whole body counts of all facility personnel should be provided in accordance with 10 CFR 20, Subpart C.

The staff has reviewed the maintenance, repair, and surveillance methods described by the applicant to ensure that all facility radiation protection procedures, practices, and criteria have been considered. The methods described ensure that occupational radiation exposures should be ALARA in accordance with Regulatory Guide 8.8. The applicant has developed procedures to ensure that exposure limits will not be exceeded by visitors, and that facility and visitor personnel will be trained in radiation protection policies and procedures. The administration and control of the radiation work permits have been established by the applicant. The procedures for the definition of radiation access control zones and for the control of all radioactive material entering or leaving the facility are acceptable.

Storage and control of licensed materials in unrestricted areas should be maintained in accordance with 10 CFR 20, Subpart I.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in the technical review of an SAR for a near-surface, low-level radioactive waste disposal facility.

The staff should use the method described in the SRP except when the applicant proposes an acceptable alternative method for compliance with NRC regulations, dictated by variances in the radiation protection program.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

---, Regulatory Guide 1.8, "Personnel Selection and Training."

---, Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring."

---, Regulatory Guide 8.3, "Film Badge Performance Criteria."

---, Regulatory Guide 8.4, "Direct-Reading and Indirect-Reading Pocket Dosimeters."

---, Regulatory Guide 8.6, "Standard Test Procedure for Geiger-Muller Counters."

---, Regulatory Guide 8.7, "Occupational Radiation Exposure Records Systems."

---, Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable."

---, Regulatory Guide, 8.9, Rev. 1, "Interpretation of Bioassay Measurements."

---, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable."

---, Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure."

---, Regulatory Guide 8.14, "Personnel Neutron Dosimeters."

---, Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection."

---, Regulatory Guide 8.26, "Applications of Bioassay for Fission and Activation Products."

---, Regulatory Guide 8.27, "Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants."

---, Regulatory Guide 8.28, "Audible-Alarm Dosimeters."

---, Regulatory Guide 8.29, "Instruction Concerning Risks From Occupational Radiation Exposure."

---, Regulatory Guide 8.34, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses."

---, Regulatory Guide 8.36, "Radiation Doses to the Embryo/Fetus."

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Revision 2, January 1991.

General

U.S. Nuclear Regulatory Commission, NUREG-0041, "Manual of Respiratory Protection Against Airborne Radioactive Materials," September 1976.

American National Standards Institute/American Nuclear Society, ANSI/ANS 3.1-1978, "Selection and Training of Nuclear Power Plant Personnel," New York.

---, NUREG/CR-3343, "Recommended Radiation Protection Practice for Low-Level Waste Disposal Sites," D. E. Hadlock et al., Battelle Memorial Institute, Pacific Northwest Laboratory, December 1983.

American National Standards Institute, ANSI N13.2-1969, "Guide for Administrative Practices in Radiation Monitoring," New York.

---, ANSI N13.5-1972, "Performance Specifications for Direct-Reading and Indirect-Reading Pocket Dosimeters for X- and Gamma Radiation," New York.

---, ANSI N13.6-1972, "Practice for Occupational Radiation Exposure Record Systems," New York.

---, ANSI N13.7-1972, "Criteria for Film Badge Performance," New York.

---, ANSI N42.3-1969, "Test Procedure for Geiger-Muller Counters," New York.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.1
ORGANIZATIONAL STRUCTURE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Project Manager

1.2 Secondary - None

1.3 Supporting - Other Technical Reviewers (as needed)

2. AREAS OF REVIEW

The staff will review the corporate level management and technical organizations of the applicant and its major contractors for the project, including the technical resources to support site characterization, facility design, construction, testing, and operation. During its review, the staff will evaluate the applicant's responsibilities, the technical staff, and the interaction arrangements and management controls used to ensure that the facility will be designed and constructed in an acceptable manner. It also will evaluate the applicant's corporate organization and technical staff that will be in place to provide support for safe facility operation, closure, and post-closure activities.

The objective of this review is to ensure that the corporate management is involved with, informed about, and dedicated to the safe design, construction, testing, and operation of the facility and that sufficient technical resources have been or are being and will be provided to adequately accomplish this objective.

2.1 Site Characterization

2.1.1 Construction

The applicant's past experience in the design and construction of waste management facilities and in activities of similar scope and complexity should be described. The applicant's management, engineering, and technical support organization should also be described. Organizational charts reflecting the applicant's current headquarters and engineering staff structure and planned modifications and additions to reflect the added functional responsibilities associated with the addition of the facility should be included. These added responsibilities should be identified and should include the items listed in items (1) and (2) below:

(1) Design and Construction Responsibilities

Implementation or delegation of the following areas of responsibility should be described:

(a) principal site-related technical and engineering work such as that pertaining to meteorology, geology, soils, seismology, hydrology, demography, and environmental effects

(b) design of facility and ancillary systems

(c) review and approval of facility design features

(d) site layout with respect to environmental effects and security provisions

(e) development of sections of the SAR

(f) material and component specification review and approval

(g) procurement of materials and equipment

(h) management of construction activities

(i) quality assurance regarding design and construction

(2) Preoperational Responsibilities

The proposed plans for the management organization in regard to the following items of the initial test program should be described:

(a) development of plans for the preoperational testing of the facility

(b) development and implementation of staff recruiting and training programs

(c) development of facility maintenance programs

In regard to items (1) and (2) above, the description should include how these responsibilities will be delegated and implemented within and from the headquarters staff and should identify the working or performance level and responsible organizational unit, including an estimate of the number of persons expected to be assigned to each of the various units with responsibility for the project. In addition, the role the management will have in interacting with the architect/engineer, including the required review of contractor work by the applicant's staff, should be described.

The applicant also should identify general qualifications and requirements in terms of numbers, educational backgrounds, and experience for identified positions or classes of positions and specific educational background and experience for assigned management and supervisory positions relative to items (1) and (2) above.

For identified positions or classes of positions that have functional responsibilities other than those given in the SAR, the expected proportion of time assigned to the other activities should be described. In addition, the early plans for providing technical support for the operation of the facility should be provided.

The staff will review the technical staff to determine its capability to perform the activity described in the SAR. The information submitted should include a description of the specific activity (including scope), organizational description and charts reflecting organizational lines of authority and responsibility for the project, the number of persons assigned to the project, and the qualification requirements for principal management positions related to the project. For those organizations with extensive experience, a detailed description of this experience may be provided in lieu of the details of their organization as evidence of technical capability. However, a specific description of how this experience will be applied to the particular project should be provided.

2.1.2 Operation

The applicant should provide (1) organizational charts showing the corporatelevel management and technical support structure, including the relationship of the waste disposal portions of the structure to the rest of the corporate organization, and the specific provisions that have been made for the technical support for operations and (2) the organizational unit and any augmenting organizations or personnel that will manage or execute any phase of the waste management program, including the responsibilities and authorities of principal participants.

Technical services and backup support for the operating organization should become available before the preoperational testing program is conducted and should continue throughout the life of the facility.

The applicant should (1) identify, in terms of numbers, the educational background and experience requirements for each position or class of positions providing technical support for facility operations and (2) include the educational background and experience of individuals holding the management and supervisory positions providing support in the areas identified below:

(1) structural, soil mechanics, materials, and hydraulic engineering
(2) health physics and radiation protection
(3) maintenance support
(4) operations support
(5) quality assurance
(6) training
(7) safety review
(8) fire protection
(9) outside contractual assistance

In addition, the LLOB staff will coordinate other branch evaluations that are related to the overall review of the management and technical support organization.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on the organizational structure in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The corporate-level management and technical support structure, as demonstrated by organizational charts and descriptions of functions and responsibilities, should be free of ambiguous assignments of primary responsibility. A corporate officer should clearly be responsible for radioactive waste disposal activities, without having ancillary responsibilities that might detract his/her attention to radiological safety matters. Design and construction responsibilities should be reasonably well defined in terms of both numbers of persons and experience required to carry out their responsibilities. The staff must recognize that there are many acceptable ways to define and delegate job responsibilities.

With respect to technical support for operations, the applicant's plans for headquarters staffing may not yet be firm. It is acceptable, therefore, if these plans are not fully specific in terms of numbers of people, provided the applicant has made a sufficiently firm commitment to ensure the responsibility can be met. Variations in staffing may also be expected between applicants who lack prior experience with waste disposal operation and those who have such experience. It is important that the staff assure itself that applicants in the former category do not underestimate the magnitude of the task. The staff should be alert to the possibility that excessive workloads may be placed on too small a number of individuals. Interaction arrangements and controls between the applicant and major contractors should be examined to ensure that the applicant will be in charge of and responsible for design and construction activities.

The review procedure consists, therefore, of

(1) an examination of the information submitted to determine that all subject matter identified in Section 2 has been addressed

(2) a comparison of the information with the acceptance criteria of Section 4 in light of the additional points set forth earlier in this SRP

(3) corporate headquarters and site visits by one or more members of the Division of Waste Management (WM) staff to review, discuss, and verify implementation of the management structure and technical resources; with respect to site visits, in addition to the WM staff, review teams may include inspection and enforcement personnel.

In addition, if the applicant, at the time of the review, has had experience in the operation of a previously licensed waste disposal facility, the staff may seek independent information relative to headquarters staffing and qualifications by discussions with inspection personnel or review of inspection reports.

The staff will then determine, on the basis of the foregoing, the overall acceptability of the applicant's management and technical support organization and staffing plans.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The applicant's description of its resources to deal with safety-related problems associated with the proposed facility should provide contributory evidence on the technical qualifications of the applicant, as required by 10 CFR 61.23(a).

4.2 Regulatory Guidance

There are no regulatory guides that apply to the organizational structure for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to the areas of review in this SRP are given in the following sections.

4.3.1 Construction

The information is acceptable if the following conditions have been met:

(1) The applicant has identified and functionally described the specific organizational groups responsible for implementing the responsibilities for the project.

(2) The applicant has described the method of implementing its responsibilities for dealing with the safety-related aspects of the design and construction of the project and the transition to operation of the facility, including control of major contractors.

(3) Clear unambiguous management control and communications exist between the organizational units involved in the design and construction of the project.

(4) Substantive breadth and level of experience and availability of personnel exist to implement the responsibility for the project.

(5) The applicant has clearly described the roles and functions of the architect/engineer and contractor during both design and construction and has demonstrated control over the decisions of the architect/engineer and contractor.

(6) The applicant has designated the responsible organizations that will participate in the test program, and early plans indicate reasonable assurance that such designated organizations can collectively provide the necessary level of staffing with suitable skills and experience to develop and conduct the test program.

(7) The applicant plans to use the facility operating and technical staff in the development and conduct of the test program and in the review of test results.

(8) The applicant has identified plans for the organization and staffing to oversee design and construction of the facility.

4.3.2 Operation

The information is acceptable if the following conditions have been met:

(1) The applicant has identified and described the organizational groups responsible for implementing the responsibilities for the initial test program and technical support for the operation of the facility.

(2) The applicant has described the method of implementing its responsibilities regarding the initial test program, technical support, and operation of the facility.

(3) The organizational structure provides for the integrated management of activities that support the operation and maintenance of the facility.

(4) Clear management control and effective lines of authority and communications exist between the organizational units involved in management, operation, and technical support for the operation of the facility.

(5) Substantive breadth and level of experience and availability of personnel exist to implement the responsibility for technical support for the operation of the facility. The need to supplement the corporate structure with additional experienced personnel for the initial years of operation will be determined on a case-by-case basis.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the organizational structure for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.1.

The applicant has described (1) clear responsibilities and associated resources for the design and construction of the facility and (2) its plans for management of the project. The staff has reviewed these plans and concludes that they provide adequate assurance that an acceptable organization and staff resources have been established to satisfy the applicant's commitments for the design and construction of the facility. These findings contribute to the

requirements of 10 CFR 61.23(a); that is, the applicant is technically qualified to engage in design and construction activities required to carry out the disposal operation.

The applicant has described its organization for the management of and its means for providing technical support for the facility staff during operation of the facility. The staff has reviewed these measures and concludes that the applicant has an acceptable organization and adequate resources to provide technical support for the operation of the facility under both normal and abnormal conditions.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.2
QUALIFICATIONS OF APPLICANT

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Project Manager

1.2 Secondary - None

1.3 Supporting - Other Technical Reviewers (as needed)

2. AREAS OF REVIEW

The staff will review the applicant's operating organization as described in the SAR, including the structure, functions, and responsibilities of the organization established to operate and maintain the facility. It will review the following specific information:

(1) An organization chart showing the title of each position, the minimum number of persons to be assigned to common or duplicate positions, and (if appropriate) the number of operating shift crews

(2) The functions, responsibilities, and authorities of facility positions equivalent to the following:

(a) overall facility management
(b) operations supervision
(c) operating shift crew supervision
(d) technical supervision
(e) radiation protection supervision
(f) maintenance supervision
(g) emergency supervisory structure
(h) quality assurance supervision (when part of the facility staff)

For each position, where applicable, the applicant should describe required interactions with offsite personnel or personnel in positions identified in SRP 8.1. Such a description should include defined lines of reporting responsibilities (e.g., from plant manager to immediate superior) as well as functional or communication channels. In the SAR, the applicant also should describe (a) the line of succession of authority and responsibility for overall facility operation should an unexpected and temporary event occur and (b) the authority that may be delegated to

operating supervisors and to shift supervisors, including the authority to issue standing or special orders.

If the facility contains or will contain facilities other than those related to the application, the applicant should describe the interactions with the organizations operating such facilities. Any proposed sharing of persons between the facilities, their duties, and the proportion of time each will be assigned routinely to the other facility should be described.

(3) The position titles, the total number of people planned to constitute each shift and the proposed means of assigning shift responsibility for implementing the radiation protection and emergency programs on a round-the-clock basis (if necessary).

(4) The education, training, and experience requirements (qualification requirements) established by the applicant for filling each management, supervisory, or radiation safety position category in the operating organization. At the application stage, it is recognized that many details of the facility organization and staffing may not have been made final. Consequently, the information to be reviewed should demonstrate an understanding of and commitment to the acceptance criteria in Section 4 of this SRP. This section should eventually provide evidence, in the form of personnel resumes, that the initial selections made for management and principal supervisory positions down through the shift supervisory level conform to those requirements.

In addition to evaluating the above areas of review, the staff will coordinate other branch evaluations that are related to the overall review of the applicant's operating organization and that have been performed according to the criteria in other SRPs.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on the operating organization in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

Facility staff organizational structures are not rigidly fixed; however, experience has shown that certain components are common to and necessary for all facilities. Among these are operational, onsite technical support, and maintenance groups under the direction and supervision of a facility manager. Also necessary is a radiation safety officer who reports directly to a headquarters safety officer.

The operating organization, as demonstrated by organizational charts and descriptions of functions and responsibilities, should be free of ambiguous assignments of primary responsibility. Operating responsibilities should be reasonably well defined in terms of both numbers of persons and experience required to implement their responsibilities. The staff must recognize that there are many acceptable ways to define and delegate job responsibilities. Variations in staffing may also be expected between applicants who lack

experience with waste disposal operation and those who have such experience. It is important that the staff makes certain that applicants in the former category do not underestimate the magnitude of the task. The staff should be alert to the possibility that excessive workloads may be placed on too small a number of individuals.

The structure of onsite technical support and maintenance groups may depend somewhat on headquarters staffing and the division of effort between onsite and offsite personnel.

At the initial application stage, the applicant generally will not have selected persons to fill facility staff positions. The review procedure, therefore, is to examine this section of the SAR for a commitment on the part of the applicant to conform to the stated acceptance criteria.

"Applicable experience" should be judged in light of the position responsibility. Credit for experience, which may not be entirely applicable, should be weighted to a degree commensurate with its applicability.

In addition, if the applicant, at the time of the review, has had experience in waste disposal operations, the staff may seek independent information on facility staffing and qualifications by consulting with NRC inspection and enforcement personnel or by reviewing inspection reports, or by consulting with State personnel with similar responsibilities.

The staff will then determine, on the basis of the foregoing, the overall acceptability of the applicant's operating organization and plant staffing plans. This determination necessarily will be somewhat qualitative.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to the areas of review of this SRP is

> 10 CFR 61.23, "Standards for Issuance of a License," (a), as it relates to demonstrating in conjunction with other reviews that the applicant is technically qualified to engage in activities licensed under this regulation.

4.2 Regulatory Guidance

There are no regulatory guides that apply to the operating organization for a low-level disposal facility.

4.3 Regulatory Evaluation Criteria

The applicant should demonstrate a commitment to and implementation of plans to staff the operating organization and to define and delegate responsibilities to provide assurance that the facility can be operated safely by meeting the following evaluation criteria:

(1) The reporting responsibility and authority of the functional areas of radiation protection, quality assurance, and training ensure independence

from operating pressures. In most facilities, overall management and technical direction in these areas may be concentrated at corporate headquarters.

(2) Lines of authority to the facility manager are clear.

(3) Responsibility for all activities important to the safe operation of the facility is clearly defined and independent of production operations.

(4) Distinct functional areas are separately supervised and/or managed.

(5) Managers are qualified to provide adequate backup should the incumbent be absent.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the operating organization for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.2.

On the basis of the following findings, the staff concludes that the applicant's operating organization is acceptable and meets 10 CFR 61.23(a).

The applicant has described the assignment of plant operating responsibilities, the reporting chain up through the chief executive officer of the company (applicant), the proposed size of the regular facility staff, the separation of the reporting and decisionmaking responsibilities of the production operations staff and the safety operations staff, the functions and responsibilities of each major facility staff group, the proposed shift crew complement for extended operation, the qualification requirements for members of the facility staff, and personnel resumes for management and principal supervisory and technical positions. The staff has reviewed this information and concludes that the proposed organization is acceptable.

Acceptability of the applicant's operating organization is a significant input to the determination that the applicant is technically qualified as required by 10 CFR 61.23(a) and that the applicant has complied with the organizational requirements for the facility manager and radiation protection manager and those pertaining to the qualifications of facility personnel.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition,

it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.3
TRAINING PROGRAM

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist

1.2 Secondary - None

1.3 Supporting - Operations Specialist

2. AREAS OF REVIEW

The staff will review the description and scheduling of the training and retraining programs for the facility staff in the SAR. The program descriptions should include the following:

(1) the proposed subject matter of each course, the duration of the course (approximate number of weeks in full-time attendance), the organization teaching the course or supervising instruction, and the position titles of the personnel to whom the course is given

(2) a commitment to conduct an onsite formal training program and on-the-job training so that the entire facility staff will be qualified before the initial receipt of radioactive waste

(3) the applicant's plans for conducting a position task analysis for all operating personnel, in which the tasks performed by the person in each position are defined and the training, in conjunction with education and experience, is identified to provide assurance that the tasks can be effectively performed

(4) the procedures for the orientation of incidental site visitors with regard to site safety and radiation protection

(5) the proposed means for evaluating the effectiveness of the training program for all employees

(5) any differences in the training programs for individuals on the basis of experience; individuals should be grouped according to the following categories:

(a) individuals who have had no previous experience

(b) individuals who have had experience at facilities not subject to licensing

(c) individuals who have had experience at comparable facilities

The program description section should also include a chart to show the scheduling of each part of the training program for each position or organizational unit identified in the SAR. The time scale should be relative to expected operation.

The description should delineate clearly how much of the training program has been completed at the approximate time of submittal of the SAR. The applicant should describe contingency plans for additional training should operation be significantly delayed from the date indicated in the SAR.

The application should describe the applicant's plans for retraining plant personnel, identify the additional position categories on the facility staff for which retraining will be provided, and describe the nature, scope, and frequency of such retraining.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on the applicant's training program in the SAR in accordance with NUREG-1199 and this SRP. The staff may use training course descriptions obtained independently from vendors.

3.2 Safety Evaluation

The staff should ensure that, whenever the applicant has committed to follow the position of a regulatory guide, industry standard, or other reference document, the specific revision being referred to is identified. Similarly, whenever the staff is using a position in a reference document as a basis for acceptability, the revision being used should be identified.

The staff also should ensure that the applicant has committed to a reasonable schedule for the training programs that relates to the date for the start of operations.

The staff will then determine, on the basis of the foregoing, the overall acceptability of the applicant's plant staff training plans.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to the areas of review of this SRP are

(1) 10 CFR 19.12, "Instructions to Workers," as it relates to training personnel in the necessary health protection measures associated with exposure to radioactive materials or radiation when entering a restricted area

(2) 10 CFR 61.23, "Standards for Issuance of a License," (a), as it relates to training being an integral part of personnel technical qualifications thus contributing to the finding that the applicant is technically qualified to engage in disposal operations

4.2 Regulatory Guidance

There are no regulatory guides that apply to training programs for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The applicant should demonstrate that the training provided, or to be provided, for each position on the facility staff will be adequate to ensure that all facility staff personnel training requirements will be met at the time needed, that is, before waste operations or before appointment or reappointment to the position.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the training program for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.3.

On the basis of the following findings, the staff concludes that the training for facility staff personnel is acceptable and meets 10 CFR 19.12 and 10 CFR 61.23(a).

The applicant has described the training given to facility personnel and a schedule for that training as related to the applicant's currently scheduled date for receipt of waste.

All training of the facility staff is scheduled to be completed before waste disposal operations.

Meeting the staff's requirements given above provides an acceptable basis for the finding that, insofar as the training of personnel is concerned, the applicant meets the technical qualification requirements of 10 CFR 61.23(a).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy." U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.4
EMERGENCY PLANNING

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist

1.2 Secondary - Others as Needed

1.3 Support - None

2. AREAS OF REVIEW

The LLOB staff will review the information on emergency planning in the SAR using NUREG-0696 to determine if the applicant has provided emergency preparedness plans for situations involving real or potential radiological hazards. In addition, the staff will review the findings of the Federal Emergency Management Agency (FEMA) on the state of preparedness of offsite authorities who have the responsibility for taking protective measures in the ambient air exposure pathway.

Although the LLOB staff has the overall review responsibility for emergency preparedness, certain aspects of the technical reviews will be performed by or through other branches. Examples of these areas are meteorological information, emergency action levels, emergency response facilities, and evacuation time estimates.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on emergency planning in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

Following the acceptance of the license application, a review of the applicant's onsite emergency procedures will be conducted according to a schedule established by the LLOB staff.

Most of the information to be reviewed should be found in the section of the SAR reviewed under this SRP. However, in performing the review, the staff will use as references portions of the SAR that discuss facility design and layout, routine operations, demography, land use, and major accidents postulated by the applicant. The staff also should become familiar with proposed radiation protection activities and other operational matters that are related to emergency plans. The applicant's Environmental Report and staff reviews thereof should also be consulted. Written information may also be supplemented, when appropriate, with site visits and meetings with the applicant. When significant offsite releases are postulated for the maximum credible accident, the staff will consult with appropriate State and local authorities and FEMA to verify their participation in and/or approval of the applicant's emergency plans.

The staff must determine whether or not the acceptance criteria in Section 4 have been satisfactorily met. Any deficiencies should be identified and should form the basis for a request for additional information or transmittal of position statements to the applicant. Such further review may result in a determination that (1) the applicant has proposed acceptable alternatives, (2) the facts of the case do not warrant the application of the criterion in question, or (3) the facts do warrant the application of the criterion in question and no acceptable alternative has been proposed or identified. If any deficiencies remain in the last category at the conclusion of the review, they must be identified in the Safety Evaluation Report (SER) and subsequently resolved with the participation of higher level NRC management staff.

It should be recognized that the detailed application of the acceptance criteria will in many instances require the exercise of judgment on the part of the staff. The reasonableness and adequacy of the factors involved should be viewed in the light of general emergency planning and response experience, bearing in mind that the broad objective of radiological emergency plans is to protect the public by mitigating the potential health and safety consequences of radiation exposure. Ideally, such plans would ensure neither an overreaction nor an underreaction to unexpected events. The staff should be particularly alert, however, to provisions that may result in a possible underreaction to a serious event.

If significant offsite releases are projected by the applicant or by the staff, the staff should formally request FEMA to review offsite supporting plans and provide findings and determinations of this review to the NRC on a schedule agreed on between the two agencies. The FEMA review may be performed pursuant to the FEMA proposed rule, "Review and Approval of State and Local Radiological Emergency Plans and Preparedness," 44 CFR Part 350 (Federal Register, June 24, 1980) or the FEMA/NRC Memorandum of Understanding (Federal Register, December 16, 1980). At the conclusion of the review, findings on the acceptability of the applicant's proposed plans for coping with emergencies should be prepared as input to the staff's SER.

Special assistance requests particularly with regard to the evaluation of meteorological information, emergency action levels, emergency response facilities, and evacuation time estimates should be coordinated through the enforcement

personnel, who will routinely provide for the technical review of these areas.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are

(1) 10 CFR 61.12, "Specific Technical Information," (k), which requires that the applicant describe the radiation safety program as it relates to routine operations and accidents

(2) 10 CFR 61.13, "Technical Analyses," which requires analyses for the protection of individuals during likely accidents

4.2 Regulatory Guidance

There are no regulatory guides that apply to emergency planning for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The information on emergency planning is acceptable if the following conditions have been met:

(1) The applicant's plans for coping with an emergency meet the requirements in 44 CFR 350.

(2) The applicant has established plans for responding to all credible accidents and emergencies of a radiological nature consistent with the proposed method of operations.

(3) The applicant has adequately demonstrated that the offsite release associated with the most severe credible accident consistent with the projected source term will yield an offsite dose equivalent of less than 0.01 rem to the whole body and 0.05 rem to the lungs.

If the maximum potential offsite releases yield dose equivalents greater than the above, the applicant has developed emergency procedures that include interaction with local and State authorities and appropriate notification of affected populations. Further, the applicant's emergency procedures have been developed with the full knowledge, participation, and cooperation of such authorities and affected populations.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided

in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the information on emergency planning for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.4.

On the basis of its review of the applicant's plans for coping with emergencies and subsequent consultation with [specify], the staff finds that such emergency plans are acceptable and either meet or exceed the minimum requirements of [specify].

The applicant has established, and this review has confirmed, that the types of accidents given in Table [specify] are credible at the facility.

Table [specify number and title]

Type of accident	Associated releases of radioactivity

It has been determined that the maximum offsite release of radioactivity associated with these accidents is [specify], which is within the limits prescribed in the minimum acceptance criteria.

or

It has been determined that for [type of accident] the maximum possible release of radioactivity is [specify], which is greater than that prescribed in the acceptance criteria for trivial offsite releases. However, the Federal Emergency Management Agency (FEMA) has been consulted with regard to emergency plans dealing with this type of accident and has reviewed State and local emergency response plans. FEMA concludes that State and local preparedness is adequate to cope with such an accident so that offsite exposures will be limited to acceptable levels.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for

performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," and Title 44, "Emergency Management and Assistance," U.S. Government Printing Office, Washington, DC, revised annually.

Federal Emergency Management Agency, "Review and Approval of State and Local Radiological Emergency Plans and Preparedness," 44 CFR Part 350, Federal Register, pp. 42341-42347, June 24, 1980.

Federal Emergency Management Agency/U.S. Nuclear Regulatory Commission, "Memorandum of Understanding Between Federal Emergency Management Agency and Nuclear Regulatory Commission," Federal Register, pp. 82713-82717, December 16, 1980.

U.S. Nuclear Regulatory Commission NUREG-0696, "Functional Criteria for Emergency Response Facilities," July 1980.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.5
REVIEW AND AUDIT

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Operations Engineer

1.2 Secondary - Health Physicist

1.3 Supporting - Quality Assurance Engineer, Radiation Protection Specialist

2. AREAS OF REVIEW

The staff will evaluate the applicant's plan for conducting reviews and audits of operational activities that are important to safety, as described in the SAR. The primary focus of the review should be on the provisions that will be used to implement the applicant's responsibility for proposed changes to the facility and on the procedures for after-the-fact review, evaluation of unplanned events, and evaluation of facility operations.

The applicant should describe the provisions for the facility operations staff's review of operational activities, the independent review of facility operations, and the independent assessment of activities pertaining to safety enhancement. The staff will review the following specific information:

(1) the functioning of the onsite organization with respect to the review of proposed changes to systems or procedures and of unplanned events that have operational safety significance, including subject matter to be reviewed, organizational provisions for conducting the reviews (including personnel), and the documentation and reporting of review activities

(2) the procedure and organization used to evaluate safety-related operational activities independent of the operating organization, including how and when such a program is to be implemented, subject matter to be reviewed, organizational provisions for conducting the review (including personnel), and the documentation and reporting of review activities

(3) the provisions to perform independent reviews and assessments of facility activities, including the functions of the review group, organizational provisions for conducting the activities (including personnel), and the documentation and reporting of these activities

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on the applicant's program for the review and audit of operational activities in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review each element to assess its applicability. The staff's judgment during the review will be based on an inspection of the material presented, whether items of special safety significance are involved, and the magnitude and uniqueness of the project. The staff will review any exceptions or alternatives to ensure that they are clearly defined and that an adequate basis exists for acceptance.

When the staff has determined that the acceptance criteria of Section 4 of this SRP or their equivalent have been satisfactorily addressed in the applicant's plans for conducting reviews and audits, the staff's review is complete.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to the areas of review of this SRP is

> 10 CFR 61.23, "Standards for Issuance of a License," (a), as it relates to the applicant being technically qualified to engage in licensed activities

4.2 Regulatory Guidance

There are no regulatory guides that apply to reviews and audits for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to this SRP are given in the following sections.

4.3.1 Facility Staff Review

(1) Organizational arrangements should provide for interdisciplinary reviews of subject matter.

(2) Qualification levels for plant staff personnel performing reviews should be provided.

(3) Review activities should be documented, and the results should be forwarded to appropriate members of management.

4.3.2 Independent Review

Provisions for independent review should include the formation of an independent safety review group at the corporate level that should meet the following criteria:

(1) The functions of this group should be independent of those performed to meet items (1) and (2) in Section 2 of this SRP.

(2) The group should (a) examine facility operating characteristics, NRC issuances, and other appropriate sources of information on facility design and operating experience in the area of safety improvement and (b) maintain surveillance of facility operations and maintenance activities to provide independent verification that these activities are performed correctly and that human errors are reduced as far as practicable.

(3) The group should perform independent reviews and audits of facility activities (including maintenance and modifications), operational problems, and operational analysis and aid in the establishment of programmatic requirements for facility activities.

(4) The group should provide to management no less frequently than quarterly a summary of its activities to advise management on the overall quality and safety of operations.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the program for the review and audit of operational activities for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.5.

On the basis of the following findings, the staff concludes that the program is acceptable and contributes to meeting 10 CFR 61.23(a).

The applicant has described the program for the review and audit of operational activities. The program includes reviews by the plant staff organization, reviews of safety-related activities independent of the operating organization, and reviews and assessments of facility activities by an independent group. The staff has reviewed the provisions for these reviews with respect to organizational provisions, qualification requirements of those performing the review, and subject matter to be reviewed. The staff finds that the applicant's program for the review and audit of operational activities is acceptable.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.6
FACILITY ADMINISTRATIVE AND OPERATING PROCEDURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Operations Engineer

1.2 Secondary - Health Physicist

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review (1) the administrative procedures that provide control over activities that are important to the safe operation of the facility and (2) the operating procedures that ensure that activities under routine operating, abnormal, and emergency conditions will be conducted in a safe manner. In general, detailed written procedures do not have to be included in the SAR. However, the applicant should provide general descriptions of the nature and control of the procedures given in the following sections.

2.1 Administrative Procedures

(1) procedures for review and approval

(2) equipment control procedures

(3) procedures pertaining to control of maintenance and modifications

(4) emergency planning procedures

(5) temporary changes to procedures

(6) procedures pertaining to standard orders to facility personnel, including authority and responsibility of key site personnel (site managers, assistant manager, and site radiological control and safety officer)

(7) training and orientation procedures

(8) procedures pertaining to access to control area(s)

(9) quality assurance/quality control procedures

2.2 Operating Procedures

(1) procedures for systems operation
(2) waste receipt and inspection procedures
(3) waste handling, storage, and disposal procedures
(4) trench design and construction procedures
(5) vehicle survey and release procedures
(6) abnormal, temporary, and emergency procedures
(7) instrument calibration and test procedures
(8) facility maintenance procedures
(9) environmental monitoring, sampling, and testing procedures

Because most of the information in this portion of the SAR is related directly to other portions, the LLOB staff will coordinate the evaluations specified herein with evaluations of other portions of the SAR as they relate to site administrative and operating procedures.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on facility administrative and operating procedures in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

To evaluate most of the information, the staff must use informed judgment based on experience, site visits to similar facilities, and discussions with the applicant to make a qualitative determination of the adequacy of the procedures provided by the applicant.

Where feasible and necessary to make its determinations, the staff will "walk through" specific procedures with the applicant.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is:

> 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," as it relates to administrative and operating procedures contributing to the determination that the applicant is technically qualified to engage in licensed activities

4.2 Regulatory Guidance

There are currently no regulatory guides that apply to facility administrative and operating procedures for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

There are currently no evaluation criteria pertaining to this SRP.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the administrative and operating procedures for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.6.

The staff concludes that the administrative and operating procedures described by the applicant are acceptable and contribute to meeting the applicable requirements of 10 CFR 61.

The applicant has described the program and the procedures that provide administrative controls over activities important to safety.

The applicant has described the operating procedures that provide assurance that operations under routine, abnormal, and emergency conditions will be conducted in a safe manner.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCE

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Control of a License Application for a Low-Level Radioactive Waste Disposal Facility, Rev. 2, January 1991.

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LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 8.7
PHYSICAL SECURITY

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Operations Engineer

1.2 Secondary - Health Physicist, Security Specialist

1.3 Support - None

2. AREAS OF REVIEW

The staff will review the plans for implementing security measures relating to the layout of the facility and other design features and equipment arrangements intended to provide protection of nuclear materials against theft, tampering, or radiological sabotage.

The staff will evaluate the physical security plan, which describes a comprehensive physical security program for the facility. The review will encompass the physical security organization, access controls to the facility, means of detecting unauthorized intrusion, provisions for monitoring access to controlled areas, communication systems related to security, intrusion alarm systems, arrangements with law enforcement authorities to provide assistance in responding to security threats, and the implementation schedule for the physical security program.

The staff will review

(1) diagrams, to approximate scale, displaying the following:

  (a) location of alarm stations

  (b) location of access control points to controlled areas

  (c) location of relevant law enforcement agencies and their geographical jurisdictions

  (d) interaction of the plant operations staff with the security staff

(2) the response capabilities of local law enforcement agencies during nonoperational hours

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on physical security in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review the general facility description and site-related information to determine if there are unique features that should be considered in establishing the physical security program. At this stage, it is desirable that the staff discuss the formulation of this program with the applicant.

The staff will review the physical security plan to determine its conformance with the regulations and criteria of this SRP. It will use as checklists the requirements and recommendations of industry standards for such devices as fences, gates, and locks. Site visits are not mandatory, but may be appropriate where siting and design anomalies introduce unique security problems.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are:

(1) 10 CFR 61.12, "Specific Technical Information," (m), as it relates to a description of the administrative procedures that the applicant will apply to control activities at the facility

(2) 10 CFR 61.16, "Other Information," (a), as it relates to additional information on physical security measures

(3) 10 CFR 73.67, "Licensee Fixed Site and In-Transit Requirements for the Physical Protection of Special Nuclear Material of Moderate and Low Strategic Significance," (f), as it relates to special nuclear material of low strategic significance at fixed sites

4.2 Regulatory Guidance

There are no regulatory guides that apply to physical security for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

Evaluation criteria pertaining to this SRP are:

(1) Access Requirements

The applicant should control all points of personnel and vehicle access into controlled radiological areas. All individuals should be identified, and authorization should be checked.

(2) Testing and Maintenance

The applicant should test and maintain intrusion alarms, communication equipment, and other security-related equipment and should maintain passive security devices.

(3) Response Requirements

The applicant should provide a liaison with local law enforcement authorities to provide additional security during nonworking hours

The physical security program should be implemented 1 to 2 months before fuel loading. Security features required for new fuel in storage before loading of the first unit should be implemented as soon as fuel is on site.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the requirements and guidance of this SRP and to be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the physical security plan for [name of facility] low-level waste disposal facility according to Standard Review Plan 8.7.

The applicant has submitted a comprehensive physical security plan for the protection of the facility against potential acts of vandalism, theft, or sabotage.

The staff has reviewed this plan and finds that it contains all the features considered essential for such a program and is, therefore, acceptable. In particular, it complies with the Commission's regulations including 10 CFR 61.12(m), 10 CFR 61.16(a), and 10 CFR 73.67(f).

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 9.1
QUALITY ASSURANCE* DURING THE DESIGN, CONSTRUCTION, AND OPERATION

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Quality Assurance Engineer

1.2 Secondary - Others as Needed

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will review the areas of the SAR given in the following sections as they pertain to the quality assurance (QA) program during the design, construction, and operations phase of the facility. The applicant's QA program description in the SAR should describe the management systems, assignments of responsibility and the organizational structure to accomplish the performance objectives (10 CFR Part 61). A well defined QA program description is the first important step to prevent recurrence of the kind of problems reported in the Ford Amendment Study (NUREG-1055) which reported on quality problems in nuclear power plants. The second important step is, of course, proper implementation of the planned QA program. The staff in its critical review of the QA program description presented in the application should be aware of the root causes of problems reported in the Ford Amendment Study and offer constructive criticism where it appears the same mistakes could be repeated by the applicant.

2.1 Organization

(1) organizational description and charts of the lines, interrelationships, and areas of responsibility and authority for all organizations performing quality-related activities, including the applicant's organization and principal contractors (architect/engineer, constructor, and construction manager when other than the constructor)

(2) organizational location, degree of independence from the performing organization, and authority of the individuals assigned the responsibility for performing QA functions

*see footnote page 9.1-5

(3) organizational provisions for ensuring the proper implementation of the QA program

2.2 Quality Assurance Program

(1) scope of the QA program

(2) provisions to ensure proper definition of the QA program

(3) programmatic provisions to ensure proper implementation of the QA program

(4) provisions to ensure the adequacy of personnel qualifications

2.3 Design Control

(1) scope of the QA program for design activities

(2) organizational structure, activity, and responsibility of the individuals or groups responsible for all design activities and supporting analysis

(3) provisions to carry out design activities in a planned, controlled, and orderly manner

(4) provisions to verify or check the technical adequacy of design documents including documentation of all computer codes

(5) provisions to control design changes

2.4 Procurement Document Control

(1) provisions to ensure that applicable regulatory requirements, technical requirements, and QA program requirements are included or referenced in procurement documents

(2) provisions for the review and approval of procurement documents

2.5 Instructions, Procedures, and Drawings

(1) provisions for ensuring that activities affecting quality are prescribed by and accomplished in accordance with documented instructions, procedures, or drawings

(2) provisions for including quantitative and qualitative acceptance criteria in instructions, procedures, and drawings

2.6 Document Control

(1) provisions to ensure that documents, including changes, are reviewed for adequacy, approved for release by authorized personnel, and distributed and used at the location where the prescribed activity is performed

(2) provisions to prevent the inadvertent use of obsolete or superseded documents

2.7 Control of Purchased Material, Equipment, and Services

(1) provisions for the control of purchased material, equipment, and services; for the selection of suppliers; and for the assessment of quality

(2) provisions to ensure that documented evidence of the conformance of material and equipment to procurement requirements is available at the plant site before installation or use

2.8 Identification and Control of Materials, Parts, and Components

(1) provisions to identify and control materials, parts, and components

(2) provisions to ensure that incorrect or defective items are not used

2.9 Control of Special Processes

(1) provisions to ensure the acceptability of special processes such as welding, heat treating, nondestructive testing, and chemical cleaning

(2) provisions to ensure that special processes are performed by qualified personnel using qualified procedures and equipment

2.10 Inspection

(1) provisions for the inspection of activities affecting quality, including the items and activities to be covered

(2) organizational responsibilities and qualifications established for individuals or groups performing inspections

(3) prerequisites to be provided in the written inspection procedures with provisions for documenting and evaluating inspection results

2.11 Test Control

(1) provisions for tests that ensure that structures, systems, and components will perform satisfactorily in service

(2) prerequisites to be provided in written test procedures with provisions for documenting and evaluating test results

(3) personnel qualification programs established for test personnel

2.12 Control of Measuring and Test Equipment

(1) provisions to ensure that tools, gauges, instruments, and other measuring and testing devices are properly identified, controlled, calibrated, and adjusted at specified intervals

2.13 Handling, Storage, and Shipping

(1) provisions to control the handling, storage, shipping, cleaning, and preservation of items in accordance with work and inspection instructions to

prevent damage, loss, and deterioration caused by environmental conditions such as temperature or humidity

2.14 Inspection, Test, and Operating Status

(1) provisions to indicate the inspection, test, and operating status of items to prevent inadvertent use or bypassing of inspections and tests

2.15 Nonconforming Materials, Parts, or Components

(1) provisions to control the use or disposition of nonconforming materials, parts, or components

2.16 Corrective Action

(1) provisions to ensure that conditions adverse to quality are promptly identified and corrected and that measures are taken to preclude repetition

2.17 Quality Assurance Records

(1) provisions for the identification, retention, retrieval, and maintenance of records that furnish evidence of activities affecting quality

2.18 Audits

(1) provisions for audits to verify compliance with all aspects of the QA program and to determine the effectiveness of the QA program

(2) responsibilities and procedures for auditing, documenting, and reviewing audit results and designating management levels to review and assess audit results

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review the application to assess the adequacy of the applicant's quality assurance (QA) program. The staff will use the guidance provided in NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," and this SRP as criteria to measure the adequacy of the applicant's QA program. The staff review should not only determine that the criteria outlined in NUREG-1199 and this SRP are addressed, but also determine that the QA program is designed to put in place management systems to ensure the requirements of 10 CFR Part 61 are accomplished.

3.2 Safety Evaluation

The staff will review each element of the QA program description against the acceptance criteria in Section 4.3. The staff's judgment during the review is to be based on an assessment of the material presented. The staff review should also determine if the applicant has adequately planned the work to be accomplished and whether necessary policies, procedures and instructions will be in place before work starts. The review should determine if "quality achieving" and "quality assuring" responsibilities are clearly assigned and

that the activities of both are well integrated such that the QA program is an integral part of the everyday work activities. The staff review should determine if the applicant will be able to monitor the effectiveness of the QA program implementation and make needed adjustments on a timely basis. The staff is to look for and measure the effectiveness of the QA program design, not just look for the existence of its elements.

Changes to the QA program will be evaluated to ensure at a minimum that such changes have not degraded the previously approved program. Consideration should be given to the current regulatory position in the area of the change in determining acceptability of the change.

4. ACCEPTANCE CRITERIA*

4.1 Regulatory Requirements

The regulation applicable to the areas of review of this SRP are

(1) 10 CFR 61.12, "Contents of Applications; Technical Information," 61.12(j), as it relates to a QA program description in the Safety Analysis Report

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in addressing the guidelines in Section 4.1 is provided in the following documents:

NUREG-1293, "Quality Assurance Guidance for a Low-Level Radioactive Waste Proposal Facility," Draft November 1987.

4.3 Regulatory Evaluation Criteria

The applicant (and its principal contractors such as the architect/engineer, constructor, and construction manager) must establish a QA program for the design, construction, and operations. The applicant's QA program (including that of its principal contractors) must describe in the SAR how each criterion will be met. The criteria used to evaluate this QA program are listed in Sections 4.3.1 through 4.3.18 of this SRP. The criteria include a commitment to comply with the regulations and NUREG-1293. Thus, the commitment constitutes an integral part of the QA program description and requirements. Exceptions

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*At the current time quality assurance is not a regulatory requirement related to licensing a low-level waste disposal facility. In the promulgation of the final rule, 10 CFR Part 61, quality assurance was inadvertently omitted from 10 CFR 61.12(j). Since the word changes to the final 10 CFR 61.12(j) were unintentional, the staff proposes a rulemaking action to change the terminology back to "quality assurance" as contained in the Part 61 regulation as originally proposed.

NOTE: ON JULY 22, 1993, 10 CFR 61 WAS MODIFIED TO REQUIRE QUALITY ASSURANCE. THIS SRP CHAPTER WILL BE UPDATED IN REVISION 4 TO REFLECT THIS CHANGE.

Standard Review Plan 9.1 is developed in recognition of the fact that implementation of an adequate quality assurance program is an acceptable method of addressing the quality control requirement of 10 CFR 61.12(j).

and alternatives to the criteria may be adopted by the applicant provided adequate justification is given; the review allows for considerable flexibility in defining methods and controls while still satisfying pertinent regulations. When the QA program description meets the criteria of this SRP or provides acceptable exceptions or alternatives, the program is considered to be in compliance.

The staff will ascertain if the commitments and the description of how the commitments are implemented, to the extent necessary, are objective and stated in inspectable terms.

4.3.1 Organization*

The organizational elements responsible for the QA program are acceptable if:

(1.1) The responsibility for the overall program is retained and exercised by the applicant.

(1.2) The applicant identifies and describes the major delegation of work involved in establishing and implementing the QA program or any part thereof to other organizations.

(1.3) When major portions of the applicant's program are delegated:

(a) The applicant describes how responsibility is exercised for the overall program. The extent of management supervision should be given, including the location, qualifications, and criteria for determining the number of personnel performing these functions.

(b) The applicant evaluates the performance of work by the delegated organization (frequency and method are stated - once per year although a longer cycle is acceptable with other evaluations of individual elements).

(c) Qualified individual(s) or organizational element(s) is (are) identified within the applicant's organization as responsible for the quality of the delegated work before activities are started.

(1.4) Clear management controls and effective lines of communication exist for QA activities among the applicant and the principal contractors to ensure direction of the QA program.

(1.5) Organization charts clearly identify all the onsite and offsite organizational elements that function under the purview of the QA program (such as design, engineering, procurement, manufacturing, construction, inspection, testing, instrumentation, control, operation, and maintenance), the lines of responsibility, and the criteria for determining the size of the QA organization including the inspection staff.

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

(1.6) The applicant (and principal contractors) describes the QA responsibilities of each of the organizational elements noted on the organization charts.

(2.1) The applicant (and principal contractors) identifies a management position that retains overall authority and responsibility for the QA program (normally, this position is filled by the QA Manager), and this position has the following characteristics:

(a) The position is the same as or is at a higher organization level than the position of the highest line manager directly responsible for performing activities affecting quality (such as engineering, procurement, construction, and operation) and is sufficiently independent from cost and schedule restraints.

(b) The person in the position has effective communication channels with other senior management personnel.

(c) The person in the position has responsibility for approval of QA manual(s).

(d) The person in the position has no other duties or responsibilities unrelated to quality assurance that would divert his/her full attention to QA matters.

(2.2) Conformance to established requirements (except for designs, see item (5.2) in Section 4.3.3 of this SRP) is verified by individuals or groups within the QA organization who do not have direct responsibility for performing the work being verified or by individuals or groups trained and qualified in QA concepts and practices and independent of the organization responsible for performing the task.

(2.3) Persons and organizations performing QA functions have direct access to management levels, which will ensure the capability to:

(a) identify quality problems

(b) initiate, recommend, or provide solutions through designated channels

(c) verify implementation of solutions

Those persons and organizations with the above authority are identified, and a description of how the above actions are carried out is provided.

(2.4) When unsatisfactory work has to be stopped, the following provisions apply:

(a) Designated QA personnel, sufficiently free from direct pressures resulting from cost and schedule, have the responsibility, delineated in writing, to stop unsatisfactory work and control further processing, delivery, or installation of nonconforming material.

(b) The organizational positions with stop-work authority are identified.

(2.5) Provisions are established for the resolution of disputes involving quality arising from a difference of opinion between QA personnel and other department (engineering, procurement, manufacturing, etc.) personnel.

(2.6) Designated QA individuals are involved in day-to-day activities important to the accomplishment of the performance objectives (i.e., the QA organization staff members routinely attend and participate in status meetings to ensure they are kept abreast of day-to-day work and that there is adequate QA coverage).

(3.1) Policies regarding the implementation of the QA program are documented and made mandatory. These policies are established at the Corporate President or Vice President level.

(3.2) The position description (see item (2.1) in Section 4.3.1 of this SRP) ensures that the individual directly responsible for the definition, direction, and effectiveness of the overall QA program has sufficient authority to effectively implement responsibilities. This position is to be sufficiently free from cost and schedule responsibilities. Qualification requirements for this individual are established in a position description that includes the following prerequisites:

(a) management experience through assignments to responsible positions

(b) knowledge of QA regulations, policies, practices, and standards

(c) experience in performing QA or QA-related activities in design, construction, or operation or in a low-level waste facility or similar high technology industry

(3.3) The person responsible for the onsite QA program is identified by position and has the appropriate organizational position, responsibilities, and authority to exercise proper control over the QA program. This individual is free from non-QA-related duties and can thus give full attention to ensuring that the QA program at the plant site is being effectively implemented.

4.3.2 Quality Assurance Program*

Activities related to the quality assurance program are acceptable if:

(1.1) The scope of the QA program includes:

(a) a commitment that activities affecting the quality of design, construction and operation will be subject to the applicable controls

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

of the QA program and activities covered by the QA program are identified on program defining documents.

(b) a commitment that the test program will be conducted in accordance with the QA program and a description of how the QA program will be applied

(c) a commitment that the computer code programs will be developed, controlled, and used in accordance with the QA program, and a description of how the QA program will be applied

(d) a commitment that special equipment, environmental conditions, skills, or processes will be provided as necessary to ensure the accomplishment of performance objectives.

(1.2) A brief summary of the company's corporate QA policies is given.

(2.1) The following provisions are established to ensure that quality-affecting procedures required to implement the QA program are consistent with QA program commitments and corporate policies and are properly documented, controlled, and made mandatory through a policy statement or equivalent document signed by the responsible official:

(a) The QA organization reviews and documents concurrence in these quality-affecting procedures.

(b) The organizational group or individual responsible for the policy statement is identified.

(c) The quality-affecting procedural controls of the principal contractors are provided for the applicant's review with documented agreement of acceptance before the initiation of activities affected by the program.

(2.2) Provisions are included for notifying NRC of changes (a) for review and acceptance in the accepted description of the QA program as presented or referenced in the SAR before implementation and (b) in organizational elements within 30 days after the announcement of the changes. (Note: Editorial changes or personnel reassignments of a nonsubstantive nature do not require NRC notification.)

(2.3) The QA organization and the necessary technical organizations participate early in the QA program definition stage to determine and identify the extent QA controls are to be applied to specific design and construction activities. This effort involves applying a deferred, graded approach to certain activities in accordance with importance to the design and construction and operational results.

(2.4) A description is provided that emphasizes how the detailed QA program description, particularly that pertaining to the 10 CFR Part 61 regulations will be properly implemented and carried out.

(3.1) A description is provided of how management (above or outside the QA organization) regularly assesses the scope, status, adequacy, and compliance of the QA program. These measures should include:

(a) frequent appraisal of program status through reports, meetings, and/or audits

(b) performance of an annual assessment preplanned and documented and identification and tracking of corrective action

(3.2) The QA organization and the necessary technical organizations participate early in the QA program definition stage to determine and identify the extent QA controls are to be applied to specific structures, systems and components. This effort involves applying a defined, graded approach to certain structures, systems and components in accordance with their importance to the accomplishment of the performance objectives of 10 CFR Part 61.

(3.3) A summary description is provided on how responsibilities and control of quality-related activities are transferred from the principal contractors to the applicant during the phaseout of design and construction and facility turnover.

(4) Indoctrination, training, and qualification programs are established so that:

(a) Personnel responsible for performing activities affecting quality are instructed as to the purpose, scope, and implementation of the quality-related manuals, instructions, and procedures.

(b) Personnel verifying activities affecting quality are trained and qualified in the principles, techniques, and requirements of the activity being performed.

(c) For formal training and qualification programs, documentation includes the objective and content of the program, attendees, and date of attendance.

(d) Proficiency tests are given to those personnel performing and verifying activities affecting quality, and acceptance criteria are developed to determine if individuals are properly trained and qualified.

(e) Certificate of qualifications clearly delineates (i) the specific functions personnel are qualified to perform and (ii) the criteria used to qualify personnel in each function.

(f) Proficiency of personnel performing and verifying activities affecting quality is maintained by retraining, reexamining, and/or recertifying as determined by management or program commitment.

4.3.3 Design Controls*

Activities related to design control are acceptable if:

(1) The scope of the design control program includes design activities associated with the preparation and review of design documents including the correct translation of applicable regulatory requirements and design bases into design, procurement and procedural documents. Included in the scope are field design engineering; physics, seismic, stress, thermal, and geotechnical, associated computer programs; compatibility of materials; accessibility for inservice inspection, maintenance, and repair; quality standards; etc.

(2) Organizational responsibilities are described for preparing, reviewing, approving, and verifying design documents such as system descriptions, design input and criteria, design drawings, design analyses, computer programs, specifications, and procedures.

(3.1) Organizational responsibilities are described for planning and conducting site characterization, including reviewing, approving and verifying analyses and conclusions.

(3.2) Errors and deficiencies in approved design documents, including design methods (such as computer codes), that could adversely affect structures, systems, and components performance are documented; and action is taken to ensure that all errors and deficiencies are corrected.

(3.3) Deviations from specified quality standards are identified, and procedures are established to ensure their control.

(4.1) Internal and external design interface controls, procedures, and lines of communication among participating design organizations and across technical disciplines are established and described for the review, approval, release, distribution, and revision of documents involving design interfaces to ensure structures, systems, and components are compatible geometrically and functionally.

(4.2) Procedures are established and described requiring documented verification of the dimensional accuracy and completeness of design drawings and specifications.

(4.3) Procedures are established and described requiring that design drawings and specifications be reviewed by the QA organization to ensure that the documents are prepared, reviewed, and approved in accordance with company procedures and that the documents contain the necessary QA requirements such as inspection and test requirements, acceptance requirements, and those pertaining to the extent of documenting inspection and test results.

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*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

(4.4) Guidelines or criteria are established and described for determining the method of design verification (design review, alternate calculations, or test).

(4.5) Procedures are established and described for design verification activities that ensure the following:

(a) The verifier is qualified, and neither the verifier nor his/her immediate supervisor is directly responsible for the design. In exceptional circumstances, the designer's immediate supervisor can perform the verification provided

- The supervisor is the only technically qualified individual.
- The need is individually documented and approved in advance by the supervisor's management.
- QA audits cover frequency and effectiveness of the use of supervisors as design verifiers to guard against abuse.

(b) Design verification, if other than by qualification testing of a prototype or lead production unit, is completed prior to release of procurement, manufacturing, or construction to another organization for use in other design activities. When this schedule cannot be met, the design verification may be deferred, provided the justification for this action is documented and the unverified portion of the design output document and all design output documents, based on the unverified data, are appropriately identified and controlled. Construction site activities associated with a design or design change should not proceed without verification past the point where the installation would become irreversible (i.e., require extensive demolition and rework).

(c) Procedural control is established for design documents that reflect the commitments of the SAR; this control differentiates between documents that undergo formal design verification by interdisciplinary or multiorganizational teams and those that can be reviewed by a single individual (a signature and date is acceptable documentation for personnel certification). Design documents subject to procedural control include, but are not limited to, specifications, calculations, computer programs, system descriptions, and drawings including flow diagrams, piping and instrument diagrams, control logic diagrams, electrical single-line diagrams, diagrams of structural systems for major facilities, site arrangements, and equipment locations. Specialized reviews should be used when uniqueness or special design considerations warrant them.

(d) The responsibilities of the verifier, the areas and features to be verified, the pertinent considerations to be verified, and the extent of documentation are identified in procedures.

(4.6) The following provisions are included if the verification method is only by test:

(a) Procedures provide criteria that specify when verification should be by test.

(b) Prototype, component, or feature testing is performed as early as possible before installation of plant equipment or before the installation would become irreversible.

(c) Verification by test is performed under conditions that simulate the most adverse design conditions as determined by analysis.

(4.7) Procedures are established to ensure that verified computer codes are certified for use and that their use is specified.

(5.1) Design and specification changes, including fields changes, are subject to the same design controls that were applicable to the original design.

4.3.4 Procurement Document Control*

Activities related to procurement document control are acceptable if:

(1.1) Procedures are established for the review of procurement documents to determine that quality requirements are correctly stated, inspectable, and controllable; there are adequate acceptance and rejection criteria, and procurement documents have been prepared, reviewed, and approved in accordance with QA program requirements. To the extent necessary, procurement documents should require that contractors and subcontractors provide an acceptable QA program. The review and documented concurrence of the adequacy of quality requirements stated in procurement documents are performed by independent personnel trained and qualified in QA practices and concepts.

(1.2) Procedures are established to ensure that procurement documents identify applicable regulatory, technical, administrative, and reporting requirements; drawings; specifications; codes and industrial standards; test and inspection requirements; and special process instructions that must be complied with by suppliers.

(2.1) Organizational responsibilities are described for (a) procurement planning; (b) the preparation, review, approval, and control of procurement documents; (c) supplier selection; (d) bid evaluations; and (e) the review of and concurrence in supplier QA programs before initiation of activities affected by the program. The involvement of the QA organization is described.

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

4.3.5 Instructions, Procedures, and Drawings*

Activities related to instructions, procedures, and drawings are acceptable if:

(1) Organizational responsibilities are described for ensuring that activities affecting quality are (a) prescribed by documented instructions, procedures, and drawings and (b) accomplished through implementation of these documents.

(2) Procedures are established to ensure that instructions, procedures, and drawings include quantitative acceptance criteria (such as those pertaining to dimensions, tolerances, and operating limits) and qualitative acceptance criteria (such as workmanship samples) for determining that important activities have been satisfactorily performed.

4.3.6 Document Control*

Activities related to document control are acceptable if:

(1.1) The scope of the document control program is described, and the types of controlled documents are identified. As a minimum, controlled documents include

(a) design documents (e.g., calculations, drawings, specifications, and analyses) including documents related to computer codes

(b) procurement documents

(c) instructions and procedures for such activities as fabrication, construction modification, installation, testing, and inspection

(d) documents pertaining to as-built conditions

(e) quality assurance and quality control manuals and quality-affecting procedures

(f) technical reports

(1.2) Procedures for the review, approval, and issuance of documents and changes thereto are established and described to ensure technical adequacy and inclusion of appropriate quality requirements before implementation. The QA organization, or an individual other than the person who generated the document but who is qualified in quality assurance, reviews and concurs in these documents with regard to QA-related aspects.

(1.3) Procedures are established to ensure that changes to documents are reviewed and approved by the same organizations as those that performed

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

the initial review and approval or by other qualified responsible organizations delegated by the applicant.

(1.4) Procedures are established to ensure that documents are available at the location where the activity will be performed prior to commencing work.

(2.1) Procedures are established and described to ensure that obsolete or superseded documents are removed and replaced by applicable revisions in work areas in a timely manner.

(2.2) A master list or equivalent document control system is established to identify the current revision of instructions, procedures, specifications, drawings, and procurement documents. When such a list is used, it should be updated and distributed to predetermined responsible personnel.

(3) Procedures are established and described to provide for the preparation of drawings pertaining to as-built conditions and related documentation in a timely manner to accurately reflect the actual design.

4.3.7 Control of Purchased Material, Equipment, and Services*

Activities related to the control of purchased material, equipment, and services are acceptable if:

(1.1) Organizational responsibilities are described for the control of purchased material, equipment, and services, including interactions between design, procurement, and QA organizations.

(1.2) Verification of suppliers' activities during fabrication, inspection, testing, and shipment of materials, equipment, and components is planned and performed with QA organization participation in accordance with written procedures to ensure conformance to the purchase order requirements. The procedures, as applicable to the method of procurement, provide for

(a) the specification of the characteristics or processes to be witnessed, inspected or verified, and accepted; the method of surveillance and the extent of documentation required; and the personnel responsible for implementing these procedures

(b) audits, surveillance, or inspections that ensure that the supplier complies with the quality requirements

(1.3) Procurement of spare or replacement parts for structures, systems, and components important to safety is subject to present QA program controls, to codes and standards, and to technical requirements equal to or better than the original technical requirements, or as required to prevent the procurement of defective parts.

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*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

(1.4) Selection of suppliers is documented and filed. If the "CASE" register is used to establish the qualifications of the supplier, the documentation should identify the "audit" used.

(2.1) The material, component, or equipment is inspected when it is received to ensure:

(a) The material, component, or equipment is properly identified and corresponds to the identification on the purchase document and the documentation when the item is received.

(b) The material, components, equipment, and acceptance records satisfy the inspection instructions before installation or use of the item.

(c) Specified inspection, test, and other records (such as certificates of conformance attesting that the material, components, and equipment conform to specified requirements) are available at the facility before installation or use of the item.

(2.2) Items accepted and released are identified as to their inspection status before they are forwarded to a controlled storage area or released for installation or further work.

(2.3) The supplier furnishes the following records to the purchaser:

(a) documentation that identifies the purchased item and the specific procurement requirements (e.g., codes, standards, and specifications) met by the item

(b) documentation that identifies any procurement requirements that have not been met

(c) a description of those items that do not conform to the procurement requirements and that are designated "accept as is" or "repair"

The review and acceptance of these documents should be described in the purchaser's QA program.

(2.4) For commercial "off-the-shelf" items where specific QA controls appropriate for nuclear applications cannot be imposed in a practicable manner, special quality verification requirements shall be established and described to ensure that an acceptable item has been received by the purchaser.

(2.5) Supplier's certificates of conformance are periodically evaluated by audits, independent inspections, or tests to ensure they are valid and the results are documented.

4.3.8 Identification and Control of Materials, Parts, and Components*

Activities related to the identification and control of materials, parts, and components are acceptable if:

(1) Controls are established and described to identify and control materials (including consumable material), parts, and components including partially fabricated subassemblies. The description should include organizational responsibilities.

(2.1) Procedures are established that ensure that identification is maintained either on the item or on records traceable to the item to preclude use of incorrect or defective items.

(2.2) Identification of materials and parts important to the function of structures, systems, and components important to safety can be traced to the appropriate documentation such as drawings, specifications, purchase orders, manufacturing and inspection documents, deviation reports, and physical and chemical mill test reports.

(2.3) Correct identification of material, parts, and components is verified and documented before they are released for fabrication, assembling, shipping, and installation.

4.3.9 Control of Special Processes*

Activities related to control of special processes are acceptable if:

(1.1) Organizational responsibilities including those for the QA organization are described for the qualification of special processes, equipment, and personnel.

(1.2) Procedures are established for recording evidence of acceptable accomplishment of special processes using qualified procedures, equipment, and personnel.

(2) Qualification records of procedures, equipment, and personnel associated with special processes are established, filed, and kept current.

4.3.10 Inspection*

Activities related to inspection are acceptable if:

(1) The scope of the inspection program is described that indicates an effective inspection program has been established. Program procedures provide criteria for determining the accuracy requirements of inspection equipment and criteria for determining when inspections are required or for defining how and when inspections are performed. The QA organization participates in the above functions.

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*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

(2.1) Organizational responsibilities for inspection are described. Individuals performing inspections are other than those who performed or directly supervised the activity being inspected and do not report directly to the immediate supervisors who are responsible for the activity being inspected. If the individuals performing inspections are not part of the QA organization, the inspection procedures, personnel qualification criteria, and independence from undue pressure such as cost and schedule should be reviewed and found acceptable by the QA organization before the initiation of the activity.

(2.2) A qualification program for inspectors is established and documented, and the qualifications and certifications of inspectors are kept current

(3.1) Inspection procedures, instructions, or checklists provide for the following:

(a) identification of characteristics and activities to be inspected

(b) a description of the method of inspection

(c) identification of the individuals or groups responsible for performing the inspection in accordance with the provisions of item (2.1) in this section

(d) acceptance and rejection criteria

(e) identification of required procedures, drawings, and specifications and revisions

(f) recording inspector or data recorder and the results of the inspection operation

(g) specification of the necessary measuring and test equipment including accuracy requirements

(3.2) Procedures are established and described to identify, in pertinent documents, mandatory inspection hold points beyond which work may not proceed until it is inspected by a designated inspector.

(3.3) Inspection results are documented and evaluated and their acceptability is determined by a responsible individual or group.

4.3.11 Test Control*

Activities related to test control are acceptable if:

(1.1) The description of the scope of the test control program indicates an effective test program has been established for tests including proof tests before installation and preoperational tests. Program procedures

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

provide criteria for determining the accuracy requirements of test equipment and criteria for determining when a test is required or how and when testing activities are performed.

(1.2) The applicant describes the measures that establish a test program that identifies all testing required to demonstrate that the intrinsic characteristics of the site's geologic, hydrologic and geochemical environment are capable of providing long-term isolation to meet the requirements of 10 CFR Part 61.

(2.1) Test procedures or instructions provide, as required, for the following:

(a) the requirements and acceptance limits in applicable design and procurement documents

(b) instructions for performing the test

(c) test prerequisites such as calibrated instrumentation, adequate test equipment and instrumentation including their accuracy requirements, completeness of item to be tested, suitable and controlled environmental conditions, and provisions for data collection and storage

(d) mandatory inspection hold points for witness by owner, contractor, or inspector (as required)

(e) acceptance and rejection criteria

(f) methods of documenting or recording test data and results

(g) provisions for ensuring test prerequisites have been met

(2.2) Test results are documented and evaluated and their acceptability is determined by a responsible individual or group.

(3) A qualification program is established and documented for those individual conducting the tests and certification of those individuals performing the tests are kept current.

4.3.12 Control of Measuring and Test Equipment*

Activities related to the control of measuring and test equipment are acceptable if:

(1.1) The scope of the program for the control of measuring and test equipment is described and the types of equipment to be controlled are established. This information indicates an effective calibration and adjustment program has been established.

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

(1.2) QA and other organizations' responsibilities are described for establishing, implementing, and ensuring effectiveness of the calibration and adjustment program.

(1.3) Procedures are established and described for calibration (technique and frequency), maintenance, and control of the measuring and test equipment (instruments, tools, gauges, fixtures, reference and transfer standards, and nondestructive test equipment) that is used in the measurement, inspection, and monitoring of structures, systems, and components. The review of and documented concurrence in these procedures is described, and the organization responsible for these functions is identified.

(1.4) Measuring and test equipment is identified and traceable to the calibration test data.

(1.5) Measuring and test equipment is labeled or tagged or "otherwise controlled" to indicate due date of the next calibration. The method to "otherwise control" equipment should be described.

(1.6) Measuring and test equipment is calibrated at specified intervals on the basis of the required accuracy, purpose, degree of usage, stability characteristics, and other conditions affecting the measurement. This equipment is calibrated against standards that have an accuracy of at least four times the required accuracy of the equipment being calibrated or, when this is not possible, have an accuracy that ensures the equipment being calibrated is within required tolerance, and the basis of acceptance is documented and authorized by responsible management. The management authorized to perform this function is identified.

(1.7) Calibrating standards have greater accuracy than standards being calibrated. Calibrating standards with the same accuracy may be used if they can be shown to be adequate to meet the requirements, and the basis of acceptance is documented and authorized by a responsible member of the management staff. The management staff member authorized to perform this function is identified.

(1.8) Reference and transfer standards are traceable to nationally recognized standards; where national standards do not exist, provisions are established to document the basis for calibration.

(1.9) Measurements are taken and documented to determine the validity of previous inspections and the acceptability of items inspected or tested since the last calibration when measuring and test equipment is found to be out of calibration. Inspections or tests are repeated on items determined to be suspect.

4.3.13 Handling, Storage, and Shipping*

Activities related to handling, storage, and shipping are acceptable if:

(1.1) Special handling, preservation, storage, cleaning, packaging, and shipping requirements are established and implemented by suitably trained individuals in accordance with predetermined work and inspection instructions.

(1.2) Procedures are established and described to control the cleaning, handling, storage, packaging, and shipping of materials, components, and systems in accordance with design and procedure requirements to preclude damage, loss, or deterioration caused by environmental conditions such as temperature or humidity.

4.3.14 Inspection, Test, and Operating Status*

Activities related to inspection, test, and operating status are acceptable if:

(1.1) Procedures are established to indicate the inspection, test, and operating status of structures, systems, and components throughout fabrication, installation, and testing.

(1.2) Procedures are established and described to control the application and removal of inspection and welding stamps and status indicators such as tags, markings, labels, and stamps.

(1.3) Procedures are established and described to control the alteration of the sequence of required tests, inspections, and other operations important to safety. Such actions should be subject to the same controls as those for the original review and approval.

(1.4) The status of nonconforming, inoperative, or malfunctioning structures, systems, and components is documented and identified to prevent inadvertent use. The organization responsible for this function is identified.

4.3.15 Nonconforming Materials, Parts, or Components*

Activities related to nonconforming materials, parts, or components are acceptable if:

(1.1) Procedures are established and described for the identification, documentation, segregation, review, disposition, and notification to affected organizations of nonconforming materials, parts, or components and as applicable to services (including computer codes) if disposition is other than to scrap. The procedures identify authorized individuals responsible for the independent review of nonconforming items, including their disposition and closeout.

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*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

(1.2) QA and other organizational responsibilities are described for the definition and implementation-of activities related to nonconformance control. This includes identifying those individuals or groups with authority for the disposition of nonconforming items.

(1.3) Documentation identifies the nonconforming item; describes the nonconformance, the disposition of the nonconforming item, and the inspection requirements; and includes signature approval of the disposition. Nonconformances are corrected or resolved before the initiation of the preoperational test program on the item.

(1.4) Reworked, repaired, and replacement items are inspected and tested in accordance with the original inspection and test requirements or acceptable alternatives.

(1.5) Nonconformance reports are periodically analyzed by the QA organization to show quality trends, and the significant results are reported to upper management for review and assessment.

4.3.16 Corrective Action*

Activities related to corrective action are acceptable if:

(1.1) Procedures are established and described indicating an effective corrective action program has been established. The QA organization reviews and documents concurrence in the procedures.

(1.2) Corrective action is documented and initiated following the determination of a condition adverse to quality (such as nonconformance, failure, malfunction, deficiency, deviation, and defective material and equipment) to preclude recurrence. The QA organization is included in the concurrence chain regarding the adequacy of the corrective action.

(1.3) Followup action is taken by the QA organization to verify proper implementation of corrective action and to close out the corrective action in a timely manner.

(1.4) Significant conditions adverse to quality, the cause of the conditions, and the corrective action taken to preclude repetition are documented and reported to immediate management and upper levels of management for review and assessment.

4.3.17 Quality Assurance Records*

Activities related to quality assurance records are acceptable if:

(1.1) The scope of the records program is described. QA records include results of reviews, inspections, tests, audits, and material analyses;

*The designation for each criterion in this section is related to the designation for each area of review listed in the corresponding section in Section 2.

monitoring records of work performance; records on the qualification of personnel, procedures, and equipment; and other documentation such as

(1.2) QA and other organizations are identified and their responsibilities are described for the definition and implementation of activities related to QA records.

(1.3) Inspection and test records contain the following where applicable:

(a) a description of the type of observation
(b) the date and results of the inspection or test
(c) information on conditions adverse to quality
(d) identification of inspector or data recorder
(e) evidence as to the acceptability of the results
(f) action taken to resolve any discrepancies noted

(1.4) Suitable facilities for the storage of records are described and satisfy the requirements at ANSI/ASME NQA-1. Alternatives to the fire protection rating provisions are acceptable if records storage facilities conform to National Fire Protection Association Standard NFPA 232, Class 1, for permanent records and if the 2-hour fire-rating requirement contained in proposed ANSI N45.2.9 is met by the applicant in any one of the following three ways: (1) a 2-hour-rated vault meeting NFPA 232, (2) 2-hour-rated file containers meeting NFPA 232 (Class B), or (3) a 2-hour-rated fire-resistant file room meeting NFPA 232 if the following additional provisions are met:

(a) Early warning fire detection and automatic fire suppression should be provided, with electronic supervision at a constantly attended central station.

(b) Records should be stored in fully enclosed metal cabinets. Records should not be permitted on open steel shelving. No storage of records should be permitted on the floor of the facility. Adequate access and aisle ways should be maintained at all times throughout the facility.

(c) Work not directly associated with records storage or retrieval should be prohibited within the records storage facility. Examples of such prohibited activities include, but are not limited to, records reproduction, film developing, and fabrication of microfiche cards.

(d) Smoking, eating, and drinking should be prohibited throughout the records storage facility.

(e) Ventilation, temperature, and humidity control equipment should be protected inside with standard fire-door dampers where they penetrate fire barriers bounding the storage facility.

7. REFERENCES

Essential

American National Standards Institute ANSI NQA-1, "Requirements for

American National Standards Institute/American Nuclear Society, ANSI/ANS 3.1-1978, "Selection and Training of Nuclear Power Plant Personnel," New York.

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

National Fire Protection Association, NFPA 232, "Standard for the Protection of Records." Quincy, MA, 1986.

---, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 2, January 1991.

---, NUREG-1293, "Quality Assurance Guidance for Low-Level Radioactive Waste Disposal Facility," Draft November, 1987.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 10.1
FINANCIAL QUALIFICATIONS OF APPLICANT

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Regulatory Branch (LLRB)

1.2 Supporting - Office of General Counsel (OGC)

2. AREAS OF REVIEW

The staff will review the financial information provided by the applicant to ensure the applicant can demonstrate that it either has the necessary funds or has reasonable assurance of obtaining the funds to cover the estimated costs of conducting all licensed activities over the planned operating life of the project, including costs of construction and disposal as required by 10 CFR 61.61.

The staff will review the following information to ensure that it demonstrates the financial qualifications of the applicant:

(1) a legal description of the applicant (individual, corporation, or public entity)

(2) a description of the applicant's operations from all of its business activities, including those proposed to be conducted under the license

(3) a detailed financing plan

(4) information, if applicable, with regard to parent or holding company activities, U.S. Securities and Exchange Commission (SEC) forms submitted, bond ratings, or involvement in any litigation

3. REVIEW PROCEDURES

The staff will review the financial information to ensure that it demonstrates that the financial qualifications of the applicant are adequate to carry out the activities for which the license is sought.

3.1 Acceptance Review

The staff will review for completeness the information in the SAR on the applicant's financial qualifications in accordance with NUREG-1199 and this SRP.

3.2 Financial Evaluation

The staff will ensure that the information discussed in the following sections has been provided in its review of the financial qualifications of the applicant.

3.2.1 Legal Description of Applicant

The staff will verify that the applicant has provided its exact legal name; its principal place of business; its designation as a corporation, an individual, or public entity, the State under whose laws the applicant is incorporated, organized, or authorized; and the name, title, telephone number, and mailing address of the person(s) to whom communications concerning the financial information are to be addressed.

If the applicant is incorporated, a confirmed certified copy of its articles of incorporation and bylaws or other similar documents should accompany the application. If any persons or organized groups of persons, directly or indirectly, own, control, or hold the power to vote 10 percent or more of the outstanding voting securities of the applicant, a detailed explanation of such relationship should be included.

3.2.2 Description of Applicant's Plan for Operation and Financial Structure

The staff will verify that the applicant has provided the following information:

(1) If a State or compact authority has agreed to finance, guarantee, or underwrite any portions of the construction, operation, closure, or long-term care of the facility, notarized copies of any contracts with these parties, including an explanation of the amount, length, and type of financial commitment involved in this arrangement.

(2) A statement explaining the extent to which the applicant will rely on short-term financing in connection with the proposed construction, and statements tending to substantiate the fact that such short-term loans will be made available. Schedules showing the amount, terms, and repayment periods of short-term financing shall be provided.

(3) A detailed description of the applicant's outstanding and proposed securities and liabilities, showing amount (face value and number), interest or dividend rate, dates of issue and maturity, voting privileges, and principal terms and conditions applicable to each.

(4) Copies of the company's independently audited financial reports for the past 3 years. As a minimum, this must include balance sheets and income statements (both in consolidated form if available), accumulated retained earnings statement, and a statement of changes in financial position (sources and use of funds).

(5) A statement of anticipated cash flow, including provisions during the construction period and the first three full years of operation for paying interest and dividends and for retiring debt issues.

(6) A statement showing, over the life of each issue, the annual amount of securities the applicant expects to retire through a sinking fund or other extinguishment of indebtedness.

(7) Comparative pro forma balance sheets and income statement for the construction period and each of the first three full years of operation giving the effect of the proposed construction and financing of the project.

(8) Pro forma statements for each of the first three full years of operation showing (a) annual revenues subdivided by type of service to be provided and (b) annual operating expenses including property and labor costs, depreciation, depletion, taxes, rate of return on net investment, including working capital. In the case of an application who is a public authority, similar data and amortization interest schedules for the life of each bond issue related to the facility.

(9) A statement of the proposed rates to be charged for the services to be rendered at the facility, including all charges for closure and long-term care.

(10) A statement explaining the type and amount of property and liability insurance that will be obtained for the facility, along with copies of such policies and any attached riders.

(11) Any additional data and information on sources on which the applicant proposes to rely, showing the adequacy and availability of resources for financing the proposed project.

(12) All aspects of a license applicant's business activities that contribute at least 10% to its gross revenues should be enumerated. Information of a proprietary nature should be so indicated.

(13) A listing and description of the qualifications of the principal officers of the license applicant, including relevant work experience of the management team proposed for the licensed facility. For newly formed entities, detailed resumes of the proposed principal staff should be provided.

3.2.3 Other Applicable Information

The staff will verify that the applicant has provided the following:

(1) if the applicant has a parent or holding company, copies of any fiduciary guarantees provided by parent or holding company with regard to this project. If a parent company's or other corporate affiliate's assets are used as a source of funds for any portion of the project or its activities, provide financial information of the type described in 3.2.2 should be submitted for the parent company or other corporate affiliate

(2) if the applicant is required to submit Form 10K or Form 10Q to the SEC, provide copies of these reports for the last five years

(3) if the applicant's company is evaluated by a bond rating service such as Moody's Investors Service, Inc. or Standard and Poor's Corporation, provide copies of these ratings for the last 3 years

(4) a brief description of any litigation in which the applicant is involved that might have a negative economic effect on the operation of the facility

(5) if the applicant has ever filed or been forced by creditors to file for bankruptcy, provide specific details of these actions, including details of any corporate restructuring resulting from the bankruptcy

3.3 Requests for Additional Information

The staff may request additional information after conducting its review if the information provided was not adequate. Alternative programs proposed by the applicant must meet all the terms and conditions of the NRC regulations.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to this SRP is Subpart E, "Financial Assurance," to 10 CFR Part 61.

4.2 Regulatory Guidance

There are no regulatory guides that apply to the review of the financial qualifications of an applicant for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

The financial information provided by the applicant should be specific, complete, and consistent and should provide evidence of the applicant's financial qualifications.

4.3.1 Conditions for a Positive Finding of Financial Qualification

(1) Qualifications of key personnel will be evaluated to determine whether they have expertise and experience sufficient to provide reasonable assurance that the licensed activity will be conducted such that health and safety will not be adversely affected.

(2) Costs incurred or projected to be incurred for personnel, equipment and material will be evaluated to determine that such costs are reasonably consistent with those incurred by operators of similar facilities.

(3) Revenues obtained or projected to be obtained from operation of the licensed facilities will be evaluated to determine that such revenues are reasonably consistent with those obtained by operators of similar facilities.

(4) Analyses of financial statements (i.e., income statement, balance sheet, and statement of sources and uses of funds) submitted by the license applicant will be performed. Financial statements submitted by license applicants shall be certified without qualification by an independent Certified Public Accountant as accurate and consistent with Generally Accepted Accounting Principles. Measures used to determine financial soundness will include the following:

(a) An analysis of net income achieved and projected. Net income should be positive for the years provided. Although a license applicant would not be required to show a profit in every year to be found financially qualified, a pattern of non-profitability would be of serious concern to NRC staff reviewers.

(b) Commensurate with item a, an analysis of return on equity that is reasonably consistent with that obtained by other firms in the industry. The staff will normally find unacceptable a return on equity that is or projected to be consistently below that needed to attract capital necessary for the operation of the plant. However, the staff will consider mitigating circumstances such as a relatively low debt-to-equity ratio (i.e., less than 1.2) or where a significant portion of equity is held by the licensee's management.

(c) An evaluation of short-term solvency by measures such as the current ratio (i.e., current assets divided by current liabilities. Current assets normally consist of cash on hand, marketable securities, and accounts receivable. Current liabilities normally consist of accounts payable, short-term debt, currently accruing long-term debt, accrued income taxes and other accrued short-term expenses such as wages and salaries.)

Generally, the current ratio should be at 2 or above and certainly no less than 1.5 unless special circumstances are manifest.

(d) As indicated in item b above, a relatively low debt-to-equity ratio will be viewed positively as an indication of a license applicant's ability to attract unsecured capital. However, because little or no debt can be an indication of either strong financial health or inability to attract capital from lenders, very low debt-to-equity ratios will be evaluated closely.

(5) Other criteria that will be used include: a general evaluation of the health of the industry; general news in the financial press that may have either a positive or negative impact on a license applicant's financial health; and the business and labor climate in the license applicant's geographic area.

4.3.2. Conclusion

Reviews of financial qualifications are of necessity subjective. Although financial ratios and other objective factors provide a general indication of a license applicant's financial health, mitigating or exacerbating factors may alter conclusions that are based only on a narrowly-focused analysis of objec-

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the financial assurance documentation submitted by the applicant for [name of facility] low-level waste disposal facility according to Standard Review Plan 10.1. The staff finds that the documentation demonstrates to a reasonable degree of assurance that the applicant possesses the necessary funds to cover the estimated cost of conducting all licensed activities over the planned operating life of the project, including the costs of construction and disposal. The staff, therefore, concludes that the documentation provided by the applicant complies with the requirements established in 10 CFR 61.61.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

U.S. Nuclear Regulatory Commission, NUREG-1199, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," Rev. 1, January 1988.

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 10.2
FUNDING ASSURANCES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Regulatory Branch (LLRB)

1.2 Supporting - Office of General Counsel (OGC)

2. AREAS OF REVIEW

The staff will evaluate the financial instruments required by 10 CFR Part 61.62 Subpart E, and the accompanying documentation submitted by the applicant to ensure that sufficient funds will be available to carry out disposal site closure and stabilization, including (1) decontamination or dismantlement of land disposal facility structures and (2) closure and stabilization of the disposal site so that, following transfer of the disposal site to the site owner, the need for ongoing active maintenance is eliminated to the extent practicable and only minor custodial care, surveillance, and monitoring are required. These assurances shall be based on Commission-approved cost estimates reflecting the Commission-approved plan for disposal site closure and stabilization (SRP 5.2). The financial responsibility arrangements specifically allowed include (1) surety bonds, (2) cash deposits, (3) certificates of deposit, (4) deposits of government securities, (5) irrevocable letters or lines of credit, (6) escrow accounts, (7) trust funds, and (8) combinations of the above or other such types of arrangements approved by the Commission. However, self-insurance or any arrangement that essentially constitutes self-insurance (e.g., a contract with a State or Federal agency) will not satisfy the surety requirements, since this provides no additional assurance other than that which already exists through license requirements. Recommended language for the different types of instruments is given in NUREG-1199.

The staff will ensure that the applicant has provided the following documentation for the financial instruments currently allowed.

(1) If the applicant chooses to use a performance or Surety Bond:

- a performance or surety bond with the corporate seal affixed
- a standby trust fund agreement or documentation pertaining to the applicant's arrangement with the State where the facility will be located regarding the State authority proposed as beneficiary for the bond

- A standby trust fund agreement, or documentation pertaining to the applicant's arrangement with the State where the facility will be located, regarding the State authority proposed as beneficiary for the bond.

(2) If the applicant chooses to use an irrevocable letter of credit, the required documentation includes all of the following:

- A letter of credit, addressed to NRC, stating that the letter of credit is subject to the most recent edition of the Uniform Customs and Practice for Documentary Credits, published by the International Chamber of Commerce, or the Uniform Commercial Code.

- A standby trust fund agreement or documentation pertaining to the applicant's arrangement with the State where the facility will be located, regarding the State authority proposed as beneficiary for the letter of credit.

(3) If the applicant chooses to use a corporate guarantee, the required documentation includes all of the following:

- A letter addressed to NRC, from the chief financial officer of the corporation, providing the guarantee for the applicant.

- A signed opinion, by an independent certified public accountant, of the parent corporation's year-end financial statements and footnotes for the latest complete fiscal year.

- A special report, from the independent certified public accountant, addressed to NRC.

- A signed and notarized written corporate guarantee from the corporate parent.

(4) If assets are to be held in trust by NRC or by the State (e.g., certificates of deposit or deposits of government securities, etc.), the required documentation of all of the following:

A trust agreement or documentation pertaining to the applicant's arrangement with the State where the facility will be located.

(5) If the applicant uses a statement of intent:

- A statement of intent indicating that funds will be requested and obtained sufficiently in advance to prevent delay of required activities.

- A description of the authority of the government entity to use the statement of intent.

- Evidence indicating that the parties signing the statement of intent are authorized to represent the government entity that funds will be obtained.

3. REVIEW PROCEDURES

The staff will evaluate the applicant's proposed financial assurance mechanism that will be used to ensure that sufficient funds will be available to perform the disposal site closure and stabilization. Consult Appendix A to this chapter for the checklists of materials for reviewing an application submission.

3.1 Acceptance Review

The staff will review the financial instrument, and accompanying documentation submitted by the applicant, by comparing them with those listed in NUREG-1199, to verify their completeness, and by comparing their language to that of the standard forms in NUREG-1199, to ensure that the appropriate information has been submitted.

The staff will review the financial instrument, to ensure that it contains language requiring that the financial institution issuing the financial instrument notify the applicant and NRC of its intent to cancel.

3.2 Financial Evaluation

The staff will review a financial instrument submitted by the applicant, by using the general and specific procedures provided in the following sections:

3.2.1 General Evaluation Procedures for All Financial Instruments

The staff will review the information provided by the applicant by comparing the content of the financial instrument with that of the standard financial instruments and accompanying documentation in NUREG-1199.

The staff will verify that the applicant has ensured that the parties signing the various documents are authorized to represent the firm in the transaction. If the applicant is a partnership, the signatory must indicate that he or she is signing for the partnership, that is, by using phrases such as "for the partnership" or "for the company." If the applicant is an individual, the signatory may be the applicant. If a power of attorney is needed for a signature, as may be the case if a surety bond is used, a copy of the power of attorney should be attached to the financial assurance mechanism.

The staff will ascertain if the financial instrument submitted by the applicant is allowable and effective in the State where the facility will be located and also in the State in which that provider of the instrument is located, and meets the conditions in Section 10.4.3.

The staff will determine if the financial assurance mechanism is signed as required, is complete, and will be in effect at the proper time. The staff will also determine if the face value is adequate to cover annual adjustments

for inflation, changes in plans, and any changes in the disposal site closure and stabilization plan, including the costs that would be incurred if an independent contractor were hired to close and stabilize the disposal site.

3.2.2 Financial Instrument Evaluation Procedures

3.2.2.1 Surety Bonds

If a standby trust fund agreement accompanies the bond, the staff will ensure that it complies with the suggested wording and documentation in NUREG-1199.

If the applicant has not proposed a standby trust, the applicant should propose that an authority in the State where the facility will be located be named beneficiary for the surety bond. The applicant should submit a certification from the State's Attorney General, certifying that the State authority can legally enter into such an arrangement and, if necessary, use the funds for closure and stabilization of the disposal site, in accordance with the NRC-approved disposal site closure and stabilization plan.

The staff will ensure that the applicant has submitted a copy of the pertinent page of Circular 570, showing that the surety is licensed in the State where the bond was executed and that the penal sum of the bond does not exceed the surety's underwriting limit.

The staff will verify that the applicant reviewed the broker or agent's power of attorney to ensure that the broker or agent is authorized by the surety to issue bonds in the necessary amount. The power of attorney is needed only when the applicant is obtaining a bond from a broker or agent.

The staff will ensure that documentation submitted by the applicant shows that NRC and the applicant will be notified by the surety company of its intent to cancel at least 90 days in advance of cancellations.

3.2.2.2 Irrevocable Letters of Credit

The staff will ensure that the applicant has submitted information so that it can verify that the bank, savings and loan association, mutual savings bank, or credit union issuing the letter of credit has authority to issue letters of credit, and that the letter-of-credit operations are regulated and examined by a Federal or State agency.

The staff will verify that the applicant used the guidelines, for a letter of credit, found in regulations issued by the U.S. Department of Treasury, Comptroller of the Treasury (12 CFR 7.70.16), which include:

(1) Letters of credit conspicuously stating that they are letters of credit.

(2) The bank's undertaking containing a specified expiration date, or being for a definite term.

(3) The bank's obligation to pay arising only on the presentation of a draft or other documents, as specified in the letter of credit, and the bank

not being called on to determine questions of fact or law at issue between the account party and the beneficiary.

(4) The bank's customers having an unqualified obligation to reimburse the bank for payments made under the letter of credit.

The staff should verify that the applicant submitted both the letter of credit and a separate letter stating the amount of credit applicable to the licensed site. This letter must include the number of the letter of credit, the name of the insurer, the date, the license number, name and address of the facility, and the amount of funds ensured.

If the applicant has not proposed a standby trust, it should propose that a State authority in the State where the disposal facility will be located is named beneficiary for the letter of credit. The applicant should submit a notarized statement, from the State, certifying that the State authority has the legal authority to enter into such an arrangement and, if necessary, to use the funds for closure and stabilization of the disposal site, in accordance with the NRC-approved disposal site closure and stabilization plan.

3.2.2.3 Corporate Guarantee

The staff will verify that the applicant has provided a corporate guarantee document and a letter from the corporate parent's chief financial officer, including cost estimates and data from audited financial statements, which specifically cite the disposal site facility for which financial assurance is being demonstrated by the corporate guarantee and includes the cost estimates for the closure and stabilization of the site. The staff also will verify that the letter includes the financial test calculations identical to the samples in NUREG-1199.

The staff will verify that the applicant has submitted a copy of the opinion of an independent certified public accountant of the parent company's year-end financial statements and footnotes for the latest complete fiscal year.

The staff will verify that the applicant has submitted a special report on the corporate guarantor from an independent certified public accountant. The report should confirm that the financial data in the letter from the chief financial officer can be derived from the independently audited year-end financial statements and footnotes for the latest complete fiscal year. The report also should state that no matters came to the attention of the accountant that prompted him or her to believe that the information in the chief financial officer's letter should be adjusted.

If there is any doubt about the qualifications of the certified public accountant, the staff should verify the accountant's credentials by contacting the State Board of Accountancy in the accountant's State.

The staff will ensure that the applicant has provided information that enables it to verify that the corporate parent directly owns at least 51 percent of

the applicant's voting stock and also satisfied the financial test. If there is any reason to question the validity of the financial data (e.g., if the corporate parent barely satisfies the financial test criteria), the staff may ask the firm to supply audited financial statements, or it may obtain Form 10-K, from the U.S. Securities and Exchange Commission (SEC), which provides Exhibit 22, which lists all subsidiaries of the company.

The staff will ask the corporate parent to provide NRC with documentation of any changes, in its financial condition, that would warrant filing Form 8-K with the SEC. The staff will also verify that, if applicable, the applicant using a corporate guarantee must submit SEC Form 13D. This form includes information on tender offers and acquisitions and must be submitted to the SEC by shareholders acquiring 5 percent or more of a public firm's equity. This information could alert NRC reviewers of a potential change of ownership.

The staff will verify that the corporate guarantor certified and demonstrated that it has full authority, under the laws of the State under which it is incorporated, and under its articles of incorporation and bylaws, to enter into the guaranty, and that it has full approval from its board of directors to enter into this guaranty.

If necessary, the staff may use Moody's or Standard and Poor's bond guides, in the NRC library, to verify that the bonds are rated as claimed.

If an accountant's opinion is without qualification, and the corporate guarantor meets all other requirements, the staff will approve the corporate guarantee. The financial statements should have been prepared according to generally accepted accounting principles (GAAP).

If an accountant's opinion is either adverse or a disclaimer of opinion, the staff will not allow the use of a corporate guarantee.

If an accountant's opinion is qualified by the phrase "except for" or a "subject to," the staff will do the following:

(1) Ask the corporate parent to submit a copy of its latest financial statements. Alternatively, it could obtain a copy of the latest Form 10-K from the SEC.

(2) Thoroughly evaluate the accountant's opinion, in the context of the financial statements, to determine the likelihood of the event occurring, the accuracy of the financial assessment, and the ability of the firm to meet the costs.

(3) If unable to make a decision because the information in the opinion or the financial statements is insufficient, require that the corporate guarantor submit additional information.

(4) If the matter is still unresolved, request assistance from the NRC legal counsel.

3.2.2.4 Assets Held In Trust by NRC or by the State

The staff will ensure that the applicant has submitted information so that it can verify that the applicant has demonstrated financial assurance by depositing assets such as cash, certificates of deposit, or government securities with a third party, such as the State, where the facility will be located, or in a trust fund. The trustee should be an entity that has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or State agency.

This SRP does not address the possible contractual mechanisms that a State could arrange. If an applicant proposes to have a State hold its assets, the staff will evaluate the proposal individually. Additionally, if such a State-administered trust fund has a combined feature to guarantee similar specified activities at the facilities, the staff will carefully evaluate it, to ascertain if the trust has funds clearly dedicated to meet the requirements for funding the site closure and stabilization activities of the facility.

3.2.2.5 Trust Funds (including standby trusts)

The staff will ensure that the applicant has provided information so that it can verify that the bank, savings and loan association, or other financial institution has the authority to act as trustee, and that the trust operations are regulated and examined by a Federal or State agency. If a standby trust is used, the staff will verify that the trustee is qualified to act as trustee. It will also verify that the standby trust agreement is an originally signed duplicate, and that a certificate of acknowledgement accompanies the bond or letter of credit.

The staff will also verify that the following criteria have been met:

(1) A trust fund can contain interest-bearing cash deposits. It can also contain property, such as securities or government notes. If other types of assets are allowed, the trustee should agree to pay the governmental authority a stipulated cash amount. If assets other than cash are deposited into the trust fund, it may be necessary for the trustee to buy and sell securities, with the approval of the governmental authority, or to take other steps to manage the assets, in order to maximize their value. However, unless specified under the terms of the trust, a trustee should invest under a "reasonably prudent" investor standard, as defined by statute or case law, of the jurisdiction where the trust is located.

(2) In addition to financial institutions, the NRC staff will consider any individual or organization, for the position of trustee, who can succeed in obtaining insurance for the position. (This type of insurance is commonly obtained by banks and other financial institutions.) The trustee must be an entity whose trust operations are regulated by a Federal or State agency.

(3) The terms of the trust should define the investment responsibilities of the trustee.

(4) The trustee should possess the property or fund placed in trust by the party who created the trust. The trustee has legal interest in the funds, since it has control over them, can sue to protect them, and is responsible for their preservation.

(5) The trustee should be under a fiduciary duty to comply with the terms of this trust and, unless the trust provides otherwise, is liable for breaches of this duty.

(6) The trustee is allowed to invest in time or demand deposits of the trustee institution, up to the amount insured by law. The trustee is also permitted to put trust fund assets into any appropriate, common, commingled, or collective trust fund created by the trustee.

(7) The trust agreement should contain language requiring the trustee to submit, to the applicant and NRC a statement of the valuation of the assets in the trust fund, detailing the results of investment activity and the expenses levied against the fund. Securities in the trust fund should be valued at their market value no more than 60 days before the anniversary date of the fund. The applicant may object, in writing, to the trustee's investment activities or to expenses levied against the trust fund, within 90 days of receiving the valuation statement. If objections do exist, the applicant is still obligated to deposit the necessary funds into the trust, to ensure that the amount available is equal to the cost estimates, in the approved plan, for site closure and stabilization.

(8) The applicant should alert the trustee that the trustee is responsible for annual valuations of the trust, for notifying NRC if the applicant fails to make payment when directed to do so by the Commission, and for making payments out of the trust fund, at the direction of NRC.

(9) A change in trustee does not affect the existence of the trust, itself. The trustee may be changed if the applicant is dissatisfied with the performance of the trustee or if the trustee resigns; the trustee should be changed if the trustee institution enters bankruptcy or ceases to meet the trustee qualifications. Either way, the trustee can be changed only on agreement by the applicant, the new trustee, and NRC.

(10) The trust agreement should be signed by the applicant and the trustee and should be properly notarized.

3.2.2.6 Statement of Intent

A statement of intent may be used by Federal, State, or local government licensees to provide evidence of financial assurance for required activities. The purpose of the statement of intent is to ensure that, early in the life of the licensed facility, government licensees make their funding bodies aware of the costs of required activities and the eventual need for funding. The statement must identify the facility(ies) for which it provides financial assurance and the corresponding activities and costs. The statement must also indicate that funds will be requested and obtained sufficiently in advance to

prevent delay of required activities. The submission should include evidence of the authority of the officials of the Federal, State, or local governmental agency to sign the statement of intent. Appendix A includes a checklist of evaluation criteria to be applied when reviewing statements of intent.

3.3 Requests for Additional Information

After conducting its review, the staff may request that the applicant submit additional information, or modify the submittal, to meet the acceptance criteria in Section 4 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulation applicable to the areas of review for this SRP is 10 CFR 61.62, Subpart E, "Financial Assurances."

4.2 Regulatory Guidance

No regulatory guides apply to the review of an applicant's financial assurance mechanisms.

4.3 Regulatory Evaluation Criteria

The staff will determine if the financial assurance information is acceptable by ensuring that it complies with Chapter 10 of NUREG-1199 and of this SRP, with regard to its specificity, completeness, and consistency.

An Allowable Financial Instrument is acceptable if it meets the following conditions:

(1) The financial instrument should be fully funded, before startup of operation, and should be organized so as to allow the staff (not less than annually) to review the adequacy of coverage, to account for variations in site conditions, inflation, and site closure and stabilization plans.

(2) The financial instrument should state whether the principal is a corporation, partnership, or individual and should be in a form to allow the staff to determine if it has been properly signed and notarized and will be effective at the proper time.

(3) The following apply to signatures on a financial instrument:

(a) The instrument should be legally binding on all the signatories.

(b) The applicant should ensure that the parties signing the various documents are authorized to act as representatives for the firm involved in the transactions. Persons signing on behalf of the corporate principal should designate their legal capacity and should hold the position of president or vice president of the corporation.

If persons other than the president or vice-president are signing, a resolution or other certified evidence of authority should be attached to the instrument, stating that the signatories have the authority to sign on behalf of the principal. If needed for a signature, a copy of the power of attorney should be attached to the financial assurance instrument, and the corporate seal should be affixed.

(c) If the principal is a partnership, the firm's name should appear in the caption of the financial instrument.

(d) If the principal is under joint ownership, but is not a partnership, the firm's name should appear in the caption and all owners must sign the financial statement.

(e) If applicable, a signature of the attorney-in-fact acting on behalf of the issuing organization should appear on the financial instrument. The financial instrument should be accompanied by a properly executed authorization of the power of attorney for the person signing the instrument.

(f) If applicable, the financial instrument should contain the signature of the resident agent of the organization issuing the instrument. The agent should be qualified to do business in the State where the facility will be located.

(g) Each party should sign his or her own name.

(4) The financial instrument should be issued by an organization that has the legal authority to execute such an arrangement.

(5) All financial instruments, including the original, any additions, and any replacements, should describe and pertain to the licensed facility under the original license.

(6) The financial assurance should be open-ended and cannot be cancelled without at least 90 days advance notice to NRC.

(7) The instrument should allow for automatic collection, by NRC before its expiration, if the applicant cannot provide an acceptable alternative financial assurance mechanism 60 days before its expiration. The instrument should not require proof of forfeiture.

(8) If the instrument is a bond or letter of credit, it should be accompanied by a standby trust, to receive assets in the event the applicant defaults or is bankrupt.

(9) The instrument should specify NRC, or a State agency satisfactory to NRC, as the beneficiary. If the instrument designates a State agency as the beneficiary, the applicant should submit written documentation, to NRC, that will allow NRC staff to verify that the State agrees to use any

funds received to perform the activities required in the NRC-approved plan for site closure and stabilization.

(10) To maintain the necessary amount of coverage, the financial instrument should provide for the following:

(a) The instrument should be sufficient, at all times, to cover all the costs of closure and post-closure care of the site.

(b) The amount of the financial assurance or of multiple assurances should at least equal the current cost estimates in the plan, for site closure and stabilization, and should reflect total costs incurred if an independent contractor were hired.

(c) The instrument or a succession of instruments should provide coverage throughout the term of the license.

(d) An instrument used for multiple licensed facilities must specify the types and number of activities required for each facility, and the location of each facility.

(e) The mechanism should be adjusted for inflation, using the following procedure:

- The applicant should adjust the cost estimates for inflation within 30 days after each anniversary of the date on which the first cost estimate was prepared. The adjustment should be made using the inflation factor derived from the annual implicit price deflator for gross national product as published by the U.S. Department of Commerce, in its Survey of Current Business. The inflation factor is the result of dividing the latest published annual deflator by the deflator for the previous year.

- The first adjustment should be made by multiplying the cost estimates by the inflation factor, giving the adjusted cost estimate. Subsequent estimates should be made by multiplying the latest adjusted closure cost estimate by the latest inflation factor.

- The staff suggests this adjustment procedure because of the inherent time delay (of 9 to 18 months) in the publication of a historical annual implicit price deflator for gross national product (AIPD-GNP) by the U.S. Department of Commerce. The procedure will use both the latest published historical figure for AIPD-GNP and the latest forecast of AIPD-GNP.

(f) If the current cost estimates exceed the coverage, because of inflationary increases or changes in plans, the applicant should arrange to increase coverage and submit evidence of the increase, to NRC, within 60 days after the cost estimates increase. If cost

estimates decrease, the applicant may apply to NRC for approval of a decrease in coverage.

(11) An applicant should obtain replacement financial assurance coverage in the event of bankruptcy of the institution issuing the financial instrument. The trustee should be changed if the trustee institution enters into bankruptcy.

(12) The applicant should inform NRC, within 10 days after it or the organization issuing the financial instrument learns it is named as a debtor in a bankruptcy proceeding.

(13) If ownership or operating responsibility for the activities is transferred, NRC will not allow the applicant to terminate the original financial instrument until such time as the new applicant has obtained an acceptable assurance.

(14) An issuer of a financial instrument should notify both the applicant and NRC, by certified mail, of its intent to cancel the financial instrument. The financial instrument should ensure that the instrument is not cancelled during the 90 days beginning with the date the notice was received by both NRC and the applicant, as evidenced by the return receipts.

(15) The applicant should be responsible for obtaining another financial assurance mechanism, if the financial institution or corporate guarantor gives notice that it intends to cancel.

(16) The applicant may change the financial assurance mechanisms in use, with prior written approval from NRC. The new mechanism, if approved, should become effective before or at the time the previous mechanism expires. If a letter of credit or a surety bond is used, the applicant should also establish a standby trust fund.

(17) The instrument should clearly state the terms and conditions under which the applicant may cancel the instrument, and should provide for notification and approval by the appropriate State or Federal authority, before cancellation by the company.

(18) The instrument should be established so that the applicant will have the financial assurance released after NRC has agreed that all license conditions for closure and post-closure care have been met. NRC will send written notification, to the applicant, allowing termination of the financial assurance mechanism and a return of any funds held.

5. EVALUATION FINDINGS

5.1 Introduction

The staff should verify that the information in the Safety Analysis Report (SAR) is sufficient to satisfy the requirements and guidance of this SRP and

to enable the staff to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff has reviewed the financial assurance documentation submitted by the applicant for [name of facility] low-level radioactive waste disposal facility, according to 10.2. The staff determined that the financial assurance mechanisms submitted by the applicant are sufficient to ensure that funds will be available to close and stabilize the disposal site so that, after the disposal site is transferred to the site owner, the need for active maintenance is eliminated to the extent practicable, and only minor custodial care, surveillance, and monitoring are required. The staff, therefore, concludes that the financial assurance mechanisms comply with 10 CFR 61.62.

6. IMPLEMENTATION

This SRP provides guidance, to NRC, in its technical review of the SAR low-level radioactive waste disposal facility. Applicants and licensees may also use this guidance regarding NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the method described herein.

7. REFERENCES

Essential

Council of Economic Advisors, Economic Indicators, U.S. Government Printing Office, Washington, DC, published monthly.

International Chamber of Commerce, Uniform Customs and Practice for Documentary Credits, Paris, France, 1983.

U.S. Code of Federal Regulations, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart E Financial Assurance," Part 61, Chapter 1, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

Lawyer's Cooperative Publishing Co., Uniform Commercial Code, Rochester, NY., 1985.

U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, U.S. Government Printing Office Washington, DC 20004, published monthly.

U.S. Department of the Treasury, Circular 570, "Companies Accepted on Federal Bonds," Washington, DC, published annually in Federal Register.

U.S. Nuclear Regulatory Commission, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility," NUREG-1199, Revision 1, January 1988.

Dun and Bradstreet Corporation, Moody's Investors Service, 99 Church Street, New York, NY, 1993.

Standard and Poors Corporation, 25 Broadway, New York, NY, 1993.1

NUREG-1200
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 11
LICENSE CONDITIONS

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Licensing Project Manager

1.2 Secondary - As designated by Licensing Project Manager depending on proposed license conditions

1.3 Support - Office of the General Counsel (OGC)

2. AREAS OF REVIEW

In the SAR the applicant will have, either explicitly or by implication, developed terms and conditions under which it feels it is qualified to hold a license and against which it feels its performance should be judged. These conditions will be included as part of Sections 4-10 of the SAR. They may or may not be highlighted by the applicant with regard to their degree of restriction pursuant to 10 CFR 61.25.

3. REVIEW PROCEDURES

Having reviewed the individual sections in the SAR and drawn conclusions about their acceptability and completeness in individual portions of the Safety Evaluation Report, the staff will develop additional requirements and conditions and associated categorical restrictions that it deems necessary to promote the common defense and security and protect health or minimize danger to life or property. These conditions may (1) supplement the SAR, (2) clarify restrictions under which certain changes can be made, or (3) summarize a requirement(s) for the benefit of others who will be affected by the license. The applicant will be provided an opportunity to review and comment on the proposed license conditions.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The regulations applicable to this SRP are:

(1) 10 CFR 61.23, "Standards for Issuance of a License"
(2) 10 CFR 61.24, "Conditions of Licenses"

(3) 10 CFR 61.25, "Changes"

4.2 Regulatory Guidance

There are no regulatory guides that apply to license conditions for a low-level waste disposal facility.

4.3 Regulatory Evaluation Criteria

Any suggestions with regard to supplemental license conditions by the applicant will be considered preliminary in nature and proffered solely to facilitate the licensing process. The responsibility for developing additional requirements and conditions falls primarily on the Commission staff. Therefore, with respect to the SAR, as tendered by the applicant, there are no evaluation criteria pursuant to this SRP.

5. EVALUATION FINDINGS

5.1 Introduction

The staff's review should verify that sufficient information has been provided in the SAR to satisfy the 10 CFR Part 61 requirements and that the information is consistent with the guidance in this SRP. On the basis of this information, the staff should be able to conclude that this evaluation is complete. The staff can document its review as follows.

5.2 Sample Evaluation Findings

The staff, having completed its technical review of the SAR for [name of facility] low-level waste disposal facility, pursuant to conclusions documented in Section(s) [and] of this SER, finds the need for the following license condition(s) in addition to the SAR tendered by the applicant.

Condition(s)	Reason for need

The staff has reviewed and discussed the license condition(s) with the applicant who agrees with its(their) inclusion in the SAR.

6. IMPLEMENTATION

This SRP provides guidance to the NRC staff in its technical review of an SAR for a near-surface low-level radioactive waste disposal facility. In addition, it may be used as guidance by applicants and licensees regarding the NRC's plans for performing such a technical review.

Except when the applicant proposes an acceptable alternative method for complying with the Commission's regulations, the staff will use the methods described herein.

7. REFERENCE

Essential

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, DC, revised annually.

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

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Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION – NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as 8. above.

10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

The Standard Review Plan (SRP) is prepared for the guidance of staff reviewers in the Office of Nuclear Material Safety and Safeguards in performing safety reviews of applications to construct and operate a low-level waste disposal facility. The principal purpose of the SRP is to assure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. It is also a purpose of the SRP to make information about regulatory matters widely available and to improve communication and understanding of the staff's review process by interested members of the public and the nuclear industry. NUREG-1200 consists of 11 chapters containing approximately 60 individual SRP sections. Each section identifies the disciplines appropriate to perform the review, the matters that are reviewed, the basis for review, how the review is performed, and the conclusions that are sought. The SRP will be revised from time to time to reflect changes in regulatory policy and to update technical information in the text.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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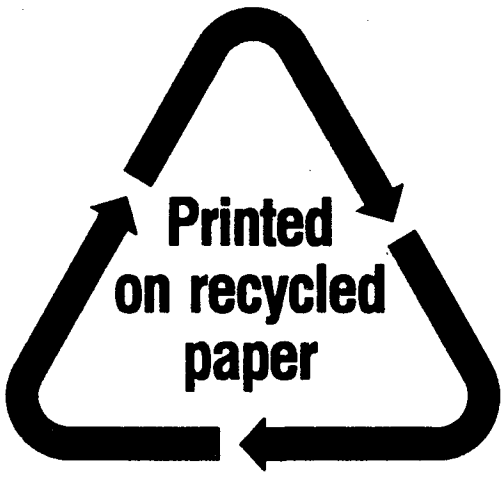

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