UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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MEMORANDUM FOR: Vandy Miller
Assistant Director for State
Agreement Programs
Office of Governmental and
Public Affairs

FROM: Richard L. Bangart, Director
Division of Low-Level Waste Management
and Decommissioning
Office of Nuclear Material Safety
and Safeguards

SUBJECT: REVISION OF NUCLEAR REGULATORY COMMISSION GUIDANCE ON LOW-LEVEL WASTE DISPOSAL

We are enclosing, for your information and for the States, copies of draft revised Standard Review Plan (SRP) Sections. The draft revised SRPs cover topics on: (a) surface water hydrology (SRPs 2.4.1, 3.4.4, 5.1.1, and 6.3.1); (b) design of soil cover systems (SRP 3.2); (c) waste disposal operations (SRPs 4.1, 4.2, and 4.3); (d) introduction to performance assessment and analysis of radioactivity release (SRP 6.1); and (e) occupational radiation protection (SRPs 7.1, 7.2, 7.3, and 7.4). In addition, we have included a new SRP section (SRP 1.0, Licensing Process) that is often referred to as the "roadmap" section. The revised guidance is in response to the Staff Requirements Memorandum (SECY 90-331) and fulfills staff commitments related to the September 21, 1990, Commission Paper on "Conformity of Guidance on Low-Level Waste Disposal Facilities with the Requirements of 10 CFR Part 61." The revisions contained in the draft SRPs were described by the Low-Level Waste Management staff at the July 15-17, 1991, Low-Level Waste Regulatory Workshop sponsored by the Office of Governmental and Public Affairs/State Programs.

The enclosed draft revised SRPs are being transmitted to your office so that they may be transmitted to the States for any comments that the States may wish to make. We will also formally issue the draft revised SRP Sections by way of a Federal Register Notice. A 60-day period for public comment will be reserved before formally issuing the final revisions in NUREG-1200, after having addressed issues raised during the comment period. This advance transmittal of the revised SRPs to the States involved in low-level waste regulation is intended to provide the maximum period for State review, while the arrangements and details for formally issuing the Federal Register Notice are completed.

Any questions that you may have on the draft revised SRPs may be directed to Paul H. Lohaus on extension 2-0553.

ORIGINAL SIGNED BY E.Q.T. for

Richard L. Bangart, Director
Division of Low-Level Waste Management
and Decommissioning
Office of Nuclear Material Safety
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Enclosures: SRPs 1.0 through 7.4

Distribution: Central File #204.1.4NMSS r/f RBangart ETen Eyck JAustin
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PDR YES X PDR NO ___ ACNW YES X NO ___ ___
Category: Proprietary ___ or CF Only ___ ___

SUBJECT ABSTRACT: REVISION OF NRC GUIDANCE ON LLW DISPOSAL

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Joan -

Please have this checked for Dr. CF, etc & return to me. Thanks

Lee Fridley

PI-37

Enclosure

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

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 1
LICENSING PROCESS

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1. INTRODUCTION

"The Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Facility," NUREG-1200 (SRP) provides guidance for the review and evaluation of the nuclear safety aspects of applications for licenses to construct and operate low-level radioactive waste (LLW) disposal facilities. Such licenses are required under 10 CFR Part 61 entitled "Licensing Requirements for Land Disposal of Radioactive Waste." To receive a license, the applicant must demonstrate, in a license application, that the proposed facility will conform to the standards for the issuance of a license cited in 10 CFR 61.23 and will thereby meet the four specifically stated performance objectives of 10 CFR 61.40 to 61.44.

The responsibility of the staff in the review of an application for a license for a LLW disposal facility is to determine that the proposed facility 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 carry out this responsibility, the staff is required to obtain reasonable assurance, through evaluation of information in an application and through selected independent assessments, that the applicant has demonstrated compliance with specific regulatory requirements. In carrying out this responsibility, the staff must also clearly state and identify for the applicant those standards, criteria, and bases which the staff will apply in reaching a licensing decision.

The burden of proof for compliance with the requirements for licensing always rests with the applicant. Analyses by the NRC staff 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. In the case of a staff determination of non-compliance, the staff must inform the applicant of the specific requirements with which the applicant has not complied and the basis upon which the decision of non-compliance was made.

4. RELATIONSHIP OF SRP TO PERFORMANCE OBJECTIVES AND LICENSING STANDARDS

One aspect of site licensing that lends itself to a relatively uncomplicated example of the relationships among performance objectives, licensing standards, and the SRP is that of protecting future inadvertent intruders.

Addressing this concern, the performance objective set forth in 10 CFR 61.42 requires, in broad terms:

> Protection of individuals from inadvertent intrusion.
>
> Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site or contacting the waste at any time after active institutional controls over the site are removed."

In the Standards for Issuance of a license, that broad requirement is reinforced, no less broadly, by 10 CFR 61.23(c) as:

> The applicant's proposed disposal site, disposal site design, land disposal facility operations (including equipment, facilities, and procedures), 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 § 61.42, Protection of individuals from inadvertent intrusion.

These generalized criteria are directly addressed in the SRP by Review Plan 6.2 - "Intruder Protection" which considers in detail the separate issues of waste segregation, minimum depth of burial, and the design and construction of engineered intruder barriers. But in addition to SRP 6.2, another seventeen SRPs also require review of information that, in one way or another, affects the protection of inadvertent intruders; these are listed in Table 1-1.

5. HIERARCHICAL STRUCTURE OF PART 61

In its development, Part 61 was given a hierarchical structure. At the outset, in conformance with safety goals established by NRC's authorizing legislation, overall performance objectives were established to define the level of nuclear safety and environmental protection that should be achieved in the land disposal of LLW. In support of the goals and objectives, Part 61 next establishes specific technical requirements for near-surface disposal of LLW to help ensure that the performance objectives will be met. Requirements were established for each of the major components of a disposal system, including the site characteristics, facility design and operation, waste form

and classification, and institutional controls. Figure 1-1 depicts the hierarchical structure of Part 61 and its supporting base.

At the apex of the triangle (Figure 1-1) stands the ultimate goal that the disposal of low-level radioactive waste shall not be inimical to the common defense and security and will 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 Waste Policy Act, and the Low-Level Radioactive Waste Policy Amendments Act. The performance objectives are specifically stated in 10 CFR 61.40 through 61.44 and address protection from releases of radioactivity, inadvertent intrusion, operations and post-closure stability. The need to satisfy the performance objectives provides the basis for the content of the three successive foundation levels of the hierarchy -- technical requirements, NRC guidance, and license applicant information -- and the performance objectives are in turn supported by these levels as they direct the license application and its evaluation towards their fulfillment.

For its technical requirements, 10 CFR 61.23 establishes the standards for the issuance of a license and links the technical requirements with the performance objectives. It also identifies the specific findings that NRC must make to issue the license. Specific requirements stated in 10 CFR 61.23 address siting, facility design, operations, waste form, waste classification, institutional control, financial assurance, environmental monitoring, security, criticality safety, reporting and record keeping. It also requires that the provisions of 10 CFR Part 51 for environmental protection be met. The administrative and procedural requirements for licensing are also linked to 10 CFR 61.23 in that they specify the type of information and analyses an applicant should submit in an application that is to be reviewed by the NRC staff and which, after review, will then provide the basis for the findings required by 10 CFR 61 23 for issuance of the license.

The next lower supporting layer, designated as NRC guidance, serves as a bridge between the technical requirements level and the license application level. NRC guidance provides further elaboration of Part 61 requirements, offers acceptable approaches for meeting those requirements, describes details of the information and analyses an applicant should submit in an application and establishes acceptance criteria the NRC staff will apply in evaluating the information submitted in an application. Through these means, NRC guidance offers technical support to the applicant while allowing information from the applicant, at the base of the hierarchy, to be submitted to NRC for evaluation against the requirements of 10 CFR Part 61. At this level of the Part 61 hierarchy, three documents are especially important: these SRPs (NUREG-1200), the SF&C (NUREG-1199) previously discussed, and "Review Process for Low-Level Radioactive Waste Disposal License Application Under Low-Level Radioactive Waste Policy Amendments Act" (NUREG-1274).

The up-and-down arrows at the side of the diagram in Figure 1-1 serve to indicate that the influence from all of the upper layers need to be considered at all lower levels, and that each lower level must provide support for all levels above it.

In the following three sections, the three lower levels of the hierarchy discussed (i.e., requirements, NRC guidance, and information supplied in the license application) are discussed in further detail and integrated to show the process followed by the staff in reaching a final decision to issue or deny a license. Section 6 reviews in further detail the overall licensing process. Section 7 shows the interrelationship of the requirements of Part 61. Section 8 addresses the SRP and SF&C Guide and shows how the information required in a license application is coordinated to the criteria for acceptance set out in the SRP.

6. OPERATION OF THE LICENSING PROCESS

As noted, a detailed description of the licensing process is provided in NUREG-1274, "Review Process for Low-Level Radioactive Waste Disposal License Application Under Low-Level Radioactive Waste Policy Amendments Act". The more significant activities within that process are discussed here.

Figure 1-2 provides a diagram of the licensing process. It shows, in a more direct way than portrayed in Figure 1, the relationships between requirements in Part 61 (shown as 10 CFR 61.23 in Figure 1-2), NRC guidance (shown as SF&C and SRP) and information supplied by the applicant for a license (shown as application and supporting data and analysis).

The process is initiated by the applicant who collects organizational information, technical data and design information, prepares performance analyses, and submits an application, termed a Safety Analysis Report (SAR), required by 10 CFR 61.10-61.16 and an Environmental Report (ER) required by 10 CFR Part 51. After the license application is judged to be complete, it is then reviewed and evaluated, through the medium of the SRP, for technical and administrative conformance with licensing requirements. The Environmental Report is reviewed under "Environmental Standard Review Plan for the Review of a License Application for a Low-Level Radioactive Waste Disposal Facility", (NUREG-1300) (ESRP).

10 CFR Parts 2, 51, and 61 define the licensing process for the NRC. Upon receipt of an application, the NRC staff first conducts an acceptance review to ensure that the application is complete and contains sufficient information for the staff to conduct a detailed review. Completeness will be determined by a rapid reading and screening of the entire application against the requirements of 10 CFR 61.10 through 61.16 and by comparing it to the subject headings in NUREG documents 1199, 1200 and 1300 and Regulatory Guide 4.18. After the application has been reviewed for completeness and been found

acceptable for review, a docket number will be assigned and the applicant will be notified by the NRC. If the application is determined to be incomplete and unacceptable for docketing, the applicant will be informed and will be provided with a listing of the deficient areas.

NRC staff next begins a detailed safety review of the application against the requirements of 10 CFR Part 61 and an environmental review against the requirements of 10 CFR Part 51. The safety review is conducted following guidance in the SRP (NUREG-1200) and leads to preparation by the staff of an SER. In the SER, the staff will address and make determinations on issues such as conformance with the site suitability requirements, conformance with site design, conformance with facility operations and closure requirements and conformance with the performance objectives and other requirements contained in 10 CFR Part 61.

The environmental evaluation also comprises a significant element of the review process. An ER is required of the applicant under 10 CFR 51.45 and 10 CFR 51.62 under provisions of the National Environmental Policy Act. The contents of the ER are specified by Regulatory Guide 4.18 - "Standard Format and Content of Environmental Reports for Near-Surface Disposal of Radioactive Waste". Preparation of the ER may often use some data common to the SAR. The 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 Environmental Impact Statement (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(1) 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 make the findings set out in 10 CFR 61.23 and recommend issuance or denial of the 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, 10 CFR Part 61 contains four sections of major significance: 10 CFR 61.40-61.44 specify the performance objectives; 10 CFR 61.10-61.16 require the submittal of a license application and specify its contents; 10 CFR 61.23 establishes standards for the issuance of a license; and Subparts D, E and G elaborate and expand upon the standards of 10 CFR 61.23. These latter Subparts include, for

INTERNAL RELATIONSHIPS - 10 CFR PART 61

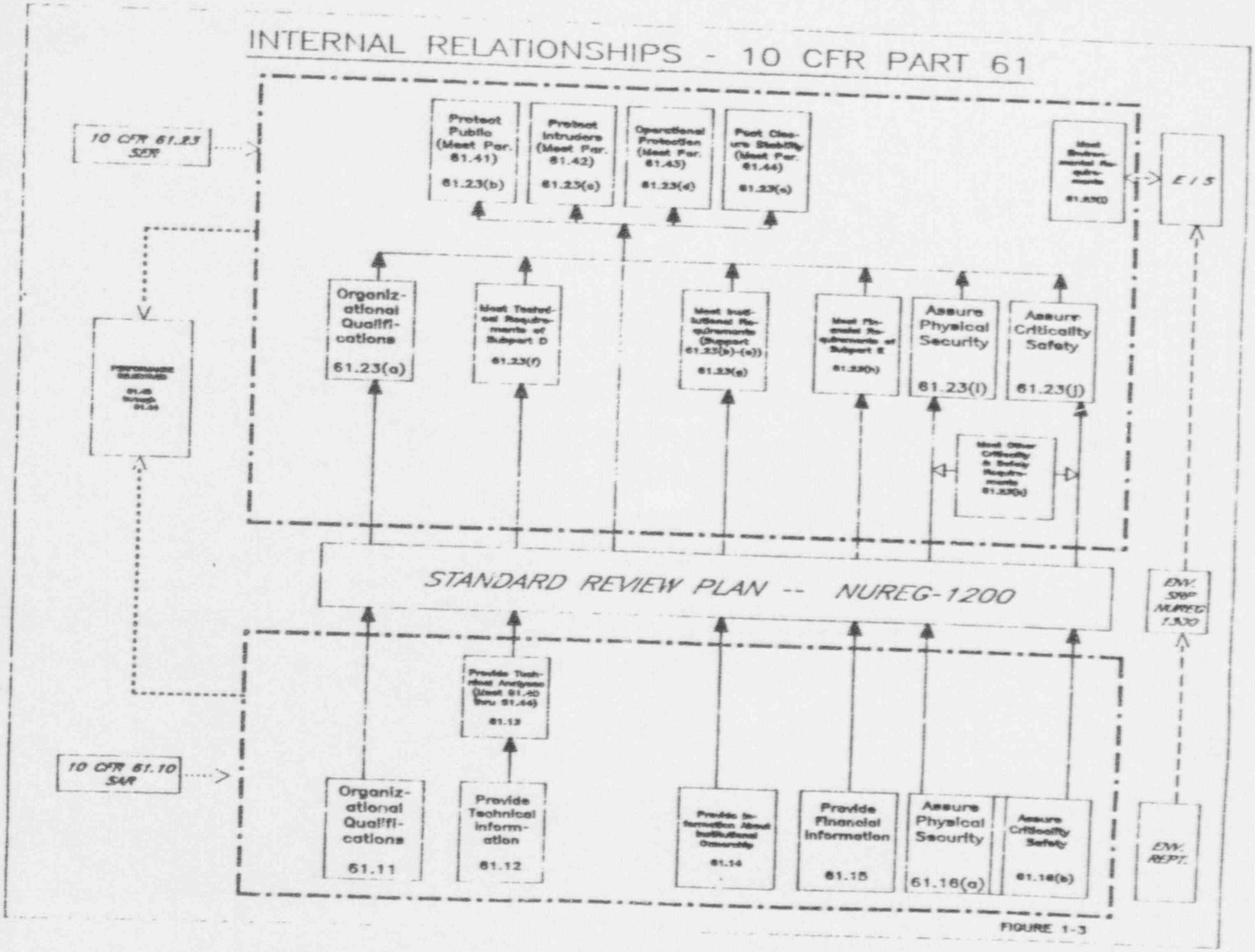

FIGURE 1-3

The Standard Format and Content Guide has been prepared by the staff to provide a uniform structure and content for the application as set out in 10 CFR 61.10 through 61.16. It contains descriptions of the information identified as necessary in an application to permit the staff to make findings required by 10 CFR 61.23. For each element of information that the staff has identified as essential in the application, the staff must also be able to identify:

- the purpose of needing and evaluating the element of information;
- the specific requirements that are applicable;
- the criteria and bases for determining the acceptability of the information submitted;
- the procedures that the staff evaluator is to follow to provide reasonable assurance that the applicable requirements have been satisfied; and
- the conclusion or type of conclusion that is sought from the evaluation of the information element under review.

Each of the above five areas is specifically addressed in the SRPs for each element of information specified in the Standard Format and Content Guide.

For the evaluation of a license application, 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. These standards are judged to have been met following staff concurrence that the total suite of performance objectives, along with related technical requirements and administrative standards have been satisfied. Because the reviews of the individual SRPs address the acceptability of individual items of information or analysis which have been submitted, any single SRP section review may address only a portion of a requirement of 10 CFR 61.23, or it may address some or all of several requirements. Consequently, successful review under any individual SRP may, by itself, provide only partial satisfaction of one or more of the required licensing criteria, so that 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, the left margin contains a line for each of the 67 individual reviews within the SRP. The headings across the top of Figure 1-4 identify those individual provisions of Part 61 that affect licensing review. Some selection was exercised in presenting individual sections of Part 61; in some cases, individual sub-sections are shown, in others, where all of the sub-sections function as a unit, only the entire section is designated. In other cases, where the Part 61 section does not affect license review under the

SRPs, it has been omitted. An "X" at the intersection of a row related to an SRP component 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 in the Part 61 section. 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 together satisfy that regulatory provision; where one SRP is identified with more than one provision of Part 61, that SRP contributes to meeting all the Part 61 requirements identified. While Figure 1-4 shows the relationship of all SRP sections to individual Part 61 requirements to be obvious and unmistakable, an added benefit offered by the matrix of Figure 1-4 is the demonstration, by the presence of multiple markings within a single column, of the interrelationships among SRPs needed to satisfy individual provisions of Part 61; or by the presence of multiple markings along a single row, which show how one SRP may address more than one provision of Part 61. For example, although SRP 6.2 directly responds to the standard of 10 CFR 61.23(c) for intruder protection, note from Figure 1-4 that seventeen other sections of Part 61 also have implications for intruder protection.

Also, for any single SRP, it is possible to verify that data needs under 10 CFR 61.10-61.16 are essential and consistent with requirements under 10 CFR 61.23.

9. SUMMARY

SRP 1 discusses some aspects of the licensing process, provides guidance on the hierarchical structure of Part 61, on the internal relationships within Part 61, and on the relationships between the requirements of Part 61 and the individual issue-oriented evaluations of the SRP, NUREG-1200. Part 61 was drafted to exhibit hierarchical structure, with safety goals and performance objectives influencing activities at all levels, and with all levels contributing to the achievement of the goals and objectives. Figure 1-1 illustrates this hierarchical structure.

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 illustrates this process.

Part 61 has been written so that 10 CFR 61.10-61.16 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

NUREG-1200
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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 provide an explanation why information recommended in this SRP is not provided. 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

(1) the site is not located in an area subject to frequent flooding, and the applicant has not proposed waste disposal in the 100-year floodplain, coastal high-hazard area, or wetland, as required by 10 CFR 61.50(a)(5)

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.

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

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. 1, January 1988.

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.

NRC staff review of E.O. 11988 and United States Water Resources Council (USWRC) guidelines (USWRC, 1978) for implementing the Order indicates that very little flexibility exists in interpreting the Order. A proposed waste disposal site located in a 100-year floodplain would only, in rare cases, be found to be acceptable. 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 floodplain.

For the purposes of this guidance, the waste disposal area is considered to be the area of actual waste emplacement. The site is defined as the area designated for waste disposal activities and includes the area of waste emplacement and the buffer zone (e.g. trenches, vault structure).

2.1 Floodplain Determinations

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 floodplain. Such differentiation is illustrated by guidelines such as those 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 riverine 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 site is located in a floodplain, as defined by the maps, it 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

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

If a site can be affected by large floods, it is also 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 site is located in an area where floods can cause groundwater levels to rise and come into contact with waste, the site would likely be unacceptable. In such cases, a transient analysis of flooding and groundwater levels would be needed to verify the adequacy of the site. It can be seen that this requirement is related to 10 CFR 61.50(a)(6), because the time needed to produce changes is groundwater levels will generally be available only for streams with large drainage areas and long flood peaks. An exception to this generalization may occur if site soils are very permeable and response times for rising groundwater levels are short.

2.2.3 Significance of Flood Hazards

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 safe disposal of the low-level waste. 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 a major consideration 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, 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 floods may be as large as the PMF. Several SRP sections address the need to design for large floods and provide criteria for determining acceptability of site designs that provide the necessary flood protection.

2.2.4 Use of Engineering Measures for Drainage Enhancement and Flood Hazard Mitigation

The staff considers that 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 an overriding issue. The staff further considers that the intent of the regulatory 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 or would be insignificantly affected by major floods. Acceptable sites, while needing some minor drainage enhancements and minimal

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 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 site may need to be evaluated in detail, 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 flooding analyses to verify that the site is not located in 100-year floodplain or a flood-prone area. If a site is proposed where development in the floodplain will occur, the site is acceptable only if the applicant can demonstrate that no reasonable or practicable alternative exists. The justification should follow the USWRC guidelines related to evaluation of alternatives and justfication of the proposed action. If the 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 site's natural capabilities to provide adequate flood protection.

3. The applicant should evaluate the 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 demonstrate that site flooding problems and other related phenomena will be easily mitigated by minor engineering modifications and that flood flows reaching the site from upstream drainage areas are easily diverted. The applicant should also demonstrate that site processes will not affect the long-term performance of engineered design features and will not invalidate the use of predictive models.

4. CONCLUSIONS

E.O. 11988 provides criteria for siting in designated floodplain areas, and generally indicates that floodplain areas should be avoided whenever possible. 10 CFR 61.50(a)(5) states that waste disposal shall not take place in a 100-year floodplain. The NRC staff concludes that very little flexibility exists in interpreting these requirements. If waste emplacement is located in a 100-year floodplain, it does not meet regulatory requirements. If a site (which includes the waste emplacement area and the buffer zone) is determined to be in a 100-year floodplain, it may not meet the requirements of E.O. 11988, unless there is no other reasonable alternative. At the site selection stage of low-level waste facility licensing, it needs to be demonstrated that no practicable alternatives exist to siting in a floodplain area.

An organized and logical procedure should be employed to determine if a site meets the 100-year floodplain and other siting requirements of 10 CFR 61.50(a) and E.O. 11988. This procedure includes: (1) examination of published floodplain maps, (2) development of detailed site-specific maps by the applicant, if

5. REFERENCES

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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

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

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) severe snowmelt conditions, where applicable, or the 100-year, 6-hour rainfall with high antecedent moisture or frozen ground conditions as the normal operational event; (2) the worst conditions resulting from maximum snowmelt or the PMP as the abnormal design-basis event; and (3) accidental blockage of single 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. Additional review guidance for the placement, compaction, and testing of soil cover systems over wastes is presented in Appendix A to this SRP.

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.

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.

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.

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 3.2 - APPENDIX A
GUIDANCE ON SOIL COVER SYSTEMS PLACED OVER LOW-LEVEL RADIOACTIVE WASTE

1. INTRODUCTION

Several studies (e.g., NUREG/CR-4701) have analyzed the individual components of a designed low-level radioactive waste disposal facility and have concluded that the cover component is one of the most important engineered barriers. All scientific and engineering disciplines involved with the safe disposal of waste agree that careful consideration needs to be given to the design, construction and maintenance of a waste cover system.

In recognition of the cover's importance, the NRC staff initiated an Interagency Agreement with the U.S. Army Corps of Engineers (COE) in March 1989, that requested the COE to provide recommendations to the NRC for the selection, placement, compaction, testing, and acceptance of soils proposed to be placed in cover systems over low-level radioactive wastes. In addition, because several areas of controversy and technical differences were known to exist when assessing the acceptability of soil cover materials, provisions were made in the Agreement with the COE to provide for peer review of the COE recommendations. The results of the COE recommendations and the peer review efforts are summarized in the three volumes of NUREG/CR-5432 which were published in February 1991. NRC staff reviewing the integrity of disposal unit covers in a license application should be thoroughly familiar with the guidance presented in these three volumes. The review guidance provided in the discussions and recommendations of Appendix A is not intended to be a complete summary of NUREG/CR-5432, but rather the highlighting of selected recommendations that the staff believes is desirable because of the uniqueness and importance of certain review issues that necessitate a conservative approach, to ensure the safe long-term performance of the soil cover systems over low-level radioactive wastes. The omission of any COE recommendation from the discussions in this Appendix A should not be taken as a position that the recommendation is less important, but rather that the recommendation covers a technical item that has general acceptance on what sound engineering practice would typically require. In this appendix, guidance is provided where a specific review item is considered to be especially important to satisfying the regulatory technical requirements and the long-term stability objective of 10 CFR 61.44. The waste cover functions required by the regulations include:

1. Minimizing infiltration through the cover from precipitation and surface runoff or runon.

low saturated hydraulic conductivity. Most of the cover functions previously listed would be satisfied with the selection of the low-permeability clay, except for Items 6 and 7 which are concerned with resisting damage to the cover, because of biointrusion and freeze/thaw considerations. The need for resistance to cover damage is crucial because of the long period of time over which the covers would be expected to perform.

The COE in NUREG/CR-5432, when evaluating the various functions of a cover system, ultimately recommended that a multi-layer cover be used to take advantage of both the low-permeability soil and the good drainage and erosion-resistant characteristics of a coarse-grained soil. The intent of the multi-layer approach is to use the best material in layers that complement and improve the performance of the adjacent layers within the cover, as well as the entire cover itself. An important condition to be met when installing a multi-layer cover is that differential settlements would be minimized by requiring (1) a firm and stable foundation beneath the wastes to be placed, (2) stable waste forms, and (3) minimization of void spaces in and around waste containers. Conversely, a multi-layer cover should not be installed at a waste disposal facility if differential settlements were not to be minimal. As an example, placing a multi-layer cover over unstable Class A waste should be avoided until such time that actual settlements and subsidence would have transpired. This time frame would reasonably be expected to be very long-much longer than conventional estimates of soil settlements, because of the slow deterioration and decomposition processes that would be anticipated for the unstable wastes.

A conceptual design for a multi-layer waste cover system is provided in NUREG/CR-5432. The staff considers the conceptual multi-layer cover that is presented to have essential components that take best advantage of available soil material properties to fulfill the required waste cover functions. For this reason, the staff, in a license application review of a cover design, would compare the actual design submitted in a SAR with the recommended conceptual design in NUREG/CR-5432 to assist in the staff's evaluation and acceptance determination of the proposed cover design. Alternatives to the recommended conceptual design would be found acceptable if properly designed and documented.

Some of the important and deliberate considerations that the COE and peer review panel weighed in the development of the conceptual design may not be readily apparent. For example, the low-permeability soil layer component of the multi-layer cover that provides the greatest contribution toward minimization of infiltration and avoidance of water contacting the waste needs to be located at a depth below the maximum frost penetration at the site of the proposed facility. If the low-permeability soil were placed within the frost-penetration zone, eventual cycles of freezing and thawing of the low-permeability soil could be expected to cause large increases in the hydraulic conductivity of this layer, and thereby significantly impair the cover's intended performance.

The thicknesses of the individual soil layers comprising the conceptual multi-layer waste cover system were carefully chosen. For example, although lift thicknesses for the various filter, bedding, and drainage materials could be thinner, and this would still permit these layers to perform their intended functions, the COE's and the peer review panel's experience with actual construction practice in the placement of thin layers suggested that the recommended minimum values shown on the conceptual design be used. The field

2.3 Laboratory and Field Testing

Although separately discussed in this appendix, laboratory and field testing considerations can not reasonably be separated from the important concerns, expressed previously regarding cover design and materials selection. Laboratory testing is typically needed to evaluate the capability of soils proposed for fulfilling the required waste cover functions. The major portion of field testing is typically needed to verify that desired engineering properties are actually being obtained as a result of the construction operations, and that controls are being carried out in the field.

The COE and the peer review panel in Volume 3 of NUREG/CR-5432 provide very useful tables (Tables 2-3 through 2-5) that list laboratory tests that should be considered in determining index properties, classification, and engineering properties. In addition, because of its importance in cover design and performance, expanded discussions are provided on the laboratory testing for hydraulic conductivity (Table 2-6). Tables 2-8 and 2-9 in Volume 3 of NUREG/CR-5432 identify field tests for evaluating test fills and controlling construction of soil covers. These tables also present a useful listing of the advantages and disadvantages of the various in situ hydraulic conductivity tests. Reviewers of a license application should find the tables that list the various laboratory and field tests to be very helpful; however, a word of caution in applying the complete test listing in a licensing review is offered. When a designer is faced with the many decisions on what soil samples need to be tested and for what engineering purposes, there is a wide range of answers, and the answer is very much influenced by the experience and philosophical approach of the individual designers. There is no exact number of tests to be performed. There are overall goals and accepted practice which would warrant at least a minimum level of testing. A regulatory reviewer, therefore, would be expected to carefully review the scope and adequacy of a testing program completed by a license applicant in order for the staff reviewer to develop reasonable confidence that the testing program completed is acceptable. Important review questions to be considered in this evaluation should include: (1) Were sufficient and representative samples taken and tested; (2) Were the proper tests to establish needed engineering properties run; and (3) Was the testing that was completed properly conducted and do the results appear reasonable? Favorable answers to these questions are needed if the staff reviewer is to be able to make an acceptable evaluation finding in a SER on the adequacy of a completed laboratory and field testing program.

Table A-1 (Continued)

Characteristic	Ratings			Comments
	Preferred	Acceptable	Undesirable	
Organic Material	None	<1% by wt.	>1% by wt.	Organic material increases hydraulic conductivity, compressibility and decreases long-term stability and shear strengths.
Shear Strengths	Dependent on project-specific conditions			Minimum strength criteria must be based on site-specific considerations for stable slopes, adequate bearing capacity, limiting settlements and cracking.

2.4 Field Placement Control and Acceptance

An essential review step directed at ensuring that the designed waste cover system will fulfill the required functions is a check of the actual license application to verify that acceptable procedures have been established to control field placement of the cover materials. This verification effort should enable the staff to develop reasonable assurance that the cover will be constructed as designed, and fulfill the important commitments given in the SAR.

It is important that an applicant provide sufficient information in an SAR to show that sources for each of the proposed cover materials are available and contain sufficient volumes. The information may consist of detailed borrow area excavation plans and sections that will support the volume estimates of the needed materials. During construction, some testing of the borrow source should be periodically performed to verify that materials changes are not occurring that would adversely impact important material properties.

Testing for field quality control during actual material placement needs to be performed on the low-permeability soils and the filter and drainage materials. The COE's and the peer review panel's recommendations for the types of tests and their frequency in construction are provided on Tables 3-5 and 3-6 in Volume 3 of NUREG/CR-5432. The testing listed on these tables include (1) visual checks on lift thickness and bonding of layers, (2) observations on completeness and number of compactor passes, (3) moisture-density relationships, (4) grain size, (5) Atterberg limits, and (6) hydraulic conductivity. Tables 3-8 and 3-9 of NUREG/CR-5432, provide important and useful COE recommendations covering placement and compaction specifications, for both the low-permeability and the drainage soils. General recommendations are also offered for handling deficiencies in meeting established specification as revealed in quality control test results and inspections. An important recommendation that both the COE and the peer review panel continuously stressed was the need to require a quality assurance program that would be implemented and executed by trained, experienced professionals, including field inspectors and their supervisors. Important considerations to be addressed in a quality assurance program include: (1) a clear identification of responsibilities of the involved parties; (2) the establishment of the actual parameters to be tested, and under which test methods, and at what frequency the parameters are to be tested; (3) the defining of allowable tolerances for the measured parameters; and (4) explicit instructions for taking corrective actions whenever deficiencies are measured or observed. Construction inspection personnel need to be properly trained and familiar with the important aspects inherent in design criteria, field performance requirements, and special details pertinent to cover design and construction.

Helpful guidance is also provided in Volume 3 of NUREG/CR-5432 on special problems associated with conditioning and processing of the cover material soils, during field placement. The guidance includes recommendations for adjusting the field moisture of soils placed for compaction that are either initially too wet or dry of optimum moisture content, the breaking up of clods in low-permeability soils, and the removal of oversize or objectionable particles from the fill materials after the fill is placed in lifts.

for each of the soil characteristics listed in Tables A-1 and A-2. Soils that are not listed as either preferred or acceptable low-permeability or filter and drainage soils should not be used in a cover design, unless an applicant proposes modifications or improvements acceptable to the staff for the undesirable material, with sufficient documentation to support a regulatory evaluation conclusion that the required waste functions will be met because of the proposed modification.

Selected soils that are improved or amended with bentonite, to reduce hydraulic conductivity, would be acceptable if (1) properly designed, (2) sufficiently controlled during construction placement operations, and (3) adequately tested to demonstrate achievement of engineering properties required to meet waste cover functions. The process of blending bentonite with certain soils to reduce hydraulic conductivity, has been proven to provide satisfactory performance. Because questions remain about the long-term durability and performance of soils amended with other additives (e.g., bitumen or lime) these other amended soils may be questionable and unreliable as the primary means for satisfying long-term cover functions. Dispersive clays that are highly erosive, but otherwise may be acceptable, should not be used in cover designs where they may be directly exposed to erosive forces.

3.3. Laboratory and Field Testing

The use of Tables 2-3 through 2-5 and Tables 2-8 and 2-9 that are presented in Volume 3 of NUREG/CR-5432 is recommended as guidance for a staff reviewer, when evaluating the scope and adequacy of laboratory and field testing programs, for the low-permeability and drainage soils to be placed in a multi-layer cover design. Reasonable caution when deciding on the required number and types of tests listed on these tables needs to be followed, keeping in mind the overall objective of developing reasonable assurance on the acceptability of the testing program completed by a license applicant.

Both laboratory and field testing to establish hydraulic conductivity are acceptable practice, provided they are conducted on representative samples and recognize the limitations inherent in the selected testing equipment and procedures. It is recommended that flexible wall permeameters be used in the laboratory testing of undisturbed soil samples and that rigid wall permeameters be used for remolded, compacted soil specimens. To best duplicate the condition and structure of field compacted soils and to have the capability of testing much larger areas and volumes of soil than can be tested in the laboratory, field tests for hydraulic conductivity of low-permeability soils should be performed on test fills (not the final cover) that are constructed using the same materials and methods as would be required by the full-size cover specifications. The recommended field tests to establish hydraulic conductivity are the pan lysimeter or the sealed, double-ring infiltrometer. At least one field test for each soil type proposed for the low-permeability layer should be run. This is considered a minimum number that is essential for verifying important design parameters and to provide a good quality control check on field performance.

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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/Hydraulic Engineer

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 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, review of 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.

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 or contamination 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 final Staff Technical Position "Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings 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 channels may eventually become part of the long-term design against flooding.

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 4.1
RECEIPT AND INSPECTION OF WASTE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Radiation Protection Specialist

1.2 Secondary - Transportation Specialist

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. These criteria should provide 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 review to 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 and commitment to identify and respond to waste packages requiring remediation.

3. REVIEW PROCEDURES

3.1 Acceptance Review

The staff will review for completeness the information on receipt and inspection of waste that is provided in the SAR in accordance with NUREG-1199 and this SRP.

3.2 Safety Evaluation

The staff will review and determine whether the applicant's waste receipt and inspection procedures and waste acceptance criteria are adequate to ensure that waste entering the site will be checked to provide reasonable assurance

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 proposed frequency for direct sampling may be less than that proposed for nondestructive testing, but it should be based on a consideration of the anticipated volumes and activities and physical characteristics of the various waste streams expected to be received at the site.

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 may incorporate singly or in tandem, 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 identification and listing (40 CFR 261) are met for hazardous mixed 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

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 requirements of 10 CFR 61.55, 61.56, 61.21, 71.87, and 20.311 and 49 CFR 173.441 and 173.443 and the performance objectives of 10 CFR 61 shall be used to determine the acceptability of the applicant's procedures for the receipt and inspection of waste. The regulations applicable to the areas of

tion 4.1 is provided in the following documents:

NRC Regulatory Documents

(1) "Technical Position on Low-Level Radioactive Waste Classification and Manifest Reporting," providing Commission guidance for 10 CFR Part 61, as it pertains to acceptable procedures for classifying waste;

(2) "Technical Position on Waste Form (Revision 1)," providing Commission 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 check lists) that U.S. Nuclear Regulatory Commission and U.S. Department of Transportation waste manifest information requirements are met and (2) result in written certification by a knowledgeable and responsible individual (such as the radiation safety officer (RSO) or the RSO's authorized representive) 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, which 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 and disposition of items that are found to be in noncompliance.

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

data. The technical data base used for comparison will be based on these data and information gathered from waste manifests accompanying previous waste shipments to similar disposal sites.

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 C Waste

(a) Procedures should, as a minimum, provide verification of 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 demonstrate 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 verify that the HIC design is appropriate for any anticipated corrosive and/or 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 U.S. Department of Transporation's external radiation or surface contamination levels;

(2) waste that is not packaged properly;

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 261 Subparts C and D.

The applicant's procedures provide for adequate and reasonable measures for the disposition of vehicles and 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 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

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.

LOW-LEVEL WASTE DISPOSAL LICENSING PROGRAM

STANDARD REVIEW PLAN 4.2
WASTE HANDLING AND INTERIM STORAGE

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Radiation Specialist

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

storage with specific attention to:

(1) the use of storage space when necessary,
(2) the procedures for efficient use of storage space,
(3) the maximum allowable time that waste, especially Class C waste will be permitted to be placed in storage before disposal,
(4) the use of interim storage for efficient testing of the waste packages for container, and contents,
(5) the processes for maintaining security in the interim storage area,
(6) the procedures for maintaining the safety of the workers during the transfer into and out of interim storage, and that all Federal and State safety regulations are observed.
(7) elements of the applicant's radiation protection program which specifically address waste in storage,
(8) the applicant's criteria for waste storage,
(9) procedures for maintaining waste packages in condition suitable for disposal.

The staff will evaluate the method proposed to protect stored waste from the effects of adverse weather conditions and water runoff. In addition the staff should evaluate the method proposed for the operation of the facility during and after sustained rainfall or other adverse weather conditions. The use of equipment, its installation and the maintenance should be reviewed according to the applicable industry standards and be coordinated 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 storage of waste that have elements common to both such as;

(1) equipment commonly used in the industry as well as specialized equipment for handling and storage of waste on-site,
(2) the manpower requirements for waste handling and storage at the disposal site,
(3) the creation of decontamination waste, the procedures and processes for handling, storage, and disposition 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 recordkeeping,
(6) the contingency procedures and processes for emergency equipment failure, accidents, and extreme natural phenomena,
(7) the procedures and processes for handling and storage of fissile materials with regard to security, safety, strategic significance, and criticality safety,

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 waste handling procedures should be similar to accepted procedures at facilities of similar design. 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 storage space only when necessary, in the use of storage space efficiently, and in 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 maintenance of waste package integrity that is consistant with disposal requirements.

4.3.3 Combined Handling and Storage Considerations

The information provided by the applicant related to combined handling and storage considerations for waste received for disposal is acceptable if the applicant: 1) has provided adequate rationale for for equipment and manpower 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 offsite following offloading and, if necessary, vehicle decontamination.

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

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".

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 - Radiation Protection Specialist

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 related to maintenance of waste package integrity during movement, clarify placement in disposal units and minimization of void spaces between packages, as well as procedures for 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) covering of emplaced 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 in this SRP include all of the above procedures plus any additional necessary procedures or operations in addition to waste handling and interim storage prior to the time that 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.

In addition, the staff shall review information on procedures to produce and maintain such records as are required to demonstrate adherence to the conditions of the license and/or 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,

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 the segregation of waste to comply with 10 CFR 61.12 and 61.55. The review and evaluation shall include the information on the methods to be employed in handling and disposal 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 related to specific emplacement procedures which address high surface radiation packages, heavy or odd shaped packages, or 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

(3) the total amount of special nuclear material in grams,
(4) the disposal unit number,
(5) the dates the disposal unit 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 the closure of individual disposal units and for the placement of 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; and
(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 postoperational 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 implementing 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. Specific guidelines considered by the staff for criticality safety verification at LLW facilities are being developed by NRC staff and will be included in subsequent revisions of this document. Generally, 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 reconfiguration of buried waste.

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 20.105 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

Guidance is provided 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,

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

Applicant information related to nuclear criticality safety is acceptable if the applicant has provided evidence of commitment to assurance of nuclear criticality safety which includes procedures for verifying SNM content of packages, maintaining package configurations as required during disposal, and

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 licensee operations will be in compliance with 10 CFR 61.23(j).

The staff concludes that the applicant has provided documentation which demonstates a complete understanding of operational responsibilites regarding the disposal 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

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.

---, "Technical Position Paper on Near-Surface Disposal Facility Design and Operation," November 1982.

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 that measured 150 ft in width, 1,000 ft in length, and 37 ft in depth.

(2) A systematic placement of the 55-gal waste drums, which were stacked

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% fine particles by weight passing the No. 200 mesh sieve and not more than 40% by weight of particles that are coarser than the 3/4-in. size and a maximum particle size not greater than 3 in. Limiting the percentage of fines to 12% 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 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 3 in. maximum particle size is recommended on the basis of the anticipated size of the unfilled intercontainer void space when 55-gal 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, to the extent practicable in keeping with the principles of ALARA, 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

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

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 5.1.1
SURFACE DRAINAGE AND EROSION PROTECTION

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 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(g), 61.23, and 61.52. The major review areas related to this aspect of the site design are identical to those given 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, review of 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,

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

Same as those listed in Section 7 of SRP 6.3.1.

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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 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 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 any movement of radioactivity may be detected and controlled, if necessary. The environmental monitoring program covers air pathways,

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 would 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

Performance assessment is defined as the analysis of a low-level waste disposal site's future behavior in terms of the annual dose to off-site individuals as specified by 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.

Analyses of the stability of the disposal site after closure (61.44) are related to performance assessment to the degree that post-closure stability could influence radionuclide releases off-site. The review evaluation and findings under the other sections in SRP 6 (SRP 6.2, Intruder Protection; SRP 6.3.1, Surface Drainage and Erosion Protection; SRP 6.3.2, Stability of Slopes; and SRP 6.3.3, Settlement and/or Subsidence), are directed at the long-term stability issues typically evaluated independently of topics perceived to fall within the

Table 6.1-1 (Continued)

Scenario	Radiation*	Release/transport mechanism	Human access location	Theoretical periods of concern**
(8) Waterborne releases from contaminated surfaces such as buildings and grounds	a,b,g	Surface water runoff	Nearest offsite watershed	O,C,S,I,P
(9) Waterborne disperson of contamination unearthed by plants and animals	a,b,g	Surface water runoff	Nearest offsite watershed	O,C,S,I,P
(10) Waterborne discharges from disposal cells (e.g., from trench sumps)	a,b,g	Surface water runoff	Nearest offsite watershed	O,C,S,I,P
(11) Waterborne 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 6.1-3 Impacts on onsite individual during institutional control per d

Scenario	Radiation*	Release/ transport mechanism	Human access location	Dose rates calculated**
(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.

Assessment Approach

A Low-Level Waste Disposal Site Performance Assessment Strategy is described by Starmer and others (1988). The strategy sets out performance assessment approaches that should be used by the license applicant and by the NRC staff in reviewing the applicant's work. The approaches center on the defensible use of models and codes for analyzing the performance of the various disposal site subsystems of a low-level waste disposal facility. The strategy is founded on the regulatory principle that exact predictions of off-site radiological exposures are not required for determining regulatory compliance. Due to the uncertainties inherent in analyzing natural and engineered systems, a performance assessment model(s) can not reasonably be expected to be an exact representation of an actual disposal system. However, to provide reasonable assurance that the performance objective (10 CFR 61.41) for off-site releases of radioactivity will be met, performance assessment models should be developed to bound the relevant behavior of the system. Although the staff strategy emphasizes applying conservatism in modeling to bound performance estimates, analytical assumptions should not be too far removed from reasonably expected circumstances.

A demonstration of compliance with the off-site dose limits established in 10 CFR 61.41 should be based on estimates of maximum dose rates extrapolated over time frames that are consistent with the radiological hazard associated with the most environmentally mobile long-lived radionuclides in the waste inventory. The overall approach for the applicant to make this demonstration should consist of two phases. In the first phase, the applicant should identify a complete set of possible release scenarios and pathways, and eliminate those from the set that are trivial, restrictive, or obviated by other scenarios. Combinations of release processes that have an extemely low probability of occurrence need not be considered. Release scenarios should be based on a reasonable range of future conditions. The applicant should provide the rationale used to eliminate potential pathways and scenarios. The set of defensible pathways and release scenarios that remain after careful examination represents the conceptual model(s) to be analyzed for the performance of the waste disposal system.

In the second phase of the performance assessment, the applicant should estimate peak doses to maximum exposed individuals based on quantitatively analyzing the disposal site conceptual model. The Performance Assessment Strategy recommends that applicants should use a "modular" modeling approach to quantify potential release and transport of radionuclides through significant environmental pathways. Depending on site specific conditions and facility design features, modeling of the disposal system should consist of at least the following discreet submodels: cover performance (infiltration, vadose zone flow, and percolation into disposal units); radionuclide releases from the near-field (loss of containment integrity, leaching, and near-field transport); groundwater transport (unsaturated and saturated zones beneath disposal); surface water and atmospheric transport; plant and animal uptake; and human dose. To assist the responsible regulatory agency in understanding dose estimates, the inputs to and outputs from individual models should be available for inspection.

demonstration. Staff modeling should be compatible with the quality and amount of data available to support performance assessments. At a minimum, the NRC staff will determine that sufficient data have been provided by the applicant to assure that performance modeling is representative of the actual disposal system. The NRC staff will review the applicant's modeling and evaluate whether the applicant's assessment provides reasonable assurance of regulatory compliance.

A typical level of independent NRC staff review could consist of the following elements:

(1) Critical review of the applicant's performance assessment, including the development of review comments and evaluating the applicant's responses to the comments;

(2) Performing selected audits of model applicability using simple, conservative models;

(3) Independent verification of the most significant performance assessment results using computer codes that have been verified, benchmarked, and documented in accordance with NRC guidance; and

(4) Assessment of uncertainties inherent in performance assessments and determination that they have been adequately considered in the results.

Although the discussions in this SRP emphasize the numerical aspects of performance assessments, the applicant's commitments and proposed limits on operations (e.g., commitment to limit site inventories of particular radionuclides or to impose particular requirements on waste form and packaging), and operational experience and training should also be considered when assessing disposal site performance. In addition, operational release pathways or exposure mechanisms that are easily monitored, and if necessary readily mitigated by operational efforts, need not be considered for numerical analysis. However, to the extent that the monitoring program is counted on as providing assurance of safety, the NRC staff should confirm that the monitoring program, including action levels proposed by the applicant, will provide early warning of radionuclides releases from the disposal site before they leave the site boundary.

To a large extent, performance assessments conducted at the time of licensing can only be regarded as the initial assessment. Final assessment of actual disposal site impacts should be made as part of the licensee's final closure plan pursuant to 10 CFR Part 61.28. At final closure the licensee should be able to provide more specific details regarding the as-built condition of the disposal facility, final cover details and actual emplaced cover characteristics, and actual radionuclide inventories. Furthermore, final performance assessments will benefit from years of monitoring data that should be used to increase confidence in the validity of performance assessment models and predictions.

A Performance Assessment Methodology (PAM) was developed for the NRC at Sandia National Laboratories to define procedures, approaches, models, and codes acceptable to the NRC staff for assessing the performance of low-level waste disposal

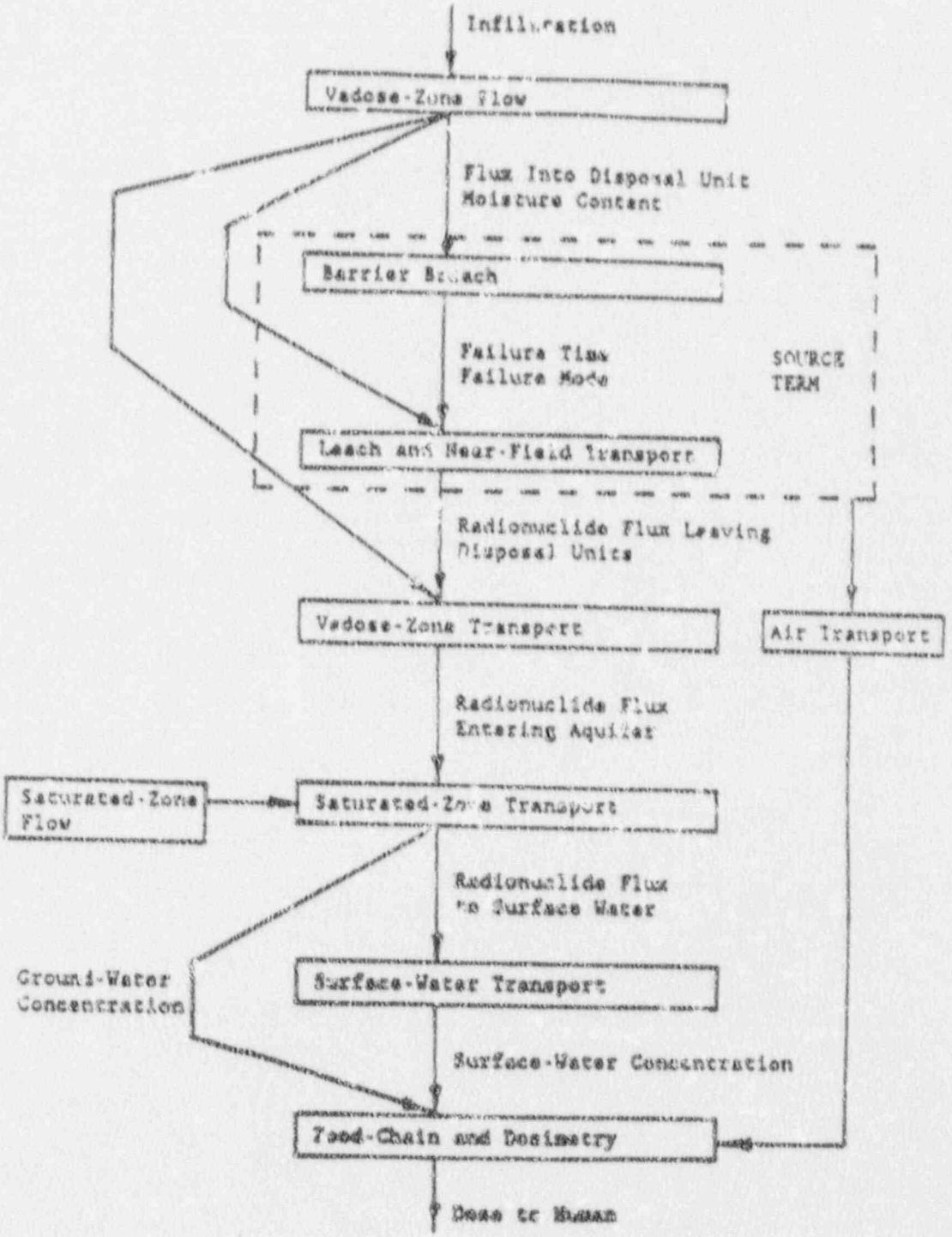

Figure 6.1-1: Components and Processes in Low-Level Waste Disposal Site Performance Assessment

Before reviewing and assessing the performance of a low-level waste disposal facility, NRC staff conducting the review should be thoroughly familiar with the guidance presented in this introductory SRP, including the Performance Assessment Strategy; and the approaches, models and, codes described in the Performance Assessment Methodology.

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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/Hydraulic Engineer

1.2 Secondary - Geologist/Geomorphologist

1.3 Supporting - None

2. AREAS OF REVIEW

The staff will revis. those hydrologic and hydraulic 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(c) 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 catchment 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:

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 provide an explanation why the recommended information is not provided. 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 Final Staff Technical Position (FSTP), "Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites."

The initial staff review of the PMF estimates will be a comparison of the applicant's estimates with actual recorded floods in the United States and in the region. Since most properly-computed PMF estimates will exceed recorded floods, the historic regional floods provide a general lower limit of the PMF.

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 the FSTP (USNRC, 1990).

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 post-construction 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.

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 dam-site 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 the FSTP (USNRC, 1990). 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.

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.

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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 - Performance Assessment Specialists

2. AREAS OF REVIEW

The staff should review the areas of the SAR in Sections 2.1 through 2.4 of this SRP to determine if the applicant has adequate procedures and poli n place to ensure that occupational radiation exposures will be within t.. limits of 10 CFR Part 20 §§ 20.101, 20.103, and 20.104, and will be maintained as low as is reasonably achievable (ALARA) in accordance with 10 CFR 61.43 and 10 CFR 20.1(c).

The staff should review the management policy as it relates to the commitment to integrate the ALARA process into all related activities involving potential exposures of personnel. The review should determine if organizational structure and personnel responsibilities and activities of the applicant are adequate to ensure that ALARA policy and procedures will not be compromised due to pressures from operational activities. The review should also determine if the ALARA policy applied to facility operations, training, development of radiation protection procedures, and design reviews are adequate. This review will be coordinated with the review of SRPs 8.1, 8.2, 8.3, and 8.6 regarding organizational structure, qualifications, and training, and operating procedures.

This review should use detailed design and operational information provided by the applicant in SRPs 3.1 (section 4.3.9), SRP 4, SRP 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 in accordance with NUREG/CR-3343 and Regulatory Guides (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.

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 review should determine if the ALARA policy includes a communication network from management to the staff and from the staff to management 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 being taken into account.

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, functionally allow the implementation of the ALARA policy, and allow the radiation protection management to have direct access to facility management as outlined in NUREG/CR-3343, RGs 8.8 and 8.10. The review should also determine the adequacy of the applicants qualifications and training program. The qualifications and training program for ALARA should include the elements provided in Section 3 of NUREG/CR-3343, RG 1.8, 8.8 and 8.10. This review should be coordinated with the review of 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 whether 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 design review should be conducted 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. Operating experience to improve the design of the facility with regard to ensuring that occupational radiation exposures will be ALARA should also be considered. This review will be coordinated with the reviews for SRPs 3.1, and 7.3.

The staff should review the SAR submitted by the applicant to determine how 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

to the applicant conducting operations in compliance with 10 CFR 20 and maintaining radiation exposures as low as is reasonably achievable.

(6) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site Closure," as related to maintaining exposures ALARA during facility operations.

(7) 10 CFR 19.12, "Instructions to Workers," 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 20.1, "Purpose," (c), as related to the applicant involved in licensed activities making every effort to maintain radiation exposures ALARA.

(9) 10 CFR 20.101, "Radiation Dose Standards for Individuals in Restricted Areas."

(10) 10 CFR 20.103, "Exposure of Individuals to Concentrations of Radioactive Materials in Air in Restricted Areas."

(11) 10 CFR 20.104, "Exposure of Minors."

4.2 Regulatory Guidance

Regulatory guidance to aid the applicant in meeting the requirements in Section 4.1 is provided in the following documents and are to be applied in relation to 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 20.1(c).

(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 20.1(c).

(6) continuing facility design reviews by competent radiation protection professionals.

Alternative proposed design policies are evaluated on the basis of a comparison with the design guidance in section 2.4 of NUREG/CR-3343 and in RG 8.8. The staff should evaluate information from SRPs 3.1 (section 4.3.9) and SRP 7.3 for acceptability based on NUREG/CR-3343 and RG 8.8 as related to design review.

Acceptability should be based on evidence that the applicant has prepared the radiation protection 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 20.1(c) to assure that occupational exposures will be maintained ALARA. The review 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 as all parts 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 ALARA review of occupational monitoring and dose assessment. The staff should review information provided 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 that the exposures meet the requirements of 10 CFR 20 and 10 CFR 61.43.

Also, the staff should determine if the guidelines of NUREG/CR-3343, including the criteria, concepts, and implementation schemes to be included as part of the operational radiation protection programs for the waste disposal facility. This review will be coordinated with the review of information in SRP 7.4.

5. EVALUATION FINDINGS

5.1 Introduction

The staff review should verify that sufficient information has been provided in the license application and amendments 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(c), and 10 CFR 19.12. The staff can document the review as follows.

5.2 Sample Evaluation Finding

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, ALARA provisions of 10 CFR 20.1(c) and 10 CFR 61.43, ALARA organizational structure and responsibilities of 10 CFR 61.11 (b1 and b2), NUREG/CR-3343, and RG 1.8. Assurances of compliance with dose limits stated in 10 CFR 20 as required by

7. REFERENCES

Code of Federal Regulations, Title 10, "Energy," U.S. Government Printing Office, Washington, D.C., 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.

U.S. ---, Regulatory Guide 1.8, "Personnel Selection and Training."

U.S. ---, Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Plants Will Be As Low As Is Reasonably Achievable."

U.S. ---, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable."

---, 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 in 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, "Waste classification," and 10 CFR 61.56, "Waste Characteristics." Once the sources of radiation exposures are determined, areas of the Sections 2.1 and 2.2 of this SRP should be reviewed to determine if the applicant has adequate procedures and policies in place to ensure radiation protection related to the involved inventories during normal operations, anticipated operational occurrences, and accident conditions according to 10 CFR 61, "Subpart C--- Performance Objectives."

2.1 Waste Inventories

The description of radioactive waste inventories during normal operations and under accident conditions at the facility should be used as the basis for designing the radiation protection program. Provisions for the labelling of radiation areas according to 10 CFR 20.203 should be determined by the concentration and quantities of radionuclides and should be described as part of the radiation protection plan. The location of the sources of radiation exposures must also be defined. The radionuclides are also to be identified by their type as source, byproduct, or special nuclear material.

Provisions should be provided for both disposed waste inventories and temporary storage waste inventories.

2.2 Airborne Radioactive Material Sources

The type and concentration of airborne radioactive material sources at the facility are determinant factors in the design of the ventilation systems, and personnel protective and monitoring measures. An assessment of the contribution to effluent releases according to 10 CFR 61.53 should be performed. The description of airborne radioactive sources should include: 1) the type of airborne radioactive material, 2) a table of the respective calculated concentrations expected during normal operations, operational occurrences, and accident conditions, 3) the models and corresponding

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if the respective requirements in 10 CFR 61 and 10 CFR 20 are met, and if the required information delineated in Section 7.2 of NUREG-1199 is provided.

The specific parts of the regulations applicable to the areas of review in this SRP are as follows:

(1) 10 CFR 20.101, "Radiation dose standards for individuals in restricted areas (a, b1, b2, b3)," as related to limiting radiation doses to protect individuals in restricted areas from whole- or partial-body exposures.

(2) 10 CFR 20.103, "Exposure of individuals to concentrations of radioactive materials in air in restricted areas (a1, a2, a3, b1, b2, c, c1, c2, c3, c4, d, e, f, g)," as related to limiting the average concentrations of airborne radioactive materials to protect individuals in restricted areas, radiation protection control of inhalation, and absorption of materials.

(3) 10 CFR 20.104, "Exposure of minors (a, b, c)," as related to limiting exposure of individuals under 18 years of age to 10 percent of the limit specified for adults.

(4) 10 CFR 20.105, "Permissible levels of radiation in unrestricted areas (a, b1, b2, c)," as related to the limits of radioactive materials in possession proposed by the applicant, and the demonstration that the proposed limits do not pose doses in excess of permissible levels.

(5) 10 CFR 20.106, "Radioactivity in effluents to unrestricted areas (a, b1, b2, c1-7, d, e, f)," as related to the determination of levels of radiation and concentrations of radioactive materials within the components of the waste treatment systems.

(6) 10 CFR 20.203, "Caution signs, labels, signals and controls (a1, a2, b, c, e)," as related to labelling radiation sources in order to minimize exposures to individuals.

(7) 10 CFR 20.205, "Procedures for picking up, receiving, and opening packages (a1, a2, b1, b2, c1, c2, d)," as related to individual exposure to external contamination and contamination removal.

(8) 10 CFR 20.207, "Storage and control of licensed materials in unrestricted areas (a, b)," as related to securing licensed materials against unauthorized removal by individuals.

(9) 10 CFR 61.12, "Specific technical information (b, c, f, h, j, k, l, 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.

(10) 10 CFR 61.13, "Technical analyses (c)," as related to assessments of expected exposures to individuals during routine operations and accident

locations, source descriptions should include accessible waste packages in areas of active disposal. The radionuclides described by the applicant should be those used in the dose assessment performance.

Acceptability should be based on evidence that the applicant describes 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. Chapter 7.0 of NUREG/CR-3343 provides recommendations for a well-planned and constructed disposal site that limits individual and equipment contact with the radiation sources. The description provided 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 type of facility and method of disposal. Additional coordination will be necessary with the review of source term analysis under the Performance Assessment Review activities of SRP 6.

Acceptability should be based on evidence that the applicant has described all waste and stored inventories and airborne sources. The description of waste inventories should include plan drawings where 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 respective tables containing pertinent quantitative parameters.

The description of airborne sources should be located on drawings to facilitate appropriate design of proper ventilation and monitoring systems when the airborne sources are 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 20.103, Appendix B. All assumptions made during the calculation of quantitative values of the appropriate sources should be specified also.

Acceptability of the source parameters should be based on whether accompanying text specifically explains the values used in the radiation protection calculations and in ventilation designs. The source parameter tables can be placed in Section 9 or referenced in other sections.

5. EVALUATION FINDINGS

5.1 Introduction

The staff review 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 (6a), 10 CFR 20.101 (a, b1, b2, b3), 10 CFR 20.103, 10 CFR 20. 105, and 10 CFR 20.106. The staff can document the review as follows.

5.2 Sample Evaluation Findings

a) 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.

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/CR-3343, "Recommended Radiation Protection Practices for Low-level Waste Disposal Sites," December 1983.

---, 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.

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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 7.3
RADIATION PROTECTION DESIGN FEATURES AND OPERATING PROCEDURES

1. RESPONSIBILITY FOR REVIEW

1.1 Primary - Health Physicist (HP), Construction Engineer, Safety Engineer

1.2 Secondary - Performance Assessment Specialist

2. AREAS OF REVIEW

The staff should review the areas of the SAR in Sections 2.1 through 2.5 of this SRP to determine if the applicant has adequate procedures and policies in place to ensure that occupational radiation exposures will be maintained within the limits of 10 CFR Part 20 §§ 20.101, 20.103, 20.104, and ALARA in relationship to design features and operating procedures. The major factors influencing design features are dose rates, anticipated operational occurrences, and accident conditions.

2.1 Specific Facility Design Features

NUREG/CR-3343 states in Section 2.4, "The design of facilities and equipment necessary for the performance of work with radioactive materials provides an early opportunity to ensure radiation exposures are as low as reasonably achievable." Considerations for design should include the functional aspects of the facility and also radiological factors including radiation zone designations for normal and accident operations. Alternative methods of disposal (alternate to shouldow land burial, SLB), such as those described in NUREG/CR-3774, Vols. 1-5, will have significant design and operating features that must be considered in this review.

The facility design should follow 10 CFR 61.12 (all parts), "Specific technical information." The illustrative examples of the components and systems listed in Sections 7.1 and 7.3 of NUREG-1199. The drawings should show scaled layouts, arrangements of all radionuclide inventory locations, and other design details as required. Shielding and ventilation system specifications should be specified either on the drawings or in separate tables.

Implementation of the aspects that can be applied to LLW disposal facilities in NRC Regulatory Guides 1.69 ("Concrete Radiation Shields for Nuclear Power Plants") and 8.8 ("Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be As Low As Is Reasonably Achievable") should be considered by the applicant and reviewed by the staff. 10 CFR 20.1, "General Provisions - Purpose," should also be used as guidance to ensure that the ALARA principle is employed in facility design.

should also be included.

2.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Subpart D of 10 CFR 61 (61.50, (2)), "Technical Requirements for Land Disposal Facilities," lists the capabilities of the disposal site including the ability to be monitored. Guidance for the applicant is provided in Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring," and U.S.A. Standards Institute document, USAS-N13.2-1969, "USA Standard Guide for Administrative Practices in Radiation Monitoring. 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 for placement of monitoring devices, and additional details, are designated in Section 7.3 of NUREG-1199. The ALARA principle should apply to monitoring under the guidance given in Regulatory Guide 8.8 (all parts as 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 review should evaluate the criteria and method for obtaining representative samples of airborne radioactivity concentrations in work areas. Procedures for locating suspected high-radiation areas and areas of suspected high concentrations of airborne radioactivity should be included in the SAR. The high-range radiation monitoring capability during and after accident conditions should be included also and reviewed by the staff (10 CFR 20.203, all parts).

2.5 Operational Procedures

The staff should review the methods used to develop detailed operational plans and procedures to determine if the ALARA management policy is adequately addressed in the development of such plans and procedures. The review should determine if information from past experience and other design features and operations are incorporated into the operational plans and procedures. The staff should also review the descriptions of criteria and conditions under which various operating procedures are implemented for specific operations. The review should determine if the applicant has addressed how operating procedures are reviewed and updated as a result of ALARA audits. The review should determine if the applicant has implemented the management policy regarding ALARA in the radiation protection program. This review will be coordinated with the review of information in SRP 7.4 and SRPs 4.1, 4.2, 4.3, and 5.2. SRP 7.4 discusses the radiation protection program and procedures, while SRPs 4.1, 4.2, and 4.3 describe the procedures for the receipt and inspection of waste, waste handling and interim storage, and waste disposal operations. SRP 5.2 describes the review for the applicants decontamination and decommissioning program. SRP 8 also addresses operational concerns and will have significant impact on this review.

2.6 Dose Assessment

The radiation dose standards are set forth in 10 CFR 20.101. The basis for the dose assessment should include detailed information on the expected occupancy of site radiation areas for each radiation zone, and the estimated

The staff should evaluate the adequacy of the shielding design on the basis of acceptable radiation shielding codes. Verification of calculations may be made 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 rearrangement of radiation zones or relocation of equipment.

The staff should determine whether the applicant has followed guidance provided in Regulatory Guides 1.69, 8.2, and 8.8 (as described above), and design feature safety procedures set forth in NUREG/CR-3343 (Sections 2.0 and 6.0), to meet the requirements of 10 CFR 20. Comparison with current industry standards should also be employed. Verification of the applicant's reference to guides and regulations should be performed. The alternatives described by the applicant should be validated by comparison with those alternatives described in the cited regulatory guides.

The staff should review the SAR to determine that the recommendations made in Chapter 7.0 of NUREG/CR-3343, "Contamination Control and Decontamination," have been adequately addressed by the applicant. Procedures for receiving and inspecting waste will be evaluated to ensure that adequate protection from radiation exposures resultant from damaged or opened packages will be maintained. Classification of sources identified as long-lived and short-lived, and respective concentrations of the inventories will also be evaluated. Coordination with review of SRP 4 is suggested for 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 respective requirements in 10 CFR 61 and 10 CFR 20 are met, and if the required information delineated in NUREG-1199 is provided.

The specific parts of the regulations applicable to the areas of review in this SRP are as follows:

(1) 10 CFR 20.1, "Purpose (c)," as related to persons involved with licensed activities making every reasonable effort to maintain radiation exposures ALARA.

(2) 10 CFR 20.101, "Radiation dose standards for individuals in restricted areas," as related to design features, shielding, ventilation systems, monitoring, and dose assessment for the purpose of controlling occupational radiation exposures.

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) U.S. AEC Regulatory Guide 1.69, "Concrete Radiation Shields for Nuclear Power Plants," 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) U.S. AEC Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring," as related to radiation monitoring programs influencing design criteria.

(3) U.S. NRC 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 compliance with 10 CFR 20.1 (c) concerning actions taken during design, construction, operation, and decommissioning to ensure that occupational exposures ALARA.

(4) U.S. NRC Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable," as related to compliance with 10 CFR 20.1 (c) in maintaining occupational exposures ALARA and influencing the design features.

(5) NUREG/CR-3343, "Recommended Radiation Protection Practices for Low-Level Waste Disposal Sites (Section 2.4)," 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 prevention of criticality accidents during handling, storing, processing, and transporting of 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

The areas in the general facility site and the areas inside of the structures should be subdivided into radiation zones and labelled according to 10 CFR 20.203, "Caution signs, labels signals and controls." The radiation zones are identified according to design dose rates and the criteria used in selecting maximum dose rates. Maximum zone dose rate should be defined for each zone according to anticipated occupancy and access control. The areas that are to be occupied on a predictable basis 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 within the limits set forth in 10 CFR 20.

The bases for the dose rates are the number of persons occupying a zone and the time occupying or passing through the zone. The anticipated operational occurrences include waste receipt, handling, processing, storage, and emplacement for disposal; routine operational surveillance and inspections; and normal maintenance. The facility can be zoned and sufficient radiation protection can be incorporated in the design features so that individuals should receive a fraction of the 10 CFR 20 dose limits on the basis of experience from operating facilities and predictions made for new designs.

Procedures provided by the applicant as having significant impact on occupational exposures will be thoroughly evaluated to determine whether correct procedures are in place considering ALARA provisions. All other procedures submitted by the applicant and reviewed under SRPs 3, 4, and 8 will also be reviewed to determine whether all significant potential doses have been considered. Procedures should be evaluated on the bases of the proposed radiation protection program as described in the next section.

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 in-house codes to perform shielding calculations to ensure reliability and accuracy.

ANSI N101.6-1972, "Concrete Radiation Shields," provides guidance on the fabrication and installation of concrete shields for occupational radiation protection that can be used by the applicant when applicable to LLW disposal facilities. Acceptability of shield construction should be based on guidance from the documents mentioned above or an alternative proposal deemed acceptable by the staff. Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be As Low As Is Reasonably Achievable," provides additional acceptance criteria regarding shielding and isolation in radiation protection design that can be applied to LLW disposal facilities in specific instances.

4.3.3 Ventilation Systems

Acceptability of ventilation systems should be based on the criteria for ventilation rates that ensure the radioactivity in the airflow remain ALARA from low to high potential airborne radioactivity areas, and through filters and vents. Also, the ventilation systems are acceptable if the applicant has

actual sampling process proposed by the applicant and the techniques involved in the sampling. Detailed air sampling procedures are also described in NUREG/CR-3343, Section 6.11. Acceptability of the airborne radioactivity monitoring system is based on the following criteria:

(1) Identification of the radionuclides likely to be present and potential maximum concentration of radionuclides should be provided by the applicant in accordance with 10 CFR 20, Appendix B, Table 1, as described in NUREG/CR-3343, Section 6.11, "Air sampling/monitoring."

(2) Air should be sampled at normally occupied locations with the potential for 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 should be capable of detecting maximum permissible concentration (MPC)-hours of particulate radioactivity from any normally occupied area that may contain airborne radioactivity. Dilution in the ventilation system should be taken into account. NUREG/CR-3343, Section 6.11 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 at 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. Guidance for the choice of air filters is given 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 should have an audible alarm and variable alarm setpoints. Monitors in high-noise areas should also have visual alarms.

(8) Readout and annunciation are provided in a centrally-manned location.

(9) The applicant should make provisions for changes in air sample characteristics that are anticipated with changes in operations (NUREG/CR-3343).

(10) Air sampling should consider physical characteristics, such as particle size, to assist in the determination of intake and exposure pathways or mechanisms.

Accident Radiation Monitoring Systems

The following Regulatory Guides provide guidelines that can be applied to LLW disposal facilities in part and can be used by the applicant where appropriate. The Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring," provides guidance on surveys to evaluate radiation hazards. Instrumentation to monitor for accidental criticality is acceptable

within regulatory limits and ALARA, consistent with 10 CFR 20.1 (c), and the dose-limiting provisions of 10 CFR 20.101, 10 CFR 20.103, 10 CFR 20.203, and 20.207. The guidance provided in Regulatory Guides 8.8 and 8.10 has been considered by the applicant. The design features incorporated on the basis of experience gained on 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 have the potential to limit exposure to workers during operations, to provide remote operational capability, to reduce the time required for work in radiation fields, and any other features to reduce radiation exposure to workers.] These design features are consistent with Regulatory Guide 8.8 and are acceptable to the staff.

d) Access control is in accordance with 10 CFR 20.203 and is acceptable.

e) The applicant has described the [number] zones contained within the restricted area. The dose rate criteria for each of the zones is derived from expected occupancy and access restrictions. These criteria are used as the basis for the radiation shielding design and allows for selection of equipment in accordance with Regulatory Guide 8.8. During facility operations and under refueling conditions, provisions have been made for the health physics staff to re-evaluate area access classifications and to monitor area entry for the purpose of updating zone postings and entry requirements in accordance with 10 CFR 20.203.

f) The radiation sources, as reviewed according to SRP 7.2, capable of producing radiation levels in excess of 100 rads per hour should be shielded and clearly marked (10 CFR 20.203), indicating that potentially lethal radiation fields are possible.

g) When temporary shielding is used, the applicant has made provisions for administrative controls will be initiated (Regulatory Guide 8.2). Local audible and visual alarming monitors will be installed to alert personnel when temporary shielding is removed.

h) 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 Regulatory Guide 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 Regulatory Guide 8.10 and are acceptable.

i) The general shielding design methodologies and source term inventories for the [name the facility] are similar to operating facilities.

j) The basic radiation transport analysis used by the applicant for the shielding design is based on the following codes and are acceptable: [list the appropriate computer codes].

k) All concrete shielding in the facility will be constructed in general compliance with Regulatory Guide 1.69. The staff finds the shielding design and associated methodologies in the application acceptable.

l) The ventilation system designed by the applicant ensures that personnel

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), Regulatory Guide 8.12, and ANSI N16.2-1969.

s) The dose assessment provided by the applicant complies with Regulatory Guide 8.19 and is acceptable. The dose assessment includes a completed summary table of occupational radiation exposure estimates and a detailed explanation of the dose assessment process. The applicant has made provisions for a systematic, ongoing review of the design features and facility operations. Review procedures are described. This ongoing review includes recording procedures and documenting requirements, and identifying the ALARA-related changes resulting from 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 in the SRP except when the applicant proposes an acceptable alternative method for compliance with NRC regulations dictated by variances in facility design.

7. REFERENCES

American National Standards Institute, 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, Wasnington, D.C., revised annually.

---, 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.

U.S. Nuclear Regulatory Commission, NUREG-1[illegible], "Standard Format and Content of a License Application for Low-level Radioactive Waste Disposal Facility," Rev.1, January 1988.

---, 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

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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 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 given in the following sections of this SRP to determine if the applicant has adequate procedures and policies in place to that occupational radiation exposures will be maintained by the propagation of a radiation protection program. The factors influencing the radiation protection program are: ALARA programs, training programs, external and internal exposure control, respiratory protection, surveillance, radioactive waste management, facilities and equipment selection, and external dose analysis (NUREG/CR-3343).

2.1 Organization

Guidance for the responsibility and authority for the radiation protection program is given in NUREG/CR-3343, Section 2.2. The description of the program should include the administrative organization, including the authority and responsibility of personnel 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 personnel responsible for supervising the handling and monitoring radioactive material should also be indicated. The program should encompass a feedback mechanism that will be evaluated by the staff.

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

Guidance for the selection and implementation of equipment, instrumentation, and operations is found in Section 6 of NUREG/CR-3343. The applicant should describe the criteria for selecting portable and laboratory equipment, and instrumentation for performing radiation and contamination surveys. The equipment and instrumentation should be used for airborne radioactivity monitoring and sampling, area radiation monitoring, and for personnel monitoring during normal operations, anticipated operational occurrences, and

The applicant should indicate that the equipment necessary to measure radioactivity, radiation fields, and exposures are adequate. The number, type range sensitivity, calibration method and frequency, availability, and planned uses of the equipment should be described by the applicant. The applicant should also describe the planned uses of portable, fixed, laboratory, and personnel monitoring instrumentation. The planned uses of equipment should be verified by the staff for adequacy 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 applicant should provide the methods for ensuring the development of the training and indoctrination program and radiation protection instruction manuals are accounted for by the applicant. The review should verify that the applicant has formulated procedures to control storage and movement of radioactive material, to control exposures, and to control contamination. The applicant should show that procedures are in place whereby the management and radiation protection staff will become involved in review activities for potential and actual activities exceeding prespecified exposure levels.

The review of the plant organization, the functional responsibilities, and the qualifications of personnel are reviewed with SRP 8.2. The staff will review the radiation protection organization, function, and personnel qualifications using the criteria that can be applied to LLW disposal facilities in Regulatory Guides 1.8 and 8.8, and in accordance with 10 CFR 61, "Subpart C--Performance Objectives."

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 of this SRP.

4. ACCEPTANCE CRITERIA

4.1 Regulatory Requirements

The information in the SAR is acceptable if the respective requirements in 10 CFR 20 and 10 CFR 61 are met, and if the required information delineated in NUREG-1199 is provided.

The specific parts of the regulations applicable to the areas of review in this SRP are as follows:

(1) 10 CFR 19.12, "Instruction to Workers," 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 20.1, "Purpose (c)," as related to personnel involved in licensed activities maintaining radiation exposures ALARA.

(3) 10 CFR 20.101, "Radiation Dose Standards for Individuals in Restricted

(16) 10 CFR 61.11, "General Information," as related to the organizational structure and authority, and training requirements of key personnel.

(17) 10 CFR 61.12, "Specific Technical Information," as related to maintaining occupational exposures ALARA.

(18) 10 CFR 61.13, "Technical Analyses," as related to assessments of expected exposures due to routine operations and under accident conditions.

(19) 10 CFR 61.23, "Standards for Issuance of a License," as related to providing reasonable assurance that the standards for radiation protection will be met.

(20) 10 CFR 61.24, "Conditions of Licenses," as related to the requirement to maintain reports and provide adequate record-keeping.

(21) 10 CFR 61, "Subpart C---Performance Objectives," as related to maintaining occupational exposures ALARA.

(22) 10 CFR 61, "Subpart D---Technical Requirements for Land Disposal Facilities," as related to the capability of the facility design to be adequately monitored.

(23) 10 CFR 61.52, "Land Disposal Facility Operation and Disposal Site closure," as related to placement, characterization, and accurate location of waste to maintain occupational exposures ALARA.

(24) 10 CFR 61.55, "Waste Classification," as related to 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 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

(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 8.29, "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.

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

Evaluation criteria should include the results from dose assessment calculations exhibiting that the occupational doses will remain consistently below action levels and will not exceed regulatory limits considering all

including audible alarm dosimeters for early determination of individual doses (Regulatory Guides 8.4),
(c) count rate meters or personnel air samplers to be worn on protective clothing, and
(d) film badges or thermoluminescent dosimeters (TLDs) in accordance with Regulatory Guide 8.3.

(4) Respiratory protection equipment should conform to 10 CFR 20.103. 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), and
(f) full-face mechanical filter respirators.

(5) Acceptability should be based on the guidance of Regulatory Guide 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 rooms 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 20.203, 10 CFR 20.204, and 10 CFR 61.55,
(f) storage and control capability for licensed materials in unrestricted areas in accordance with 10 CFR 20.205 and 10 CFR 20.207, and
(g) at least one readily accessible radiation protection station used for storage of 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

Acceptability should be based on access control criteria in accordance with 10 CFR 20.203, 10 CFR 61.12, NUREG/CR-3343, and the RGs as applicable to licensees, Regulatory Guide 1.8, Regulatory Guide 8.8, and Regulatory Guide 8.10. Appropriate alternatives may be considered by the staff if applicable.

The Radiation Protection Program should be reviewed to ensure that procedures are in place to assess whether the regulations governing disposal activities are adequately addressed.

5.2 Sample Evaluation Findings

a) The staff has reviewed the radiation protection program for [name of facility] low-level, waste disposal facility according to Standard Review Plan 7.4.

b) On the basis of the following findings, the staff concludes that the program is acceptable and complies with 10 CFR 19.12, 10 CFR 20 and 10 CFR 61.

c) The objectives of the radiation protection program are to provide reasonable assurance that the limits set forth in 10 CFR 20.101, 10 CFR 20.103, 10 CFR 20.104, 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 objective of the radiation protection program is to reduce unavoidable exposures, and maintain occupational exposures and person-rem doses ALARA.

d) The duties of the facility radiation protection manager include [list duties]. The radiation protection organization and implementation of the program is acceptable and complies with 10 CFR 19.12, 10 CFR 20.1 (c), and Regulatory Guides 1.8, 8.2, 8.8, 8.10, and 8.13. The applicant has made provisions for the training of personnel and qualifications descriptions in accordance with the regulations.

e) 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.

f) Both permanent and temporary facility personnel should be assigned beta-gamma 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.

g) The applicant has made provisions for caution signs, labels, and signals in accordance with 10 CFR 20.203 and 20.204, 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.

h) 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 bioassays have been made by the applicant and are acceptable. Whole-body counts of all facility personnel should be provided in accordance with 10 CFR 20.103.

---, 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.

---, 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 Reasonably Achievable."

---, Regulatory Guide, 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program."

---, Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposure 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."