
Standard Format and Content of a license application for a **Low-Level Radioactive Waste** **Disposal Facility**

Safety Analysis Report

**U.S. Nuclear Regulatory
Commission**

Office of Nuclear Material Safety and Safeguards

January 1987



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Standard Format and Content

of a license application for a Low-Level Radioactive Waste Disposal Facility

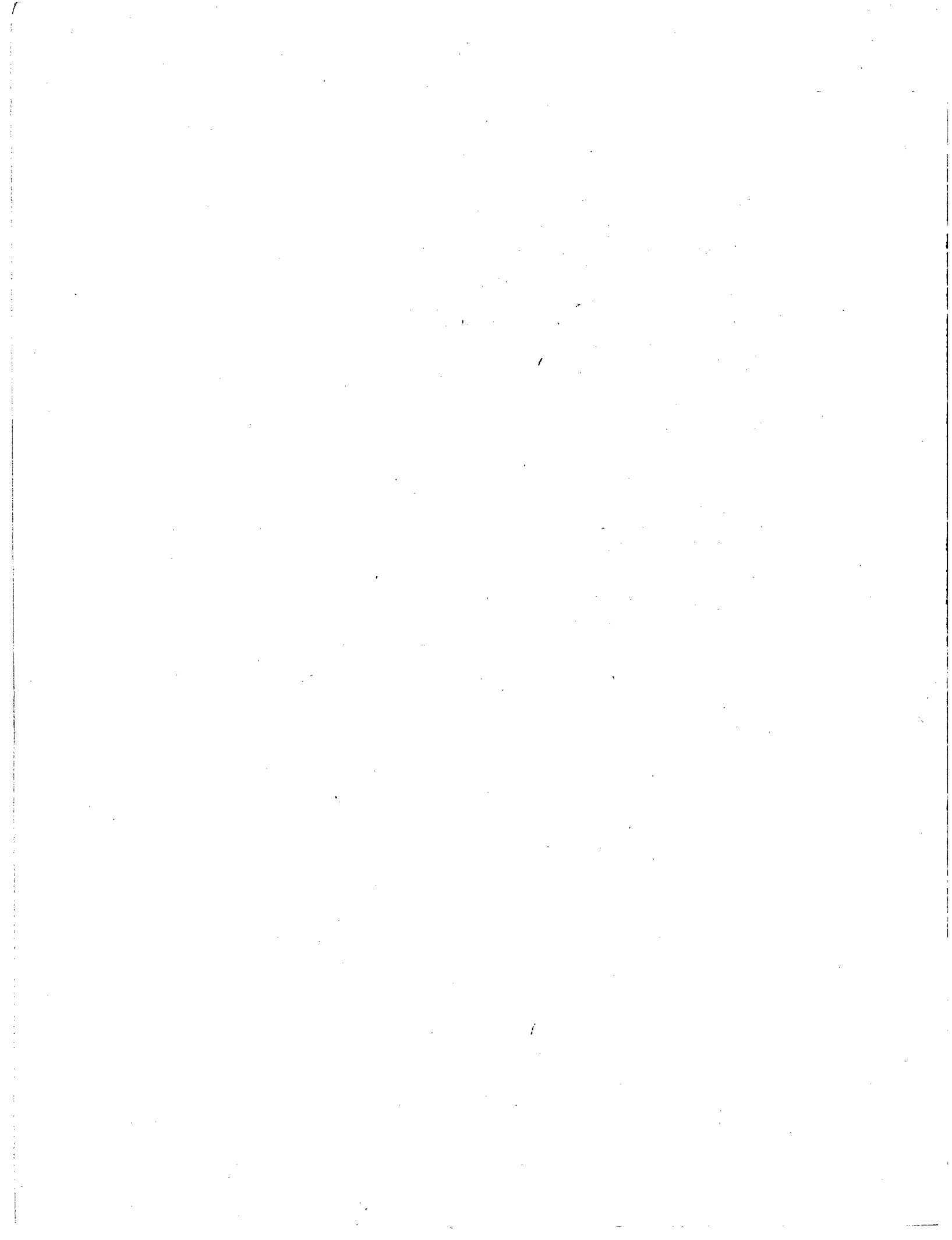
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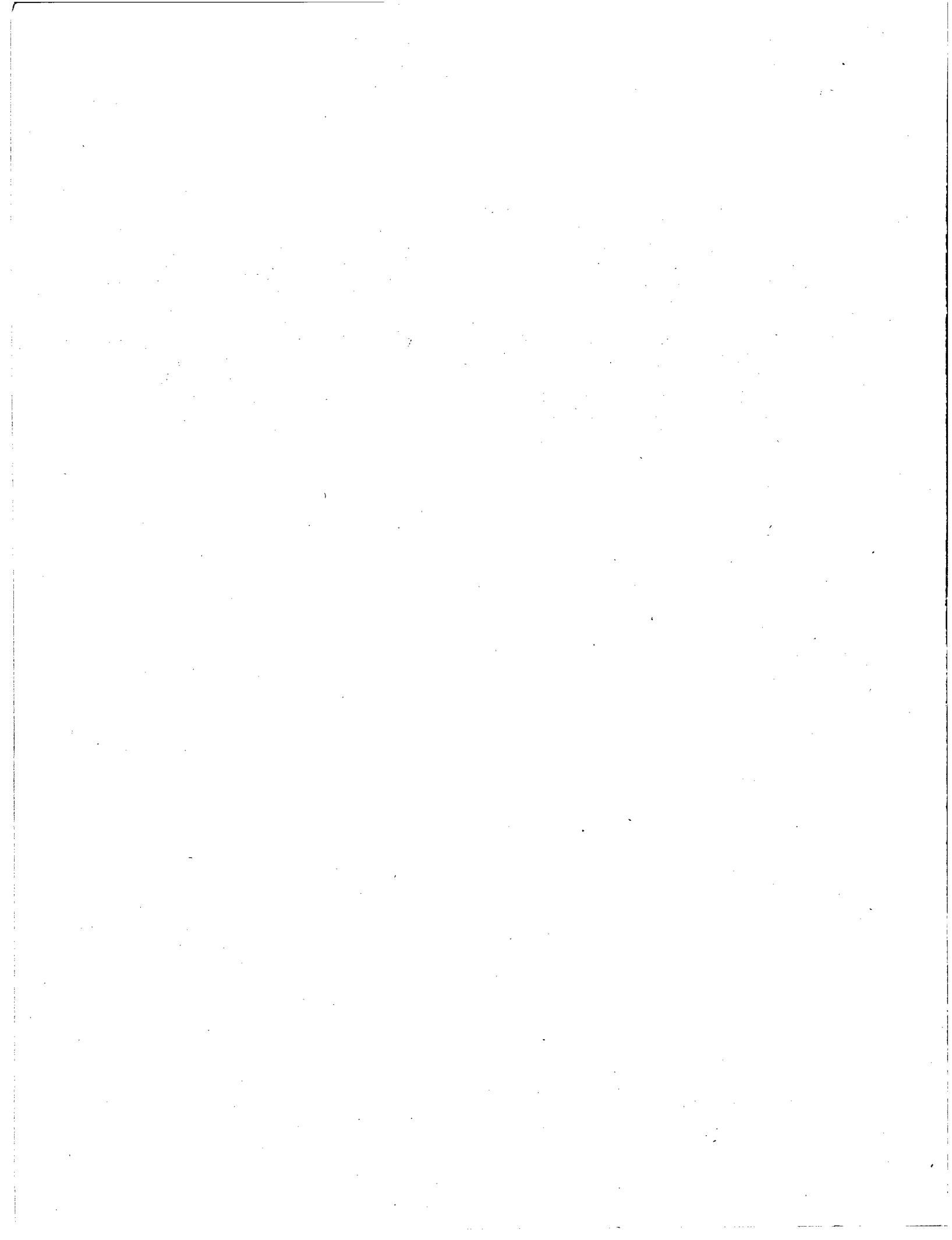




ABSTRACT

This document discusses the information that should be provided in the Safety Analysis Report and establishes a uniform format for presenting the information necessary to fulfill the licensing requirements for land disposal of radioactive waste called for in 10 CFR 61.

The uniform format will (1) help ensure that the Safety Analysis Report contains the information required by 10 CFR 61, (2) aid the applicant and NRC staff in ensuring that the information is complete, (3) help persons reading the Safety Analysis Report to locate information, and (4) contribute to shortening the time needed for the review process.



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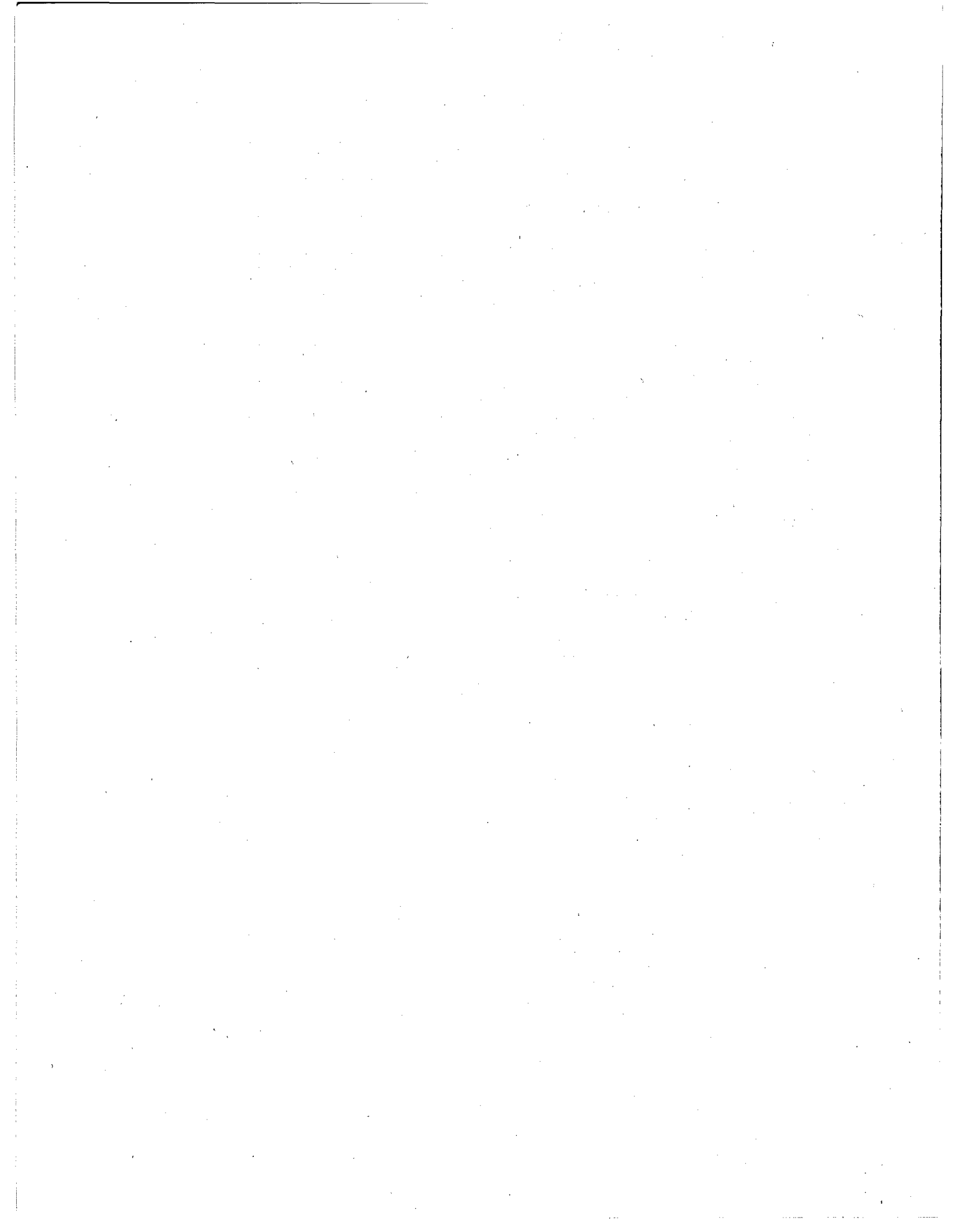
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ACKNOWLEDGMENTS

This document was prepared under the supervision of Clayton Pittiglio, who acted as project manager, and is based on contributions from the following staff members:

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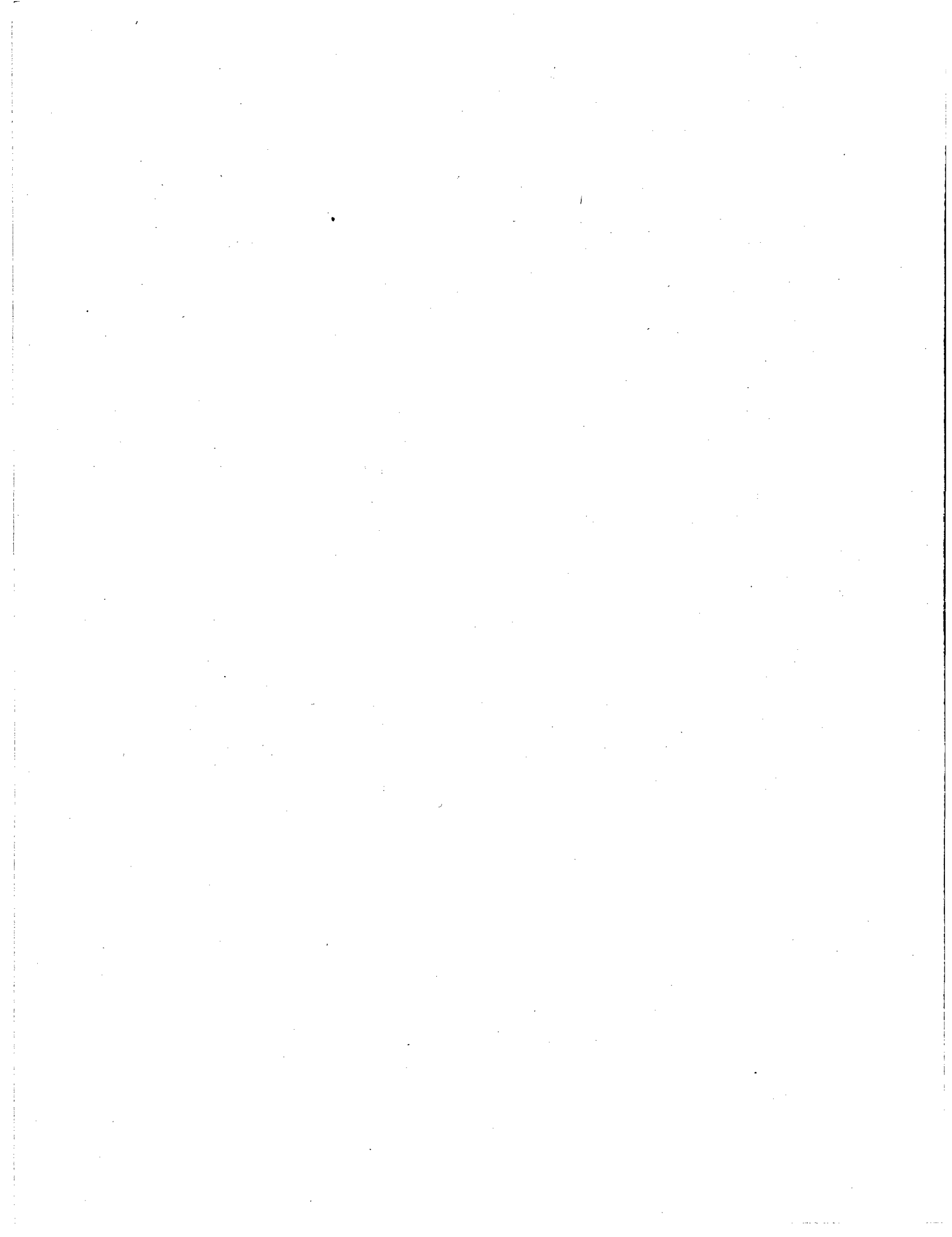
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Special thanks are due to Kristin Westbrook, who assumed the daily project management responsibilities necessary to complete this project; the Editorial Section, specifically Mary Mejac who edited this document; the Electronics Text Processing Branch; and the secretarial staff of the Division of Waste Management.



INTRODUCTION

A U.S. Nuclear Regulatory Commission (NRC) license is required to receive, possess, and dispose of low-level radioactive waste. The requirements for a license are contained in Title 10 of the Code of Federal Regulations, Part 61 (10 CFR 61), "Licensing Requirements for Land Disposal of Radioactive Waste." 10 CFR 61.10 through 10 CFR 61.16 specify in general terms the information to be supplied in an application for a license to construct and operate a land disposal facility for the purpose of disposing of low-level radioactive waste. The application must contain sufficient information and analyses to provide reasonable assurance that the performance objectives in Subpart C of the regulation will be met.

The application will consist of both a Safety Analysis Report (SAR) and an Environmental Report (ER). This document provides guidance on the type of information that should be included in the SAR, specifically that specified in 10 CFR 61.11 through 10 CFR 61.16.

The ER accompanying the license application should be prepared in accordance with Subpart A of 10 CFR 51. Guidance for the preparation of the ER is contained in Regulatory Guide 4.18, "Standard Format and Content of Environmental Reports for Near-Surface Disposal of Radioactive Waste." Information included in the ER may be referenced in the SAR.

The purpose of this document, "Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility" (hereinafter referred to as NUREG-1199), is to explain in more detail the information to be provided in the SAR and to establish a standard format for presenting the information. Use of the standard format will (1) help ensure that the SAR contains the information required by 10 CFR 61, (2) aid the applicant and NRC staff in ensuring that the information is complete, (3) help persons reading the SAR to locate information, and (4) contribute to shortening the time needed for the review process.

This initial version of NUREG-1199 applies to SARs for near-surface low-level radioactive waste disposal. Near-surface disposal encompasses the full range of technology that can be applied to low-level waste disposal near the earth's surface, that is, shallow land burial, deeper burial at depths up to 30 m, and the use of engineered structures, barriers, and other types of structures, some of which may protrude partially above the surface. NRC is currently developing additional guidance for the above near-surface disposal concepts. Once completed, NUREG-1199 will be revised to reflect any additional information requirements.

NUREG-1199 presents a format for SARs that is acceptable to the NRC staff. However, conformance is not required. The staff will accept SARs with different formats if they provide an adequate basis for the findings requisite to issuing a license. Staff review of SARs with different formats may take longer because the staff is familiar with, and its review procedures are based on, NUREG-1199.

FILING OF THE APPLICATION

The applicant initially will file one original and two copies of the SAR and ER so the staff can determine if they are acceptable for docketing. The documents will be treated initially as tendered documents until the determination is made. A copy of the tendered documents will be available in the NRC Public Document Room, 1717 H Street N.W., Washington, DC. The applicant will be notified of the results of the determination. Requirements for the filing and distribution of the application are given in 10 CFR 61.20 and the Commission's procedures for handling the application are given in 10 CFR 2.101, 2.102, and 2.103.

PROPRIETARY INFORMATION

Proprietary information must be submitted separately. It should be clearly identified and should be accompanied by the applicant's detailed reasons and justifications for requesting that the information be withheld from public disclosure, as specified by 10 CFR 2.790.

STYLE AND COMPOSITION

General Format

The applicant should present the information in the SAR as clearly as possible. Technical bases should support the applicant's claims of the adequacy of the designs or design methods.

The applicant should follow the numbering system and headings of NUREG-1199.

Appendices should be used to provide supplementary information not specifically identified in NUREG-1199.

Abbreviations

Abbreviations should be consistent throughout the SAR and consistent with generally accepted use. Any abbreviations, symbols, or special terms should be defined where they first appear.

Numerical Values

Where appropriate, estimated limits of errors or uncertainty should be given.

Graphics

Graphic presentations--such as drawings, maps, diagrams, sketches, and tables--should be used when they present information more adequately or conveniently than would just a text description. The applicant should ensure that graphic material is legible and that the physical scales are sufficiently large so that the details and notations can be read. Symbols should be clearly defined. A figure or table should be placed within the section of the SAR in which the primary discussion of its contents appears.

Physical Specifications

All material submitted as part of the SAR should conform to the following physical standards:

(1) Paper Size

The size of text pages should be 8½ x 11 inches; a larger size, where required for legibility, is acceptable if the bound size does not exceed 11 inches, and the finished copy, when folded, does not exceed 8½ x 11 inches.

(2) Ink

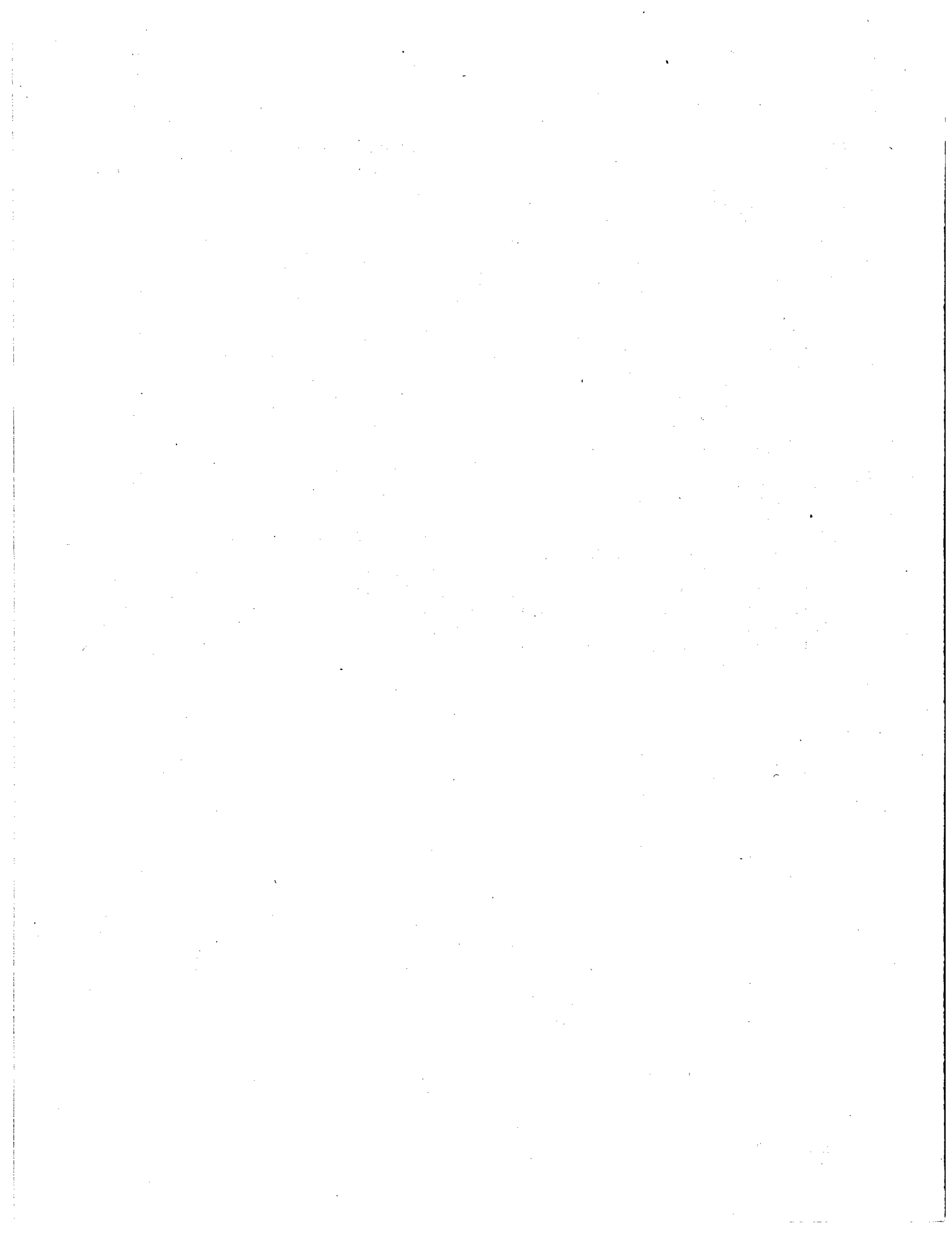
The color of the ink must be sufficiently dense to record on microfilm or image-copying equipment.

(3) Printing and Binding

The text pages should be single spaced and printed on two sides. The pages should be punched for a standard three-hole looseleaf binder.

(4) Revisions

Updated or revised data and text should be provided on pages that will replace the original pages. "Pen-and-ink" or "cut-and-paste" changes should not be used. The changed or revised portion on each page should be indicated by a change line, which is a vertical line in the outside margin, next to each line actually changed. The date of change and change number should appear at the bottom outside margin of each page that has been changed. Each change submittal should include a listing of all pages changed in that submittal.



1 GENERAL INFORMATION

1.1 Introduction

The applicant should provide general information that should include the applicant's identity, qualifications, and organizational structure; an overview of the purpose and scope of the proposed project; and general information on the applicant's financial and technical qualifications. The applicant also should indicate its level of understanding of the nature and complexity of low-level radioactive waste disposal, as required by 10 CFR 61.23.

1.2 General Facility Description

The applicant should present an overall introduction to the SAR and a general description of the facility and its location. This section should enable the reader to obtain a basic overall understanding of the proposed disposal operation and facility without having to refer to other sections. The information in the other sections can then be reviewed from a better perspective.

Facility Description

The applicant should describe the facilities, land, buildings, and equipment to be used in the operation of the facility. Where appropriate, scaled engineering drawings should be used. The description should also include the purpose of each feature and the interrelationships of the features. The applicant also should generally describe the movement of personnel, material, and equipment during facility operations.

Land Use

The applicant should provide a land-use survey based on local land-use plans, aerial photography, topographic maps, or other sources. The survey should include land-use patterns within approximately 10 km of the site. Trends in land use in the vicinity should be identified.

Principal Features

The applicant should describe the following principal features of the disposal facility:

(1) Restricted Areas

The applicant should describe and display the areas to be restricted as defined in 10 CFR 20.3(a)(14).

(2) Site Boundary and Buffer Zone

The applicant should describe and display the boundary that encompasses the area owned and controlled by the applicant and indicate the existing and proposed fenced areas and the location and extent of the buffer zone.

(3) Groundwater Users

The applicant should identify groundwater users within a 10-km radius of the disposal site and give the location, source (hydrogeologic unit), rates of use, and type of use (such as industrial, agricultural, livestock, domestic, or municipal). Point-of-use water quality should be described.

(4) Utility Supplies and Systems

The applicant should identify and describe the utility supplies and systems and the sources of water to be used at the facility, including the location and purpose of supply wells and utility lines, if appropriate.

(5) Disposal Units

The applicant should describe the design of the disposal units, including types of materials, dimensions, shapes, and sections through the disposal unit that show the characteristics of the disposal unit.

(6) Covers

The applicant should describe the cover design, including thickness, type of materials to be used, slopes, and sections through the disposal units that show the characteristics of the covers.

(7) Surface Water Control Features

The applicant should describe (a) the features of the disposal facility designed to control the velocity, direction, and overland flow and infiltration of surface water and (b) the disposal site drainage design and how the design will prevent erosion and inundation of the disposal site as a result of large floods up to and including the probable maximum flood (PMF).

(8) Intruder Barriers

The applicant should describe the design of the intruder barrier to be used at the facility, including the types of materials to be used, the dimensions of the barrier, and the method of construction or emplacement of the intruder barriers.

(9) Markers

The applicant should describe the design of the permanent disposal unit and facility boundary markers to be placed at the disposal facility, including the materials to be used and the dimensions of the unit.

(10) Boundaries and Markers

The applicant should demonstrate that the disposal units are accurately located and marked in such a way that the boundaries of each unit can be defined easily and should include considerations of marker durability.

(11) Survey Control Program

The applicant should describe the survey used to accurately locate and map the boundaries of each disposal unit and the survey control program. This program should include at least three permanent survey marker control points referenced to United States Geologic Survey (USGS) or National Geologic Survey (NGS) survey control stations. The USGS or NGS control stations must provide horizontal and vertical controls as verified against USGS or NGS record files.

(12) Site Utilization Plan

The applicant should describe the types of disposal units and their configurations, layout facilities, land features, roadways, buildings, and equipment. The information should include the planned order of the development of the disposal units. Where appropriate, engineering drawings and sectional drawings should be used.

(13) Support Facilities

The applicant should describe the facilities necessary to support the disposal facility operations.

(14) Administration Buildings

The applicant should describe the functional features of the administration buildings, including laboratories, record storage areas, dining areas, showers, and decontamination and change rooms.

(15) Storage and Waste Handling Area

The applicant should describe the functional features of the storage and waste handling area, using engineering drawings as appropriate. The features described should include the capabilities for waste reception, off-loading, storage, handling, repackaging of damaged containers, and decontamination of transport equipment.

(16) Decontamination Areas

The applicant should describe, using engineering drawings as necessary, the facilities to be used for decontaminating, transporting, and handling waste, and other equipment. The vehicle maintenance area, if appropriate, should be described briefly.

(17) Physical Security

The applicant should describe the physical security measures, including barriers to entry and exit points from the disposal site (including controlled access points) and systems for the positive identification of individuals entering and leaving the disposal site.

(18) Equipment and Equipment Storage

The applicant should describe (a) the equipment to be used for off-loading, handling, and transporting waste within the disposal facility; (b) the equipment to be used for preparing the disposal units; and (c) the facilities to be used for equipment maintenance and storage. Engineering drawings and photos should be included as necessary.

(19) Excavated Materials Area

The applicant should (a) describe the facilities for surface storage and protection of excavated materials and discuss wind erosion, water runoff, and siltation of the facility water control features; (b) describe the use of the excavated material for backfill and the planned disposal of excess material; and (c) discuss the potential effect of storing the excavated material in the immediate vicinity of the facility on the stability of the facility.

1.3 Schedules

The applicant should provide the proposed schedules for (1) construction, (2) receipt of waste, (3) the first emplacement of waste at the proposed land disposal facility, (4) operations, and (5) closure.

The schedules should show that the applicant has considered the time needed for regulatory reviews and for hearings by regulatory and public interest groups.

1.4 Institutional Information

The applicant should explain the coordination with, or participation by, a State or States in developing the proposed disposal facility. The relationship of the proposed site to compacts should be presented. The discussions should meet the requirements of 10 CFR 61.14 and the demonstrations required by 10 CFR 61.59.

Land Ownership

The applicant should provide or reference information to confirm that radioactive waste under the proposed license will only be disposed of on land owned in fee by the Federal or State Government, including certification by the Federal or State Government that owns the disposal site property that (1) the Federal or State Government is prepared to accept transfer of the license when the provisions of 10 CFR 61.30 are met and (2) the Federal or State Government will assume responsibility for custodial care after site closure and observation and maintenance following closure.

If the proposed disposal site is land not owned by the Federal or State Government, the applicant must submit evidence that arrangements have been made for assumption of ownership in fee by the Federal or State Government.

Institutional Control

The applicant should describe the institutional program to physically control access to the disposal site following transfer of the disposal site from the

disposal site operator. The institutional control program should include, but not be limited to, descriptions of plans and programs for carrying out environmental monitoring, periodic surveillance, and minor custodial care at the disposal site, as well as procedures and mechanisms for the administration of funds to cover the costs of these activities.

Institutional Arrangements

The applicant should describe the records to be transferred to the custodial agency and the arrangements for the transfer. (Guidance on closure of a near-surface disposal facility is given in NRC Technical Position Paper, "Low-Level Waste Burial Ground Site Closure and Stabilization.")

1.5 Material Incorporated by Reference

Duplication of information should be avoided. Similar or identical information may be requested in various sections of NUREG-1199 because it is relevant to more than one portion of the facility or the staff's evaluation. The information should be presented in the principal section of the SAR and appropriately referenced in the other applicable sections.

Reports or other documents that are referenced in the text should be listed at the end of the section in which they are referenced. Where proprietary documents are referenced, a nonproprietary summary of the document should also be referenced. Where appropriate, referenced information may be included as an appendix to the SAR.

1.6 Conformance to Regulatory Guides

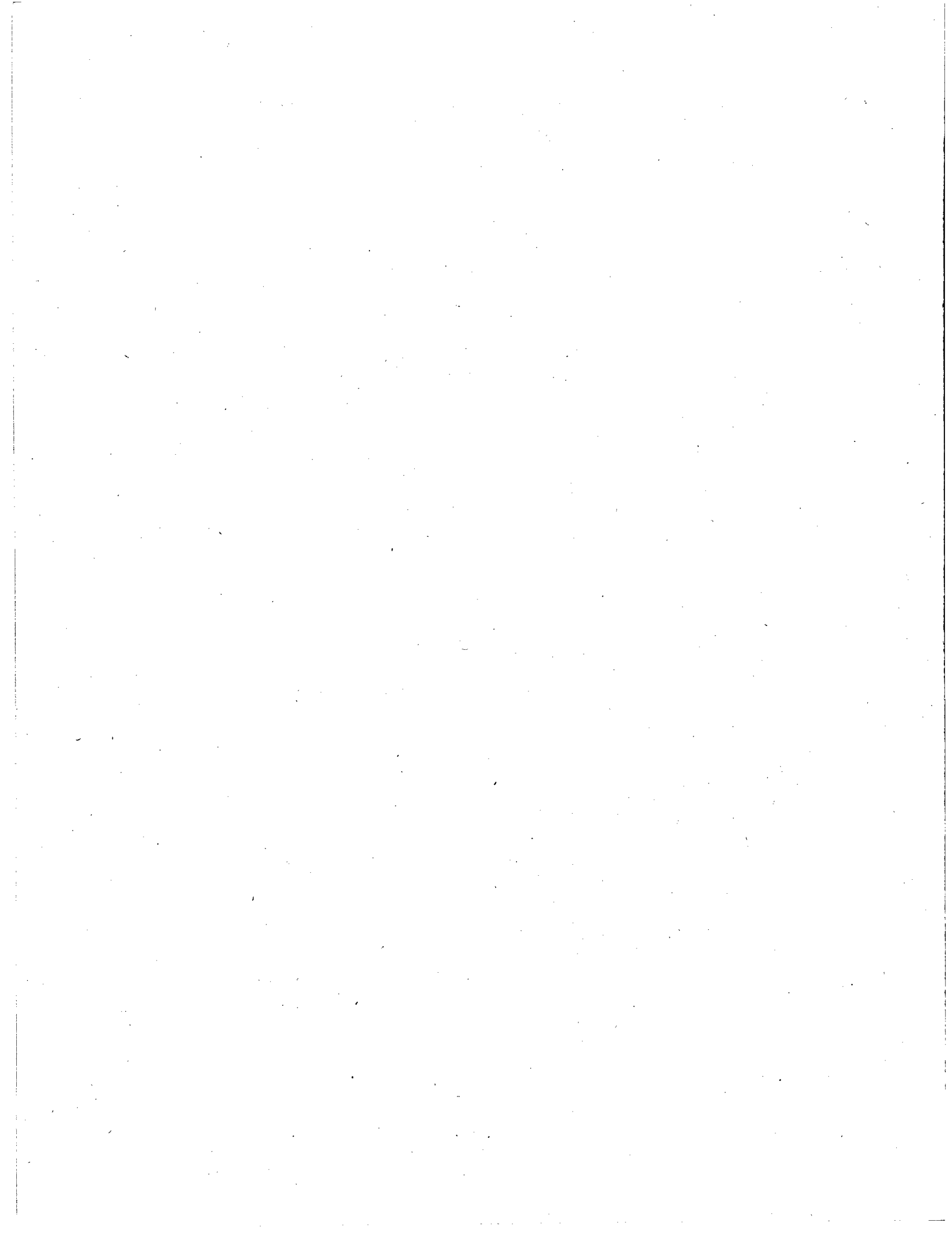
The applicant should note the area and degree of conformance and/or nonconformance to applicable NRC regulatory guides. The reasons for the nonconformance should be given. Included in the explanation should be the alternatives that have been incorporated that support the acceptability of the application.

1.7 Summary of Principal Review Matters

The applicant should include a summary of principal review matters, which should contain documented evidence of efforts to identify major licensing issues during the preparation of the SAR and objective assessments of licensing issues.

The applicant also should document interactions with government bodies, technical experts, public interest groups, environmental groups, and affected tribes and provide summaries of their positions on review matters as identified during the development of the SAR.

The applicant also should identify specific areas in the SAR where the principal review matters have been dealt with and resolved.



2 SITE CHARACTERISTICS

The applicant should provide information on the natural and demographic characteristics of the site and vicinity. The information should include descriptions of the geologic, geotechnical, hydrologic, meteorologic, climatologic, and biotic features of the disposal site and vicinity; present and projected population distribution and land use; and site activities and controls. The applicant should explain how these site characteristics have influenced facility design and operating criteria and should show the adequacy of the site characteristics with respect to the long-term performance of the waste disposal system.

2.1 Geography, Demography, and Future Developments

2.1.1 Site Location and Description

Location of Facility

The applicant should describe the disposal site location by specifying the latitude and longitude as well as the universal transverse mercator (UTM) coordinates. The applicant should indicate what land is owned, as well as potential expansion areas and the legal status of the expansion areas. The State and county in which the disposal site is located should be identified, along with nearby towns and cities, and the location of the disposal site relative to prominent features such as rivers and lakes. To facilitate presentation of this information, U.S. Geological Survey (USGS) 7½- or 15-minute topographic maps should be provided. Contiguous maps should be provided that show the upstream and downstream drainage areas and an approximate 10-km radius around the disposal site. A map also should be provided that shows the detailed topography of the disposal site. The detailed map should use a contour interval such as 2 feet or 1 meter and should include plot plans, the locations of characterization borings and monitoring wells, and the positions and types of geologic characterization activities.

Nearby Facilities

The applicant should identify the significant facilities or activities near the site and provide a justification for siting near these features. The applicant should show that these features have not created baseline environmental conditions that would make the monitoring program being proposed ineffective. (The guidance on meeting these requirements is contained in the NUREG-0902.

2.1.2 Population Distribution

Population data should be based on the most recent U.S. census data and State and local population projections available. Residential population should be shown on a map that identifies places of significant population grouping, such as cities and towns within a 10-km radius. Concentric circles should be drawn (with the site at the center point) at distances of 2, 4, 6, 8, and 10 km. The

circles should be divided into 22-1/2-degree sectors, and each sector should be centered on one of the 16 compass points (with reference to true north, e.g., north-northeast, northeast). A table appropriately keyed to the map should provide the current residential and transient populations within each area of the map formed by the concentric circles and radial lines. The same table or separate tables should provide the projected resident and transient populations within each area for (1) the expected first year of facility operation and (2) for census years through the operational lifetime of the facility. The table should provide population totals for each sector and annular ring and a total for the population within 10 km of the site. The basis for population projections should be described. The distance to the nearest residence should be noted, and the basis for population projections should be described. The populations of any towns within 50 km of the site that exceed 10,000 persons should also be given.

The applicant should describe the effect (if any) on the disposal facility of the current and projected population and land use (see Section 2.1.1). The applicant should present the analyses used to determine these effects and provide the information that demonstrates how the facility would not be inhibited from meeting the performance objectives.

2.2 Meteorology and Climatology

The applicant should provide a general description of regional climatological conditions and a site-specific description of meteorology and microclimate. The applicant should provide a general description, including regional averages and extremes, of the following parameters: air masses, high- and low-pressure systems, frontal movement, airflow patterns, temperature, humidity, and various forms of precipitation. To the extent feasible, the applicant should correlate the relationship between regional atmospheric conditions and local meteorological conditions. The applicant should also provide the seasonal and annual frequencies of regional severe weather phenomena such as tornadoes, convective storms, hail, and waterspouts.

In the discussion of local meteorological parameters, the applicant should include those used as a design basis and those used for performance assessment, including

- (1) maximum snow, ice, and wind loads to which structures may be subjected
- (2) weather- and climate-related radionuclide transmission parameters including average and extreme wind vectors and average and extreme duration and intensity of precipitation events
- (3) routine, chronic weather-related site deterioration parameters
- (4) extreme site deterioration parameters such as tornadoes, waterspouts, thunderstorms, and extreme forms of air pollution

The applicant should also provide a general characterization of the local meteorology considering airflow vectors, temperature, precipitation, water vapor, atmospheric stability, evapotranspiration potential, and general air quality.

Description and characterization of local meteorology should be based on at least 12 continuous months of site-specific data.

2.3 Geology and Seismology

2.3.1 Geologic Site Characterization

The applicant should provide information on the geologic characteristics of the site and the region around the site. 10 CFR 61, Subpart D, "Technical Requirements for Land Disposal Facilities," provides the principal requirements to be considered by the staff in its geologic evaluation of proposed low-level waste disposal facilities. The information should include the geologic illustrations, data, and analyses that demonstrate that the geologic and tectonic processes affecting the site do not inhibit its ability to isolate radioactive waste. These processes would include the effects of fault displacement, uplift, collapse, subsidence, tilting, and volcanic and seismic activity. The basic geologic information required to provide a basis for evaluation is discussed below.

A literature search should be made by the applicant for geologic studies of the site by government agencies, academic institutions, or commercial companies; and any published reports, maps, or other geologic information on the site should be referenced. Such information as geologic or geophysical surveys, borings, excavations, or remote-sensing studies should be documented. The applicant's investigators should be identified, the investigatory techniques described, and any field or laboratory data included in the documentation. The effects on the site of man's activities in the area, such as subsurface addition or withdrawal of fluids or mineral extractions, should be evaluated, including maps showing the location and depths of these activities.

Regional Geology

The applicant should describe and discuss the tectonic history of the region, regional geomorphology, physiography, stratigraphy, and geochronology. All tectonic structures should be identified, in particular folds and faults in the region around the site, and their geologic and structural history should be discussed. The relationship between seismicity and tectonic structures and the earthquake-generating potential of any active structures should be determined. A regional tectonic map showing the site location and its proximity to tectonic structures should be provided. Appropriate references of supporting documents should be provided with regional physiographic and topographic maps, geologic and structure maps, fault maps, stratigraphic sections, boring logs, and aerial photographs.

The applicant should discuss the relationship between the regional and site physiography. The structural geology of the region should be described, and its relationship to the site geologic structure should be discussed. Any faults, folds, open jointing, fractures, and shear zones in the region must be identified, and their significance to the facility should be discussed. Also, the applicant should investigate the possible existence of crustal tilting, subsidence, karst terrain, landsliding, and erosion.

When a low-level waste disposal site is to be located within a region of active plate tectonics characterized by volcanism, the applicant should collect all

available data resulting from geophysical and geodetic monitoring in the region. The sequence and ages of the volcanic flows should be described, and the potential for renewed volcanic activity and the effect on the site should be determined.

Site Geology

The applicant should identify any existing or potential site conditions that could compromise the ability of the site to fulfill the performance objectives of 10 CFR 61. The applicant should describe the surface and subsurface geologic characteristics of the disposal site and its vicinity. The description should include local stratigraphic units and their accepted names, ages, genetic relationships, and lithologies. To facilitate the presentation, these descriptions should be accompanied by appropriately scaled geologic maps. Descriptions of mineralogy, particle size, organic materials, degree of cementation, zones of alteration, and depositional environment of unconsolidated strata should be included.

Stratigraphic columns and cross-sections illustrating the strata receiving the waste (candidate horizon) and the surrounding units should accompany and be noted on the geologic map. Isopach maps of near-surface stratigraphic units, the candidate horizon, the bedrock surface, and other units that are part of the disposal system should also be provided.

The applicant should describe the geomorphology of the disposal site, and should include USGS topographic maps that emphasize local geomorphic features pertinent to the disposal site. The applicant should describe the geomorphic processes affecting the present-day topography of the disposal site and vicinity. Information should include descriptions of processes such as mass wasting, erosion, slumping, landsliding, and weathering where appropriate. The discussion of relevant geomorphic processes should include their rates, frequencies of occurrence, and controlling mechanisms or factors.

The applicant should describe the location, attitude, and geometry of all known or inferred faults in the disposal site and vicinity. Those faults that can reasonably be expected to affect waste isolation should receive special emphasis. The applicant should discuss the relationship of these faults to the present-day local stress field. Fault displacements should be identified and potential recurrence intervals addressed. The applicant should identify any potential effects on the disposal site as a result of deformation during fault displacement.

The applicant should discuss the nature and rates of deformation such as folding within the disposal site and relate these to the local stress regime. Any joint sets within the disposal site including their densities and orientations should be described, and their relative ages discussed. Remineralization and mineralization history of the various joint sets should also be discussed. Solution cavities and crevices in the bedrock should be described and discussed if applicable.

The applicant should perform an evaluation, from an engineering-geology standpoint, of the geologic features that affect the waste disposal facilities, trenches, and borrow areas. Profile and cross-sectional illustrations should be provided through these areas, and descriptions of zones of alteration or

weathering, zones of structural weakness, and all potentially unstable strata or soils should be discussed.

2.3.2 Seismic Investigation

The applicant should provide information on the seismological and geophysical investigations to be carried out at the site and the region surrounding the site. The principal regulation used in determining the scope and adequacy of the submitted information and analysis is 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste." This and additional guidance (10 CFR 100, NUREG-0902, and "Standard Review Plan for UMRCA Title 1 Milling Tail Remedial Action Plans") will aid the staff in its evaluation of the acceptability of the site for granting a license.

Information about the following should be provided: seismicity, tectonic characteristics of the site and region, correlation of earthquake activity with geologic structures and tectonic provinces, maximum earthquake potential, seismic wave transmission characteristics of the site, design earthquake, settlement and liquefaction, and geophysical methods for site characterization.

This section should include, but not necessarily be limited to, the information mentioned above. The outline mentioned here is mainly intended to provide guidance to the applicants and licensees regarding the information that is necessary to complete an acceptable Safety Evaluation Report.

Seismicity

The applicant should provide a complete list of all historical earthquakes that have a magnitude of 3 or more or a modified Mercalli intensity of IV or more within 200 miles of the site. The listing should include all available information about the earthquakes such as epicenter coordinates, depth of focus, origin time, intensity, and magnitude, augmented by a map showing the locations of these earthquakes. The references from which the information was obtained should be indicated.

In addition, any earthquake that induced geologic hazard (e.g., landsliding or liquefaction) should be identified, and the acceleration that caused the hazard should be provided.

Tectonic Characteristics of Site and Region

The applicant should identify all the regional and local geologic structures and tectonic activity that may contribute to earthquake generation or affect the suitability of the site as a repository. A map of all tectonic provinces within 200 miles of the site should be provided. The criteria used to delineate the tectonic provinces should be discussed. When capable faults are identified in the vicinity of the site, a regional scale map showing the location of the faults, their characteristics, and the earthquakes associated with them should be presented.

Correlation of Earthquake Activity With Geologic Structures or Tectonic Provinces

The applicant should provide a correlation between the earthquakes and the geological structures or tectonic provinces within 200 miles of the site. Whenever an earthquake can be reasonably correlated with a geologic structure, the rationale should be presented. When an earthquake cannot be correlated with a geologic structure, the earthquake should be discussed in relation to the tectonic province.

Maximum Earthquake Potential

The applicant should identify the largest earthquake associated with each geologic structure (maximum credible earthquake) or tectonic province (maximum historical earthquake) within 200 miles of the site. Isoseismal maps should be presented for these earthquakes. On the basis of these largest earthquakes, ground motion should be estimated using the appropriate attenuation model applicable to the site. For floating earthquakes in tectonic provinces other than the site, the ground motion should be estimated on the basis of the distance of the tectonic province closest to the site. For floating earthquake in the same tectonic province as the site, appropriate distance should be used to estimate the ground motion.

Seismic Wave Transmission Characteristics of the Site

The applicant should provide a detailed description of the material overlying the bed rock at the site. The description should include velocities, densities, and elastic modulus of the material.

Design Earthquake

The applicant should determine the acceleration resulting from the largest earthquake at the free surface and at the depth of concern for the location of the facility. Where the earthquake is associated with a geologic structure, the magnitude should be determined using appropriate relationships between magnitude, type of fault, and fault length and the acceleration should be estimated using the appropriate attenuation relationship applicable to the site (NUREG/CR-3756). Potential for amplifications of vibratory ground motion in the overburden should be addressed. In some instances site-specific response spectra may have to be compared with the design of the structures.

Settlement and Liquefaction Potential

The applicant should provide information on areas of actual or potential surface or subsurface settlement or liquefaction affecting the stability of the cover materials in Sections 5.1.2 and 6.3. The water table elevation and its variation should be provided.

Geophysical Methods

The applicant should discuss all the geophysical methods used to support the geological characterization of the site. A map showing all site exploration work (such as track lines and shot points) and locations of collected data should be provided.

2.4 Hydrology

2.4.1 Surface Water Hydrology

The applicant should provide sufficient data and technical analyses to describe the surface water hydrology characteristics of the site and to demonstrate that the site suitability requirements of 10 CFR 61.50(a) are met. The information should be sufficiently complete to allow an independent evaluation to be made.

Hydrologic Description

Sufficient graphical and quantitative data and information to fully characterize the site drainage and surrounding watershed fluvial features, including important water users, should be provided. Water resource data including maps, hydrographs, and stream records from other agencies (e.g., U.S. Geological Survey and U.S. Army Corps of Engineers) should be cited and related to the site conditions.

Disposal Site and Facilities

The disposal site and the elevations of all structures, equipment, and systems should be described. The applicant should provide topographic maps of the disposal site that show natural drainages and man-made features (and any proposed changes to them), and should provide cross-sections that show the proposed location of waste material and trench covers as related to streams, drainage channels, erosion protection, and other hydraulic features. In accordance with 10 CFR 61.50(a)(5), the information should indicate that the site is generally well-drained and free of areas of frequent ponding.

Description of Surface Hydrology

The applicant should describe the surface water bodies of the disposal site and surrounding areas, including the location, size, shape, and other hydrologic characteristics of all streams, lakes, or coastal areas. A description of existing and proposed water control structures and diversions (both upstream and downstream that may influence the site) should be included. Flow-duration data that indicate minimum, maximum, and average historical observations for surface water bodies in the site areas should be included. The applicant should provide aerial photography and maps of the site and adjacent drainage areas and should identify features such as drainage areas; surface gradients, and areas of flooding.

Surface Water Users

The applicant should provide an inventory of all existing and planned surface water users, whose intakes could be adversely affected by accidental releases of contaminants. The inventory should include the owner, location, type, and amount of use; source of supply; type of intake; and surface water quality data.

Flooding and Flood History

The applicant should provide data and information used to determine the capability of the site to withstand floods (both water levels and velocities) and

flood waves. The date, level, peak discharge, and related information for major historical flood events in the site region, including stream floods, surges, seiches, tsunamis, dam failures, ice jams, floods induced by landslides, and similar events, should be included. In accordance with 10 CFR 61.50(a)(5), the information should demonstrate that the site is not located in an area of frequent flooding.

Using the guidance in Executive Order 11988, the information and analyses used to delineate the 100-year floodplain should be provided. Topographic and/or aerial photographs that delineate the 100-year floodplain at the disposal site should be included. The information should be sufficiently complete to allow determinations to be made that waste disposal will not take place in a 100-year floodplain, coastal high-hazard area, or wetland, in accordance with 10 CFR 61.50(a)(5).

The applicant should discuss the flood potential from streams, reservoirs, and adjacent watersheds. The probable maximum water level at the site (see Regulatory Guide 1.59, "Design Basis Floods For Nuclear Power Plants," for guidance) should be provided.

The applicant should describe any man-made changes to the surface water hydrologic system that may influence the potential for flooding at the site. (Such changes may include construction of reservoirs, urban development, strip mining, lumbering, etc.). The description of these changes should include the proximity of the affected area to the site, the surface water bodies affected, the size of the area affected, and the potential effects at the site.

Upstream Drainage Areas

In accordance with 10 CFR 61.50(a)(6), the applicant should provide information that demonstrates that upstream drainage areas have been or will be minimized to decrease the amount of runoff that could erode or inundate disposal units. The applicant should provide maps and should describe how the minimization of upstream areas was incorporated into the site selection process.

2.4.2 Groundwater Characterization

The applicant should provide sufficient information to (1) describe the hydrogeology of the disposal site (10 CFR 61.12(a)), (2) demonstrate that the disposal site is capable of being characterized, modeled, analyzed, and monitored (10 CFR 61.50(a)(2)), (3) demonstrate whether the disposal site can provide sufficient depth to the water table so that groundwater intrusion, perennial or otherwise, into the waste will not occur (10 CFR 61.50(a)(7)), and (4) demonstrate that the hydrogeologic unit used for disposal will not discharge groundwater to the surface within the disposal site (10 CFR 61.50(a)(8)). To support these findings and conclusions, the site must be monitored for at least 1 year to ascertain the type and magnitude of seasonal fluctuations. Further, the data and detailed descriptions of the methodology used to collect the data should be included or referenced.

Saturated Zone

Data on the saturated zone should demonstrate that seasonal fluctuations of the water table will not result in groundwater interactions with the waste material

and that groundwater discharge at the surface will not occur within the disposal site. The information presented pertaining to the saturated regime should describe all potentially affected aquifers, including the lateral extent, thickness, water-transmitting properties, recharge and discharge zones, groundwater flow directions and velocities, and other information that can be used to create an adequate conceptual model of the saturated zone.

Detailed descriptions should be included for all monitor wells, including location, elevation, screened intervals, depths, construction and completion details, and hydrogeologic units monitored. The description should include domestic, industrial and/or municipal wells or other monitoring devices, if applicable, and any construction and completion details for these devices, when available. Descriptions of all aquifer tests should also be provided, including test data and a discussion of the assumptions, analysis, and test procedures used.

Physical parameters such as storage coefficients, transmissivities, hydraulic conductivities, porosities, and intrinsic permeabilities should be included. The applicant should provide an accurate description, to the extent practicable, of groundwater flow directions and velocities (horizontal and vertical) for each potentially affected aquifer. When applicable, the groundwater hydrology should be described by making use of hydrogeologic columns, cross-sections, and water table and/or potentiometric maps.

Unsaturated Zone

Information on and descriptions of the unsaturated zone should be adequate so that a conceptual model of the unsaturated flow regime on site and in the vicinity can be obtained. To support these findings, the applicant should describe the lateral extent and thickness of permeable and impermeable zones, potential conduits of anomalously high flux, and direction and velocity of unsaturated flow. Information on all monitor stations including location and depth should be provided. Investigation of physical parameters includes, but is not limited to, the spatial and stratigraphic distribution of the total and effective porosity; water content variations with time; saturated hydraulic conductivity; characteristic relationships between water content, pressure head, and hydraulic conductivity; and hysteretic behavior during wetting and drying cycles, especially during extreme conditions. When appropriate in describing the unsaturated zone, the applicant should use cross-sections, columnar sections and maps representing spatial variability of physical parameters, lateral extent of affected strata, and flow paths of water movement.

Numerical Analyses

The description of the numerical analyses techniques used to characterize the unsaturated and saturated zones should include the model type, justification, documentation, verification, calibration and other associated information. The description should include the input data, data generation or reduction techniques, and any modifications to these data. To the extent practicable, the applicant should demonstrate that the results of the model adequately represent the physical system to determine if compliance with the applicable requirements of 10 CFR 61.12(a) and 61.50(a)(2),(a)(7), and (a)(8) is reasonably ensured.

2.5 Geotechnical Characteristics

The applicant should provide information on the geotechnical characteristics of the waste disposal facility site in accordance with 10 CFR 6.12(a), 10 CFR 61.23(f), and 10 CFR 61.50(a). Information should be presented that thoroughly defines the conditions and engineering properties of both soil and/or rock at the facility. Information on the geotechnical characteristics of the disposal site should include (1) the scope and results of geotechnical and geophysical investigations conducted at the site, (2) the scope and results of field and laboratory tests conducted to determine the engineering properties of various materials at the site, (3) the groundwater conditions at the site, (4) the fill borrow materials proposed for the facility, and (5) interpretation of the site stratigraphy and selection of the design parameters on the basis of the data in the SAR. If any of the information relevant to the geotechnical characteristics of the disposal site is presented elsewhere in the SAR, such information need not be repeated here but should be appropriately cross referenced.

Field Investigations

Field investigations should consist of the following:

(1) Geological, Geochemical, and Seismological Investigations

The scope and format for the information to be provided in these areas are initially identified in Sections 2.3 and 2.6 of this document. However, the following specific information is required under this section:

- (a) Definition of the geologic features including discussions, geologic maps, profiles of the site stratigraphy, structural geology, geologic history, and engineering geology of the site. The geologic features to be addressed for the site and its immediate vicinity are (i) areas of actual or potential surface or subsurface subsidence, solution cavities, uplift, collapse and/or swell, (ii) zones of alteration or irregular weathering profiles and zones of structural weakness, (iii) unrelieved stresses in bedrock and their potential for creep and rebound effects, (iv) rocks or soils that might be unstable because of their mineralogical, physical, or chemical properties, and (v) history of deposition and erosion including glacial and other preloading influence on soil deposit
- (b) Geochemical conditions at the site that address the long-term effects of the environment (weather conditions, rain, etc.) on the physical and engineering properties of the soils and rocks at the disposal facility.
- (c) The design-basis seismic event including details on magnitude of the earthquake, the elevation or level at which the design-basis earthquake is defined at the site, the maximum value of the horizontal component of the acceleration, the maximum particle velocity, the duration of the earthquake, and the potential for amplifications of ground motion as a result of soil conditions at the site.

(2) Geotechnical and Geophysical Investigations

The scope and results of the geotechnical and geophysical investigations performed to define the occurrence and properties of the underlying materials at both the site and proposed borrow areas should be presented. Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," provides general guidance and recommendations for developing investigation programs and for conducting subsurface investigations, including guidance on the spacing and depth of boring and sampling. This should be used as a general guide in developing the field investigations program for a low-level waste disposal facility. The information in the SAR should include the following:

- (a) a plot plan(s) clearly showing the outline of the facility and the locations of all borings, probes, pits, trenches, seismic lines, piezometers, and geologic profiles
- (b) profiles and adequate number of cross-sections of the site showing the subsoil and rock layering and illustrating in appropriate detail the relationship of the proposed facility to the subsurface materials
- (c) logs of borings, probes, pits, trenches, and geophysical investigations in sufficient detail as described in Regulatory Guide 1.132 and the results of the seismic refraction and reflection surveys in detail including tabulation of the dynamic characteristics of the soil and rock materials which were encountered

Field and Laboratory Testing and Engineering Properties

The applicant should provide a detailed and quantitative discussion of the criteria used to determine that the samples were properly taken in accordance with the guidance of Regulatory Guide 1.132 and tested in sufficient number to define all the soil and rock parameters needed for characterizing the site in accordance with the general guidance of Regulatory Guide 1.138. For sites underlain by saturated cohesionless soils and/or sensitive clays, the applicant should show that all zones that could become unstable because of liquefaction or strain-softening phenomena have been sampled and tested to evaluate their liquefaction potential. Methods and procedures currently accepted in the geotechnical engineering profession for testing and determining the engineering properties of soils and rocks should be used. Test methods should be appropriately referenced, and the preparation of laboratory samples should be discussed, when appropriate because of unusual conditions or deviations from standard practice. The information should show that the static and dynamic engineering properties of soils and rocks were properly determined and that reasonable and conservative values were adopted for design. This should include an explanation of how the developed data were used in the analyses, how the test data were enveloped for design, and why the design envelope is conservative. A table indicating the values of the parameters used in design should be presented.

Groundwater Conditions

The scope and format for the information to be submitted on the groundwater conditions at the site are initially given in Section 2.4.2 of this document. However, the following specific information is required under this section:

- (1) the location of the groundwater table and the elevation range of seasonal fluctuations in the groundwater level
- (2) the presence of perched, aquifer, and artesian conditions; groundwater movement; hydraulic conductivity and infiltration characteristics of site and borrow materials; hydraulic gradients; and installation details and monitoring records for piezometers and observation wells
- (3) design water level as determined by severe design-basis events such as a probable maximum flood

Borrow Materials

Information on fill borrow materials should include the following:

- (1) plan showing the limits, grades, and slopes of the area proposed for borrow materials and the location of borings drilled and test pits dug to determine the quantity and type of fill material available
- (2) the physical and engineering properties of soil and rock borrow materials, to be used in the construction of the facility, based on adequate explorations and testing; engineering properties should be based on laboratory tests performed on representative samples of borrow material compacted to the same range of density and moisture contents as that to be specified during construction

Stratigraphy and Design Parameters

Information on the stratigraphy and design parameters should include the following:

- (1) plot plans, adequate number of cross-sections, and profiles showing subsurface soil and rock layering at the site; the cross-sections should show the location of the borings and data from borings used in developing the soil and rock layering; the stratigraphy should be developed using all the data collected, particularly zones of soft/loose conditions encountered in the explorations
- (2) the recommended design parameters based on a reasonable and conservative interpretation of the test data for the soil and rock materials at the site; the recommended design parameters may be presented in a tabular form and also in a graphical form, where appropriate, to demonstrate the conservatism of the recommended values of the design parameters

2.6 Geochemical Characteristics

Water Chemistry

The applicant should provide information on the background and anticipated changes in water chemistry for groundwater and surface water systems that may be affected by site construction and waste disposal and local precipitation. Data on and descriptions of the following parameters should be included:

- (1) concentrations of inorganic constituents (including important trace elements), complexing ligands, dissolved gases, organic constituents (including total organic carbon and total organic halogens, stable isotopes (or concentration ratios), and background radionuclides
- (2) pH, oxidation/reduction conditions determined by various methods, alkalinity, ionic strength, total dissolved solids, and density
- (3) temperature
- (4) nature of colloidal-sized materials
- (5) observations of degassing

Data that assess seasonal variations should be provided. The applicant should also provide information on sampling, preservation, storage, and analytical procedures, including details on filter sizes used during sampling and analysis of water samples and analytical detection levels. Information on quality assurance and quality control procedures used during sampling, preservation, storage, and analysis, such as split, spiked, standard, blank samples, and ion balance calculations should also be provided.

Geochemistry of Soils and Rock Units

The applicant should provide information on the classification, identification of the mineralogy, and chemical characterization of the soils and rock units. The applicant should provide information describing sampling, preservation, storage, analytical, and experimental procedures. Information on solubility, ion exchange, and sorption experiments should be provided, including the range of chemical and physical conditions used to bound the results. Information on quality assurance and quality control procedures used during sampling, preservation, storage, analysis, and experimentation should be provided.

Geochemical Modeling

The applicant should provide information on the conceptual models and documentation of codes used to model site geochemistry. Information on validation exercises, data bases (e.g., thermodynamic constraints for aqueous complexation, mineral solubility, and gas solubility reactions and binding constants or distribution coefficients for sorption models), input and output data, and interpretation of results should also be provided.

2.7 Natural Resources

The applicant should provide an analysis (or analyses) demonstrating that there will be no effect on the site that would cause the site to fail to meet the performance objectives in 10 CFR 61 if natural resources were exploited during construction, operation, and closure, after closure, or after the removal of active institutional control.

In addition, the applicant should describe the known natural resources at or near the site, the exploitation of which could result in inadvertent intrusion into the wastes after removal of active institutional control. The applicant

should consider resources such as minerals and hydrocarbons, geothermal energy sources, sand and gravel, timber, and water. The description should include information such as the types of resources, their location, and current and projected uses. (Some or all of this information may be referenced in the Environmental Report.)

2.7.1 Geologic Resources

The applicant should document the information required by the NRC staff to review SAR sections on known natural resources at the proposed disposal site. The applicant should be able to show compliance with 10 CFR 61.12(h) and 61.50(a)(4).

The applicant should demonstrate that there will be no natural resources at the proposed site which, if exploited, would result in inadvertent intrusion into the disposal site after removal of active institutional control. The applicant must further show that if known natural resources in the site area are exploited during construction, operation, and closure, or after closure, the site will not be compromised. License requirements apply to resources that may occur near or at the ground surface, in hydrologic units used for disposal or isolation, and at depths that require excavation or drilling through the disposal units.

"Known resources" are those resources designated in U.S. Geological Survey Circular 831 as "identified resources." Identified resources would include measured, indicated, and inferred resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Geologic evidence includes, but is not limited to, assays, geologic maps, geophysical and geochemical surveys, and core logs.

Information Needs

The applicant should describe natural resources occurring at or near the site. Resources include metallic and nonmetallic minerals and ores; fuels, such as peat, lignite, and coal; hydrocarbons, including gas, oil, tar sands, and asphalt; geothermal resources; industrial mineral deposits, such as sand and gravel, clays, aggregate sources, shales, and building stone; timber; agricultural lands; and waters in the form of brines. Potable, agricultural, or industrial ground or surface waters are addressed in Section 2.4. Description of these resources should include information on resource type, occurrence, location, extent, net worth, recoverability, and current and projected use. The applicant should address economic, marginally economic, or subeconomic known or identified natural resources as defined in U.S. Geological Survey Circular 831.

The identification of mineral, fuel, and hydrocarbon resources should not be limited to the site and should include areas of known resources near and surrounding the site which, if exploited, would compromise the safety of the site. The applicant should identify known resources through field observations as well as through research of published and unpublished reports and records. The SAR should include maps showing all active and abandoned wells, boreholes, and excavations at the site. Those wells, boreholes, and excavations that preceded site characterization should be distinguished from those that were part of site characterization. Borehole logs should accompany maps. Maps depicting areal geology - including lithologic units, structure, and stratigraphic relationships; current land use; and locations of all active or abandoned mines, quarries,

borrow pits, and prospects - should be included with the SAR. The applicant should also provide reasonable assurance that indirect effects (such as erosion or alteration of surface water pathways) of the exploitation of nearby natural resources will not compromise the suitability of the site.

Information Sources

The identification of resources should include a literature search of Federal, State, academic, and local published and unpublished records. Federal sources include, but are not limited to, U.S. Geological Survey, Bureau of Mines, Department of Agriculture, and Bureau of Land Management reports and maps.

State geologic survey publications and files provide a good source for geologic and economic mineral studies, assays, maps, and borehole logs. Academic (college and university) records may include useful theses and other studies of specific areas. Local courthouse records may provide information on leases granted for exploratory work, which would include drilling, geologic mapping, and trenching at and in the vicinity of the site. Discussions with local landowners in the site vicinity may also provide useful information.

Conventional methods such as drilling and trenching to identify resources may compromise the site; therefore, when possible, borings and other excavations done as part of site preparation studies should be used in resource assessment and evaluation. Other useful methods of natural resource assessment include surface sampling, geologic mapping, and geochemical and geophysical surveys.

The applicant should notify the NRC early in the site characterization process if any resources of economic value are encountered. Additional information may be requested if the applicant is unable to demonstrate that the performance objectives of Subpart C, 10 CFR 61, can be met. The acceptability of the site characterization will be based on whether all known natural resources have been adequately identified and whether the presence of identified resources will result in intrusion into low-level wastes after removal of active institutional controls.

2.7.2 Water Resources

The applicant should provide a description of water resources and a demonstration that exploitation of these resources will not result in failure to meet the performance objectives in 10 CFR 61, Subpart C, as required by 10 CFR 61.50(a)(4). Water resource information should be sufficient to be able to determine whether or not the disposal area contains any known natural resources which if exploited would result in failure to meet the performance objectives in 10 CFR 61.41 through 61.44. A description of present and projected local and regional use of ground and surface waters should be included.

The applicant should provide a description of historical, present, and potential future local and regional groundwater use. Information pertinent to this section includes, to the extent practicable, location of points of groundwater withdrawal, discharge rates, and use of the groundwater. The description of water resources should also include information and perched aquifer water use.

The applicant should describe the historical, present, and potential future uses of surface water in the vicinity of the proposed facility, including present and potential rates of withdrawal, point of withdrawal, percentage of stream

flow withdrawn, and the use of the resource whether it be for livestock, municipal, residential, or industrial uses. Recreational activities should also be described including swimming, fishing, boating, and other foreseeable activities.

The applicant should describe any mathematical methods used to estimate effects on potential water users, including assumptions, verification, calibration, and other ancillary information. All input data should be described, including data associated with potential future uses and information obtained by Federal, State, and local agencies and private firms. If conservative assumptions were used in place of rigorous analyses, the rationale and defensibility used in the determination of exploitable resources should be described.

The applicant should present the results in a format that facilitates NRC staff review, such as future water table or piezometric surface maps, changes to groundwater flow direction and velocities (from those determined in previous investigations), and changes to the groundwater/surface water relationship. In summary, all conclusions should be supported by adequately conservative or realistic procedures that demonstrate that the exploitation of water resources will not result in failure to meet the performance objectives of 10 CFR 61, Subpart C.

2.8 Biotic Features

The applicant should provide the following:

Onsite Areas

- (1) A map of the site and vicinity showing the boundaries of major plant communities, the locations of minor communities, special habitats (e.g., spring seeps, bogs, sink holes, and cliff faces), and any habitats used by species that affect facility performance. The site boundary, the construction zone, other areas to be cleared, and the buffer zone should be shown on this map. A map showing habitats used by "important" species in the vicinity of the site that are expected to be affected by facility construction and operation should be provided. These maps should be supplemented when available with recent aerial photographs showing the site and adjacent land areas (from the Environmental Report (ER)).
- (2) Area occupied by each natural and man-made habitat type identified in item (1) above (from the ER).
- (3) Onsite data on the botanical species composition of, and relative abundance in, the major vegetation layers (e.g., overstory and understory), in enough detail to identify the communities as to dominant species (from the ER).
- (4) Summary of onsite natural and human-induced effects (e.g., farming, fishing, logging, grazing, and burning) and the successional state (i.e., weed, brush, pole, and mature states) (from the ER).
- (5) List of vertebrate species important to facility performance known to occur (from the ER and consultation with local, State, and Federal agencies).

- (6) List of invertebrate species of local importance or concern as disease vectors or pests. Detailed field surveys of all insect populations are not required (from the ER and consultation with local, State, and Federal agencies).
- (7) Estimates of the relative abundance of both commercially and recreationally important game and nongame vertebrates (from the ER and consultation with local, State, and Federal agencies).

Offsite Areas

- (1) Major vegetation types hydraulically or eolically downgradient (from the ER and site visit and through consultation with local, State, and Federal agencies).
- (2) List of commercially or recreationally important vertebrate animals known to occur eolically and hydraulically downgradient of the facility to a distance of 5 km.
- (3) List of other vertebrate species important to facility performance known to occur within 25 km or migratory distance, whichever is less, from the facility.
- (4) List of invertebrate species of local importance or concern as disease vectors or pests. Detailed field surveys of insect populations are not needed (from the ER and consultation with local, State, and Federal agencies).

2.9 Site Characterization Monitoring

The applicant's development of the preoperational environmental monitoring program will draw on information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site, which will be provided under other sections of the SAR.

In this section, the applicant should describe the organizational structure of the environmental monitoring program as required by 10 CFR 61.11(b)(1); the technical qualifications of the monitoring staff, including training and experience as required by 10 CFR 61.11(b)(2); and the training program for the applicant's staff as required by 10 CFR 61.11(b)(3).

This environmental monitoring and surveillance plan should consider both onsite and offsite measurements in air, water, soil, vegetation, local fauna, and local sources of food. The applicant should provide the rationale for

- (1) the location of the monitoring points
- (2) the media to be sampled at each location
- (3) the frequency of sample collection at each location
- (4) the selection of the radiological and nonradiological constituents of the samples taken from each media that are to be sampled and analyzed

- (5) the instrumentation and methods selected for field sampling, surveys, and laboratory analysis
- (6) the processing of the sample, including the types and frequencies of analyses (e.g., gamma spectroscopy and chemical oxygen demand) and the minimum detectable amounts and lower limits of detection for each constituent that is to be analyzed
- (7) the statistical basis to be used for comparing the baseline measurements to the corresponding measurements in the operational and postclosure periods of site operation, that is, a definition of a significant difference in measurement results as required by 10 CFR 61.80(vi)
- (8) the format proposed for annual reports of environmental monitoring results to be submitted to the NRC as required by 10 CFR 61.80(i)(1)

The applicant should describe the quality assurance measures and the quality control procedures for all aspects of the environmental monitoring program (e.g., testing, maintenance, and calibration of instruments; checks on sampling procedures; and laboratory analysis).

3 DESIGN AND CONSTRUCTION

3.1 Principal Design Features

The applicant should describe the principal design features of the facility that are designed to provide long-term isolation of disposed waste, minimize the need for continued active maintenance after site closure, and improve the site's natural characteristic in order to protect public health and safety. Principal design features should be identified and described for each of the following 11 functional requirements: (1) minimizing the infiltration of water into disposal units; (2) ensuring the integrity of disposal unit covers; (3) providing for the structural stability of backfill, waste, and covers; (4) minimizing contact of waste with standing water; (5) providing adequate site drainage during operations and after closure; (6) facilitating site closure and stabilization; (7) minimizing the need for long-term maintenance; (8) providing a barrier against inadvertent intrusion; (9) maintaining occupational exposure as low as is reasonably achievable (ALARA); (10) providing adequate disposal site monitoring; and (11) providing an adequate buffer zone for monitoring and potential mitigative action.

The principal design features are to be clearly described in relationship to each other to demonstrate that all of the features have been carefully considered in a coherent low-level waste disposal facility (LLWDF) plan. Specific design details (validity of assumptions, methods employed, results of studies and calculations, etc.) and principal design criteria for the 11 principal design features are to be provided by the applicant in other appropriate sections where this information is identified. The applicant should supply the following minimum descriptive information for each of the principal design features.

Water Infiltration

The applicant should provide information on (1) the covers over the waste that are designed to direct onsite precipitation away from the disposal units, (2) the onsite drainage systems that are designed to direct flow from offsite precipitation and groundwater away from the disposal units, and (3) the onsite drainage system that is designed to perform for the required period of time with minimum maintenance after site closure.

Disposal Unit Cover Integrity

The applicant should provide information on (1) the covers' ability to perform for the required period of time and to avoid the need for continuing active maintenance and (2) the covers' ability to resist degradation by surface geologic processes and biotic activity.

Structural Stability

The applicant should provide information on the structural stability of the backfill, waste, and covers that is directed toward long-term isolation of the waste and the avoidance of the need for active maintenance.

Contact With Standing Water

The applicant should provide information on measures to minimize contact of waste with standing water during periods of temporary storage and disposal operations and before and after site closure.

Site Drainage

The applicant should provide information on adequate site surface drainage provisions both during and after operations which would include direction of surface water away from the disposed waste and control of surface drainage to velocities and gradients that will not result in erosion.

Site Closure and Stabilization

The applicant should provide information on (1) the provisions for ensuring long-term isolation of the waste and avoiding the need for active maintenance and the compatibility of these provisions with the disposal site closure and stabilization plan and (2) complementary features that have improved the site's natural characteristics.

Long-Term Maintenance

The applicant should provide information on how the need for long-term maintenance after site closure is to be avoided.

Inadvertent Intruder Barrier

The applicant should provide information on barriers to be installed to protect individuals from inadvertent intrusion.

Occupational Exposure

The applicant should provide information on measures to be taken to maintain occupational exposures as low as is reasonably achievable.

Site Monitoring

The applicant should provide information on the operational and postoperational environmental monitoring and surveillance programs to be conducted at the disposal site.

Buffer Zone

The applicant should submit information on measures that provide adequate site dimensions to carry out environmental monitoring activities and to take mitigative measures, if needed.

3.2 Design Considerations for Normal and Abnormal/Accident Conditions

The applicant should present the principal design criteria for the proposed facility. These design criteria should ensure that the principal design features under normal, abnormal, and accident conditions are designed to (1) provide long-term isolation of the disposed waste, (2) minimize the need for

continued active maintenance after site closure, and (3) improve the site's natural characteristics in order to protect public health and safety.

Design criteria should be identified for the structures, systems, and components providing the following 11 functions related to the principal design features: (1) minimizing the infiltration of water into disposal units; (2) ensuring the integrity of disposal unit covers; (3) providing for structural stability of backfill, waste, 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 the need for long-term maintenance; (8) providing a barrier against inadvertent intrusion; (9) maintaining occupational exposures ALARA; (10) providing adequate disposal site monitoring; and (11) providing an adequate buffer zone for monitoring and potential mitigative action.

For each function of the principal design features, the applicant should (1) identify and describe the principal design criteria; (2) identify the normal conditions or anticipated occurrences used in design; (3) identify the abnormal conditions used in design; (4) identify any accident scenarios used in design; (5) identify the contribution to meeting the performance objectives for each structure, system, and component on the basis of the analyses and assessments in Sections 6 and 7 of the SAR; and (6) show that the relationship between the principal design criteria and the normal, abnormal, and accident conditions will reasonably ensure that the structures, systems, and components will contribute to performance as expected. Principal design criteria for each functional structure, system, and component under normal, abnormal, and accident conditions are discussed in the following paragraphs. Other relevant information on design bases, design limits, and design details (assumptions, methods, calculations, and results) may either be presented in this section or in other sections, depending on where the applicant chooses to provide the required design information.

As appropriate, the short- and long-term stability of the 11 principal design features should be analyzed for both static and dynamic loading conditions. For long-term stability considerations, the design-basis abnormal events would include (1) the maximum earthquake (Section 2.3.2), (2) the probable maximum flood (PMF) and the probable maximum precipitation (PMP) (Section 6.3.1), and (3) the extreme meteorological conditions (Section 2.2). For short-term normal operational stability considerations, the loading from the above events would meet with staff approval; however, less severe natural events would be acceptable, provided the applicant submits information that supports the adoption of the less severe event.

Water Infiltration

Principal design criteria applicable to minimizing the infiltration of water through disposal unit covers should identify the fraction of precipitation that can be allowed to infiltrate the cover. This fraction should be expressed in terms of (1) a severe snowmelt condition, where applicable at a given site, or the 10-year, 24-hour rainfall with high antecedent moisture conditions for the normal hydrologic event and (2) the worst condition resulting from snowmelt or PMP as the abnormal design-basis event. Analyses of increased infiltration resulting from cracking of the cover surface and accidents are not required,

but possible changes in infiltration rates through covers resulting from unanticipated degradation should be identified. Remedial measures should be described, allowing for the event of increased infiltration.

Principal design criteria for directing and controlling onsite precipitation or seasonal perch groundwater away from disposal units should identify the flow rates and groundwater levels that subsurface drainage system components 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; (3) accidental blockage of single drainage components as an accident condition.

Disposal Unit Cover Integrity

Principal design criteria applicable to ensuring the integrity of disposal unit covers and for providing erosion protection, at a minimum, should 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/subsidence does not affect the integrity of disposal unit covers, at a minimum, should identify (1) estimated total and differential settlements and anticipated densifications of waste and fill materials, (2) anticipated strength and durability of cover materials for the period that 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.

Structural Stability

Principal design criteria to ensure the structural stability of the fill, waste, and waste covering, at a minimum, should identify (1) the volume of anticipated voids within waste containers and within the backfill around the containers, (2) the effect of voids that might result from operational occurrences, (3) the effects of the design-basis abnormal events on structural stability, and (4) anticipated degradation of fill, waste forms, and waste cover materials for the period that the waste remains hazardous and in recognition of the geochemical environment. Analyses of reduced structural stability associated with accidents are not required.

Contact With Standing Water

Principal design criteria to prevent the contact of waste with standing water during interim storage and operations and after closure, at a minimum, should cover (1) subsurface and surface water drainage away from disposal units and temporary storage areas, (2) relative permeability of disposal unit floor natural materials to placed drain materials, (3) slopes and drainage collection features on disposal unit floors, (4) temporary platforms and covers for stored waste exposed to the atmosphere, (5) accidental failure of active drainage system components during operations, and (6) accidental failure of any passive drainage system component after closure. The design-basis hydrologic and meteorologic

events would be identical to the events identified in the section entitled "Water Infiltration."

Site Surface Drainage

Principal design criteria to ensure the safe handling of site surface drainage should identify (1) site surface drainage features, diversionary structures, and surface drainage slopes and (2) the possible effects of upstream dam failures or downstream drainage blockages as accident conditions. The design-basis hydrologic and meteorologic events would be identical to the events identified in the section entitled "Water Infiltration."

Site Closure and Stabilization

Principal design criteria applicable 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 effects of accidents after site closure are not required.

Long-Term Maintenance

Principal design criteria should identify the provisions to be incorporated that will support the avoidance of the need for long-term maintenance 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.

Inadvertent Intruder Barrier

Principal design criteria applicable to barriers against inadvertent intruders should identify the potential range of degradation rates for markers, engineered barriers, and the materials separating the stable and unstable wastes. Analyses of the effects of accidents on intruder barriers may be required at sites where the top of Class C wastes is placed at depths less than 5 m below the top surface of the disposal unit cover.

Occupational Exposure

Principal design criteria to limit occupation exposure, at a minimum, should identify on the basis of Section 7.3 of the SAR (1) ALARA requirements for receiving, inspection, handling, storage, and the disposal excavation areas; (2) required shielding for anticipated higher activity wastes; and (3) provisions for handling the accidental rupture of nonstable waste containers.

Site Monitoring

Principal design criteria applicable to site environmental monitoring and surveillance systems should identify (1) the anticipated life of monitoring system equipment and components, (2) potential rate of degradation and action to be

taken in the event of loss of the various types of monitoring equipment, and (3) the effects of design-basis abnormal events. Analyses of the effects of accidents on the monitoring system are not required.

Buffer Zone

Principal design criteria applicable to the buffer zone should identify (1) the required dimensions of that part of the buffer zone that will be available for monitoring and (2) the required dimensions of that part of the buffer zone that will be available for taking corrective measures, if unacceptable migration of radionuclides is indicated. Analyses of the effects of accidents on the buffer zone are not required.

3.3 Construction Considerations

3.3.1 Construction Methods and Features

The applicant should provide information on the construction methods and features of the disposal site and its facilities. Site plans, engineering drawings, and construction specifications, as necessary, should be supplied for staff review. The applicant should ensure that site plans, engineering drawings, and construction specifications are legible and that the physical scales of the drawings are sufficiently large so that the details and notations in the drawings are readable.

The applicant should include information on the following:

(1) Site Preparation

The applicant should discuss the construction operations needed to prepare the site for disposal of low-level radioactive waste and describe the special features unique to a specific site such as the procedures for backfilling existing wells or open boreholes.

(2) Control and Diversion of Water

The applicant should provide plans for controlling surface water and groundwater in the proposed excavations and fill areas and should discuss the construction methods for completing the control and diversion features (temporary or permanent dikes, diversion ditches, etc.) and the time schedule for completing this work.

(3) Construction of Disposal Units

The applicant should describe the construction of individual disposal units, including the sequence for the completion of these units. This information should cover conditions up to the actual placement of waste into the individual disposal unit and should include the following:

- (a) excavations - types of soil and rock materials to be removed; limits, slopes, and depths or bottom elevations shown in plan and on sectional views; requirements on final surface preparation, including identification of any unsuitable materials, and excavated surfaces where concrete is to be placed; disposition of excavated material

- (b) fill areas - limits, slopes, and heights or top elevations; requirements on surfaces to receive fill such as no placement over frozen ground, scarifying to promote bonding, and proof rolling; types of fill materials; requirements for spreading and moisture conditioning fill layers, the removal of oversize particles, and field procedures to obtain the required degree of compaction
- (c) preplacement details - provisions for directing and controlling precipitation and surface water runoff in the disposal unit excavations (thickness of permeable base or blanket layer, slopes for drainage, sump locations etc.)
- (d) quality control testing requirements (e.g., field density, fill moisture, laboratory compaction, gradation, and plasticity) including identification of test standard and test frequency

(4) Concrete and Steel Construction

The applicant should provide information on disposal facility construction where concrete and structural steel materials are used. For concrete, this information should include the design, manufacture, mixing, reinforcement, forming, transporting, placing, finishing, and curing of concrete. For structural steel, this information should include the design, fabrication, and erection of buildings and components.

(5) Backfilling

The information on backfilling should address the technical requirements applicable to the emplacement of waste packages in the disposal units, as well as the requirement that void spaces between the waste packages be filled in order to reduce future subsidence within the excavations. The information should include the following:

- (a) the planned stacking arrangement of the waste containers
- (b) the provisions that restrict the placement of decomposable materials in the excavation in order to minimize future long-term subsidence
- (c) the construction controls to be required to ensure proper gradation and moisture condition of the cohesionless backfill materials that are placed around the containers
- (d) the construction operations, and their sequence, that are planned for the actual placement of the waste containers and the backfill materials

(6) Closure of Individual Disposal Units

The information on closure should include the various construction features of materials to be placed in the cover above the backfilled waste. For many of the types of material to be placed in the excavation cover, the applicant should provide information that is similar to that previously identified for fill areas and quality control testing in this section for the construction of disposal units. Any unique consideration for these materials such as using specific construction methods that will prevent

undesirable mixing or contamination of the different materials in the excavation cover should be discussed by the applicant. Special manufacturing, handling, or placement requirements for intruder barrier materials or geotechnical fabric should be identified and discussed.

(7) Applicable Codes, Standards, and Specifications

The applicant should provide information on design and construction codes, standards, and specifications that were applied in the design and that will be applied in the construction of the facility.

(8) Construction Materials and Quality Assurance

The applicant should provide information on the materials that will be used in the construction of the disposal facility. Among the major materials of construction that may be used are the disposal unit excavation and fill materials, concrete and grouting ingredients, reinforcing bars, and structural steel. If any material not used previously in NRC-licensed facilities is proposed, the applicant is required to provide sufficient testing and user data to establish the acceptability of the material. The applicant's quality control procedures and construction techniques directed at ensuring that there will not be degradation in material quality are also reviewed.

(9) Site Plans, Engineering Drawings, and Construction Specifications

The applicant should provide site plans and engineering drawings that clearly convey the design features. The engineering drawings should show dimensions, sections, and relative locations of the various facilities within the disposal site boundary. All plans and drawings should be drawn to a scale large enough to convey the design information adequately and should be signed by a licensed engineer. As-built condition should ultimately be documented by the applicant as a permanent record for the constructed disposal facility. Construction specifications should be compatible and consistent with the design and operation requirements. The contents and procedures specified in the specifications should conform to the applicable industry codes and standards.

3.3.2 Construction Equipment

The applicant should provide information on equipment to be used for construction and off-loading, handling, transporting, and placing waste at the disposal facility. The information should include the equipment types, manufacturer's specifications, and the capabilities of selected equipment to safely handle the waste. Provisions for storage, maintenance, replacement, and inspection of equipment should also be provided. The applicant also should describe the quality assurance and quality control programs for purchasing, handling, replacing, and maintaining equipment to ensure that the equipment will perform reliably and will not impair the quality and proper functioning of the waste disposal facility.

3.4 Design of Auxiliary Systems and Facilities

3.4.1 Utility Systems

The applicant should describe the utility systems of the proposed facility, how each system provides support required by the operational needs of the proposed facility, and any adverse effects that the utility system design or potential failure could have on overall facility performance in meeting 10 CFR 61 requirements.

The applicant should describe all utility systems including communication, electric, water, lighting, sanitary waste disposal, fuel delivery, and any other utility system installed at the facility. The following information should be provided for each system: (1) an accurate description of system components; (2) an identification of which functional requirements of the principal design features in Section 3.1, if any, are supported; (3) design bases, criteria, codes, and standards used for design; and (4) any potential adverse effects on principal design features or overall facility performance that might result from failure of the utility system.

3.4.2 Auxiliary Facilities

The applicant should describe the auxiliary facilities of the proposed facility, how the auxiliary facilities support the operational needs or construction requirements of the facility, and any adverse effects that the auxiliary facility design or failure could have on overall facility performance.

The applicant should describe the auxiliary buildings required to support construction or operation of the facility and should present (1) the overall layout and design of auxiliary buildings; (2) the purpose for each building; (3) design criteria, codes, and standards used in design; and (4) potential adverse effects of building design or building failure on the overall waste disposal facility performance.

The applicant also should describe the traffic systems required to support construction or operation of the facility, and should include (1) the overall traffic system design including layouts of roadways and/or railways, (2) the purpose of the traffic system components, (3) the materials used in construction, (4) traffic controls, and (5) potential adverse effects of traffic system design or component failure on overall facility performance.

The applicant should describe any auxiliary facility that is in addition to buildings and traffic systems and identify any potential adverse effects that its design or failure could have on overall facility performance.

3.4.3 Fire Protection System

The applicant should describe the fire protection system and the system's capability to safely protect the disposal facility and workers from radiation and fire hazards if an accidental fire should occur. The fire protection system includes the equipment, procedures, training, management, and emergency planning required for fire protection at the facility.

The applicant needs to postulate accidental fire scenarios and describe the potential consequences of the accidental fires where the postulated fires could occur in areas important to radiological safety such as the waste receipt area, the waste handling area, the waste storage area, and the disposal unit areas. Both normal operating and abnormal and/or accident conditions should be considered in the postulation and analysis of accidental fires. The fire analysis should include the locations of the fire assumed to produce the severest conditions, the construction arrangement of affected structures, the materials likely to be consumed, and the safety and health effects of the smoke and heat associated with the fire.

The applicant should describe (1) the management's plan for responding to a fire emergency; (2) the procedures, materials, and equipment that will be in place for use during a fire emergency; (3) the procedures and equipment for providing offsite alarms, if required; and (4) the training programs for facility personnel both for the prevention of fires and for responding to fire emergencies. The applicant should show how the prescribed provisions and recommendations of National Fire Protection Association Codes, NFPA 801-1986, "Recommended Fire Protection Practice for Facilities Handling Radioactive Materials," and NFPA 901-1981, "Uniform Coding for Fire Protection," have been implemented in the fire protection system proposed for the waste disposal facility.

The applicant should describe the equipment to be used in preventing and responding to fires and should include building materials; fire detection equipment; sprinklers; onsite and offsite alarm systems; wet, dry, and chemical fire extinguishers; and foam extinguishing systems.

The applicant should describe the emergency response to a fire by facility personnel, the provisions for notification of the public of potential radiological hazards, and the evacuation measures for facility personnel and nearby residents, if these measures are required.

3.4.4 Erosion and Flood Control System

The applicant should provide hydrologic analyses and design details of the site flood control system to demonstrate that the requirements of 10 CFR 61.51(a) are met. Those features that will provide protection against erosion and flooding during the operational period should be fully described. The information and analyses should conclusively document that, in accordance with 10 CFR 61.51(a)(4), (a)(5), and (a)(6), surface features have been designed to direct surface drainage away from disposal units at velocities and gradients that will not result in flooding or erosion.

The applicant should provide detailed descriptions (plans, maps, and cross-sections) of the site drainage system, including channels, erosion protection, and diversion structures. The applicant should also provide detailed computations of peak flood flows, depths of flow, and velocities that constitute the bases for the design of protective features. Estimates of rainfall intensity, infiltration rates, times of concentration, hydrographs, etc., should be provided in sufficient detail to allow independent evaluations to be made of the design criteria and technical analyses.

4 FACILITY OPERATIONS

4.1 Receipt and Inspection of Waste

The applicant should describe the procedures or contracts in place that will ensure that arriving shipments comply with applicable Federal regulations and waste acceptance criteria that might be incorporated into the disposal facility license as conditions. These regulations and acceptance criteria should govern the acceptability of waste packages for routine handling operations and for long-term disposal.

Specifically, information on the following procedures should be provided:

- (1) Procedures for visual examination of the shipping documents, including any required compliance certificates and the waste manifest required by 10 CFR 20.311.
- (2) Procedures for visual examination of the waste package to ascertain if there are any irregularities in markings, labels, or probable waste contents and if the package is correctly described on the waste manifest as to its size, type, and waste contents; visual procedures in place to ensure that the "routine determinations" required by 10 CFR 71.87 are met.
- (3) Procedures to ensure verification surveys of the non-fixed (removable) radioactive contamination on the external surfaces of packages as required by 10 CFR 71.87 and 49 CFR 173.443 and procedures to verify that the external radiation levels around waste packages and transporting vehicles are within the limits of 10 CFR 71.47 and 49 CFR 173.441.
- (4) Procedures and information on testing and test equipment to be used to verify the accuracy of the waste class reported on the waste manifest. These procedures should include a proposed frequency for performing waste classification testing.
- (5) Procedures and information on testing and test equipment to be used to analytically verify that waste characteristics and waste form requirements are met and that the waste contains no hazardous constituents as determined by U.S. Environmental Protection Agency regulations 49 CFR 261. These procedures should include a proposed frequency for performing waste form testing.
- (6) Other procedures required to ensure that all waste acceptance criteria are met.

4.2 Waste Handling and Interim Storage

The applicant should provide information on the waste handling and interim waste storage operations to be performed at the disposal facility following acceptance and receipt of the waste packages. The applicant should describe the operations in sufficient detail to demonstrate that the waste will be handled

safely and stored in a manner that will prevent contact of water with the stored waste. Waste handling information to be provided should include the procedures and equipment that will be used to move the waste from the area of receipt to the permanent location of the disposal unit or, alternatively, to a location of interim storage. The applicant's description of the waste handling operations should include the procedures and equipment to be used in properly identifying and segregating the Class A, Class B, and Class C wastes for disposal. Interim waste storage information to be provided should include the buildings, restricted areas, procedures, and equipment that will be used to store waste after receipt for a short period of time before permanent disposal.

The information on waste handling should include procedures to protect facility workers during handling (training to ensure safe radiological control, decontamination provisions, use of protective clothing, etc.) and a description of the handling operations (off-loading procedures, anticipated rigging for the various types and sizes of containers, unloading equipment, etc.). The description of handling procedures should cover contingency plans for damaged waste packages and proposed procedures for repackaging.

The information on interim storage should include (1) a description of the conditions that would warrant temporary storage of the waste packages, (2) the maximum time that storage would be permitted, and (3) the applicant's procedures for maintaining a storage log and inventory with appropriate radiological monitoring provisions to ensure that above-ground storage limits were not exceeded. The applicant should describe the storage locations and facilities and the measures to be used to protect the waste from precipitation and adverse weather conditions, including surface water runoff that might come in contact with temporarily stored waste.

4.3 Waste Disposal Operations

The applicant should present information on all the waste disposal operations and procedures beyond waste handling and interim storage (if storage is required) from the actual emplacement of the waste into the individual disposal units up to closure and stabilization operations in the individual units. The applicant should discuss site closure operations pertaining to, for example, final site grading across several disposal units to ensure the proper handling of surface water runoff and long-term settlement/subsidence in other sections of the SAR.

The major operations for waste disposal to be described by the applicant in this section include waste emplacement in the individual units while maintaining the integrity of waste packages, minimizing void spaces between waste packages by controlling placement and stacking arrangements, filling the void spaces between packages to minimize future settlements, covering the emplaced wastes to ensure that surface radiation doses will meet regulatory limits, locating the individual units including permanent mapping and marking of unit boundaries and contents, closure and stabilization of individual disposal units, and allowance for a buffer zone around and beneath the disposal facility.

Waste Emplacement

The information on waste emplacement should include the operations and procedures for actually placing unstable Class A wastes and stable Class A, Class B,

and Class C wastes in the respective disposal units to be identified by the applicant. This information should identify the specific equipment to be used to place the waste while maintaining the integrity of waste packages including the use of slings, pallets, or special unhooking mechanisms to minimize worker exposure during placement. A description of the procedures for controlled placement and stacking should be provided along with a description of the shape and volume of voids that the applicant anticipates will remain between waste packages after placement. The methods to protect facility workers from exposure (shielding, protective clothing, etc.) during emplacement should be described. Information on the operations for placing Class C waste (at depths to ensure minimum cover requirements, etc.) is of special importance and should be coordinated with the information in Section 6.2, "Intruder Protection."

Filling of Void Spaces

The information on filling void spaces between waste containers should include a description of (1) the methods that will be used to minimize future subsidence (e.g., placing fill before additional layers of waste would reach elevations that would prevent optimum filling of voids); (2) the engineering properties of the fill material, gradation, ability of the material to conform around variable shapes and sizes without bridging between containers, placement moisture and density condition, permeability, and compressibility; and (3) the measures to prevent placement of decomposable materials. The applicant should provide information on the compatibility and durability of the proposed fill material in recognition of the chemical environment in which it will be placed (e.g., maintaining desired permeability characteristics) and the long-term performance required of the materials. Materials placed for subsurface and surface drainage (e.g., permeable blanket placed on excavation bottom with slope graded to sumps) to safely handle percolation and surface runoff should be described along with a discussion of the design details of the pervious blanket.

Waste Covering

The applicant should provide information on the shielding materials to be placed over the waste up to the top of the individual disposal unit. This information should include type of material, thickness and engineering characteristics (strength, compaction moisture and compacted density requirements, compressibility, and erosion resistance and radiation attenuation properties). The procedures for placement of material and the equipment to be used should also be described.

Locating Disposal Units and Boundary Markers

Information for locating, mapping, and marking disposal units and facility boundaries by field surveys and installing markers should be provided. This should include (1) the level of horizontal and vertical field survey control to be required, (2) the qualifications of survey personnel (e.g., under the direction of registered professional land surveyor), (3) the times the field surveys are to be performed (e.g., after excavation of disposal unit and before placement of waste and after the placement of the waste covering), (4) the procedures and documentation for developing a permanent office record on location of disposal units and boundary markers that will be made available before the period of institutional control, (5) the types and location of durable markers and monuments to be installed, and (6) the information to be inscribed or placed on

each boundary and disposal unit marker and monument. The information that will be visible in the field on disposal unit monuments that are to serve as permanent markers during the institutional control period should include the total activity of radioactive material in curies, the total amount of source material in kilograms, the total amount of special nuclear material in grams, the disposal unit excavation number, the dates the excavation was opened and closed by completing the covering, and the volume of waste in the disposal unit excavation.

Disposal Unit Closure and Stabilization

The information on closure and stabilization of individual disposal units should include a description of (1) the operations and procedures that will be required to prevent disturbance of completed units by ongoing waste disposal operations, (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 and infiltration, or unsuccessful growth of vegetation with resulting erosion, and (4) construction operations to be completed if problems are identified during the regular inspections.

Buffer Zone

The information on the buffer zone should include (1) the identification of buffer zone areas and dimensions on site plans for carrying out proposed operational and postoperational environmental monitoring and surveillance activities; (2) a discussion on the adequacy of these areas to permit construction and mitigative measures to be taken if the results of monitoring show remedial measures are required; and (3) a discussion of how site geology and topography, natural soil and rock characteristics, direction, depth, and velocity of groundwater, and location of wells and water users were considered in the development of buffer zone dimensions.

4.4 Operational Environmental Monitoring and Surveillance

The information in this section should demonstrate how the applicant meets the environmental and surveillance requirements in 10 CFR 61.53(b) and (c), the performance objectives of 10 CFR 61.41, the exposure limits in 10 CFR 20.105(b), and other sections of 10 CFR 20 as they apply to a low-level radioactive waste disposal facility. For the construction and operational environmental monitoring and surveillance periods, the applicant should

- (1) Submit monitoring plans that will provide adequate data for evaluation of the potential long-term health and environmental effects resulting from accidental or routine exposure conditions. Any modifications to the pre-operational plan for onsite or offsite environmental monitoring, including a disposal unit monitoring program, should be thoroughly discussed and justified.
- (2) Describe the extent of its participation in an environmental laboratory intercomparison program (such as that administered by the U.S. Environmental Protection Agency). This will provide the staff with some measure of both the precision and accuracy of the laboratory measurements of radioactivity. If these analyses are to be performed by an outside contractor,

a description of the contractor's quality assurance program and the extent of the contractor's participation in a nationally recognized laboratory measurements intercomparison program should also be included.

- (3) Describe how the monitoring system is capable of providing early warning for releases of radionuclides from the disposal site before they leave the site boundary. The rationale for the selection of recording levels, action levels, and the concentrations in each medium that lead to mitigative action should be discussed in detail.
- (4) Describe and document the mathematical/computer models to be used for calculation of dose to workers on site and the public off site (annual dose and 50-year dose commitment) when the measured concentrations of pollutants are below the limits of detection by state-of-the-art instrumentation.
- (5) Define those protective and restorative actions to be taken if an unplanned release of pollutant were to occur from the site. The plan should be based on the protective action guides developed by the U.S. Environmental Protection Agency (EPA-520/1-75-001, June 1980).
- (6) Describe any changes in the technical personnel, equipment, instrumentation, or facilities from those selected in the site characterization monitoring phase. Any changes in the training program for environmental monitoring should also be included.

5 SITE CLOSURE PLAN AND INSTITUTIONAL CONTROLS

The applicant should describe the facility closure and stabilization plan and the design features that are intended to facilitate disposal site closure and to eliminate the need for ongoing active maintenance. Information in other sections should be referenced as appropriate.

The applicant should explain the coordination with or participation by a State or States in the development of the proposed disposal facility. The relationship of the proposed site to compacts formed under the Low-Level Radioactive Waste Policy Act of 1980 should be presented. The discussions should meet the requirements of 10 CFR 61.14 and the demonstrations required by 10 CFR 61.59.

5.1 Site Stabilization

The applicant should demonstrate that disposal unit covers are designed to minimize infiltration of water into the disposal unit, to direct percolating or surface water away from disposed waste, and to resist degradation by surface geologic processes and biotic activity. Supporting information should include the results of field tests of prototype and model covers.

5.1.1 Surface Drainage and Erosion Protection

The applicant should provide hydrologic analyses and design details of the site flood control system to demonstrate that the requirements of 10 CFR 61.12(g), 61.13, 61.51, and 61.52 are met. Those features and institutional procedures that will provide protection against erosion and flooding during the closure period should be fully described. The information and analyses should conclusively document that, in accordance with 10 CFR 61.51 and 61.52, site features have been designed and constructed in such a manner that erosion and flooding of disposal units will be prevented and active maintenance will not be required.

The applicant should provide detailed descriptions (plans, maps and cross-sections) of the site drainage system, including channels, erosion protection, trench covers, and diversion structures. The applicant should also provide detailed computations of peak flood flows, depths of flow, and velocities which constitute the bases for the design of protective features. Estimates of rainfall intensity, infiltration rates, times of concentration, hydrographs, etc., should be provided in sufficient detail to allow independent evaluations to be made of the design criteria and technical analyses.

5.1.2 Geotechnical Stability

The applicant should provide information on the geotechnical stability aspects of the site closure plan for a low-level waste disposal facility in accordance with 10 CFR 61 performance objectives and technical requirements. Information on the design and construction of the disposal excavation covers, overall site cover, and related monitoring program should be detailed enough to enable an evaluation of the geotechnical stability aspects of the proposed site closure

plan. The applicant should include the following information on the geotechnical stability aspects: (1) design and construction details for the disposal excavation cap; (2) program to monitor and analyze the performance of the backfilled disposal excavations with a commitment to carry out remedial measures, if warranted; and (3) design and construction details of the overall site cover, site grading, permanent slopes of embankments, and drainage features (e.g., diversion ditches).

Disposal Excavation Cap

Regarding the disposal excavation cap, the applicant should include the following:

- (1) Information on the sequence of placing the soil cover over the disposed waste containers and constructing the initial cap for each backfilled disposal excavation. If the proposal calls for an initial cap on individual disposal excavations to be followed at final closure by the placement of a second cap as an infiltration barrier for all the disposal excavations at the site, then the details of this proposal should be presented including the time of placement for each cap.
- (2) Information on the drainage system designed to handle the surface water during the operation phase for the portion of the system that is to function during the institutional control period. This information should include size, lateral and longitudinal slope, filter and bedding materials, and demonstration of compliance with filter requirements for long-term performance.
- (3) Information on the settlement and infiltration monitoring program. This information should include details on the location, type, and typical installation details of the monitoring devices, discussion of the adequacy of the number of devices required to yield reliable data, allowing for some of the devices to fail to perform; and the interval for monitoring the data. The applicant's proposal for analyzing and evaluating the information gathered should be provided along with a commitment to initiate remedial actions, if excessive settlement of disposal excavation caps or infiltration into the closed excavations were to be observed.

The information should be adequate so that the staff can independently determine that the applicant intends to ensure that each of the filled disposal excavations will be performing as designed before starting the period of institutional control.

Overall Site Cover

Information on the geotechnical aspects of the overall site cover should include the following:

- (1) Engineering details on the several components of the overall site cover and site grading for the closure phase. This should include information on materials, thicknesses, and placement specification for the various materials proposed for the site cover; information on final grading to verify that all the surface water will be drained away from the disposal excavations; and information to show that all the permanent drains are adequately

protected with properly designed and durable filter materials to prevent clogging of drains in the long term. The final grading of the site cover should accommodate without any adverse effects the long-term settlement and/or subsidence expected at the site.

- (2) The proposed monitoring of the settlement of the disposal excavation caps and infiltration into the disposal excavations during the site-closure phase and the initial 5 years during the observation and surveillance period. This monitoring program should be similar in scope to that provided for the pre-site-closure phase. The scope or the extent of monitoring may be ultimately modified on the basis of the observations recorded and the evaluation of the preclosure monitoring data to fulfill long-term monitoring requirements.
- (3) The evaluation of the long-term stability (static and dynamic stability) of all permanent slopes at the site and the long-term settlement and/or subsidence at the site, as it applies to the geotechnical aspects of site closure phase. Sections 6.3.2 and 6.3.3 provide information on long-term stability and settlement evaluations.

The information on the geotechnical aspects of site closure should be adequate for the staff to judge the applicant's conclusions on the performance requirement of reasonable assurance that the disposal site will not experience instability of slopes, excessive settlement and/or subsidence, and infiltration of water into the backfilled disposal excavations and will not require active maintenance during the institutional control period.

5.2 Decontamination and Decommissioning

The information provided in this section should be sufficiently detailed to allow a thorough assessment of the applicant's decommissioning plan. The plan should focus on the actions necessary to return the low-level waste disposal facility to a condition that will not require active maintenance. The procedures contained in the applicant's decommissioning plan should eventually become part of the closure plan required by 10 CFR 61.28.

At a minimum the following information should be supplied by the applicant and should be discussed in the context of the decommissioning of the proposed low-level waste disposal facility:

- (1) The applicant should provide information on the facility radiation protection design features, including the methods and approach used to ensure that occupational exposures will be maintained as low as is reasonably achievable during decommissioning activities.
- (2) The applicant should include a detailed discussion of the survey methods that will be used to enable decontamination of all structures and equipment remaining on site or released off site after the operating stage of the license has been terminated. In the event that equipment is released for unrestricted use, the anticipated use should be specified. This description should include details of radiation profiles of equipment and structures. Details on survey instrumentation and sensitivity, competency of personnel conducting the survey, and radiation profiles that clearly delineate anticipated survey locations should be provided.

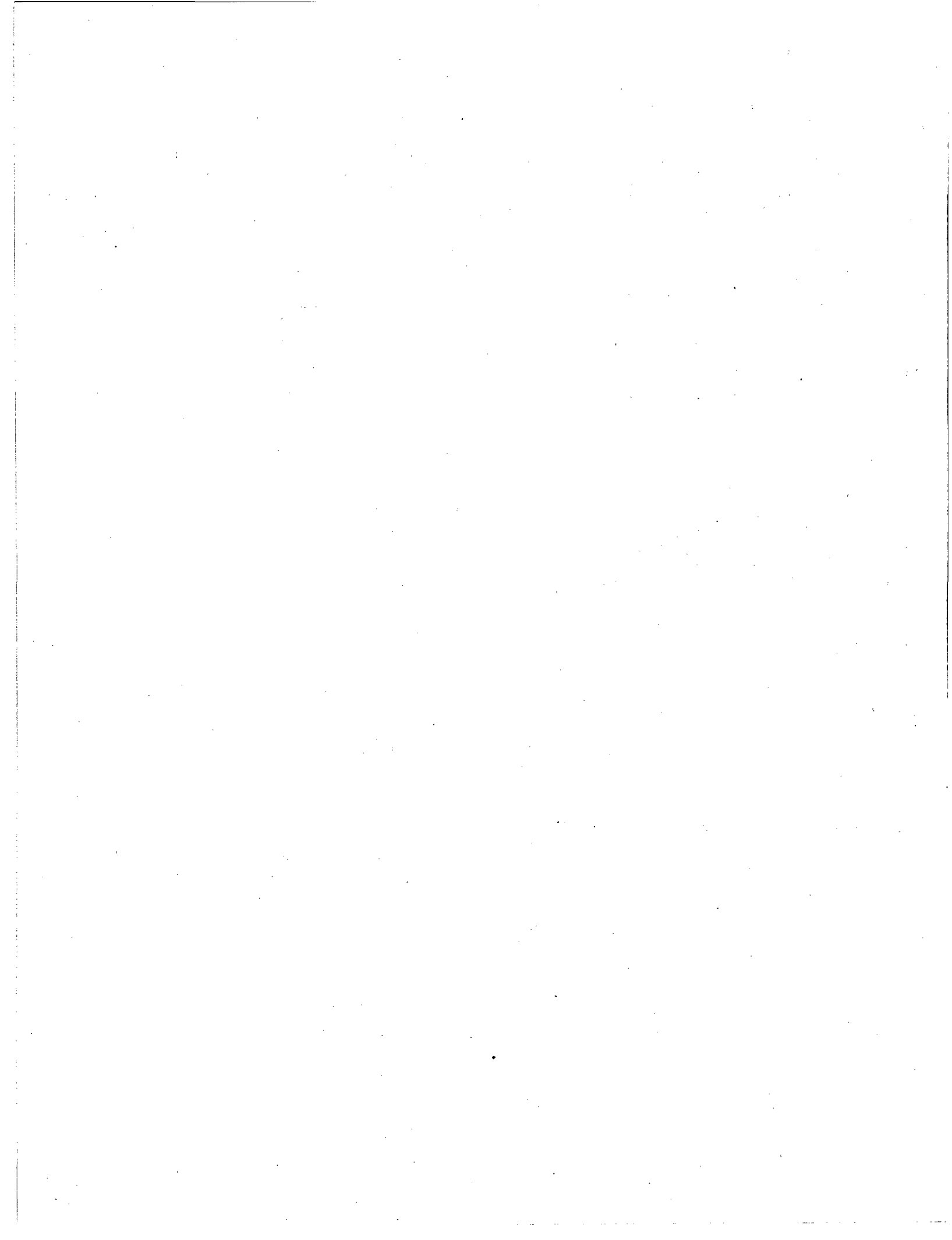
- (3) The applicant should provide information on the quantities, types, and physical, chemical, and radiological characteristics of waste that will be generated during decontamination activities. This information should include details on how waste will be classified, packaged, or stored before final disposal.
- (4) The applicant should include a thorough discussion of each alternative it has considered for decontamination, including dismantlement and final disposal of the generated waste. Cost-benefit considerations must be generated for each of the investigated alternatives, although the applicant does not have to specify an alternative choice based on the "best" cost-effective alternative.
- (5) The applicant should provide a discussion of the measured values of residual contamination for equipment, structures, and soils remaining on the site. These values should be compared with current applicable regulatory standards and guidelines (NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Power Reactors," and Draft Regulatory Guide, "Guidelines for Site Closure and Stabilization for LLW Disposal Sites").
- (6) The applicant should describe in detail the methodology for radiologically characterizing the site grounds. The site survey, as part of the methodology, will become a portion of the permanent decommissioning record and will be used to judge compliance with applicable radiation standards.
- (7) The applicant should provide all information on reports and studies on site maintenance, engineering designs and specifications, as-built plans, operational surveys, vehicle surveys, monitoring equipment calibration records, including quality assurance documentation, and any other information necessary to assess the adequacy of decontamination and decommissioning operations.

5.3 Postoperational Environmental Monitoring and Surveillance

The applicant should describe how the environmental and surveillance program will be used to demonstrate that the disposal site is stable and ready for institutional control. To explain how the monitoring system will provide an early warning of releases of radionuclides from the disposal site before they reach the site boundary, the applicant should postulate a number of hypothetical accident scenarios, report action levels (concentrations of radiological and non-radiological pollutants in the media) that will trigger mitigative activities, and discuss the reason for the selection of these levels. This section should explain how the environmental monitoring program for the postclosure observation period reflects the history of the disposal site in its earlier operational, closure, and stabilization periods.

The applicant should include the following important information: (1) how the physical and chemical characteristics of the waste inventory are reflected in the design of the monitoring program; (2) how well the predictions of the mathematical models used to estimate concentrations of contaminants in the various media are confirmed by the results of the monitoring measurements; (3) the rationale behind any modifications to the monitoring plan used in the operational phase, such as changes of location of the monitoring stations and the

frequency of sampling; (4) the statistical basis to be used to define a significant difference between the measured and background concentrations; (5) the emphasis of the program on the monitoring for long-lived nuclides that are poorly retained by soils, e.g., carbon-14, technetium-99, and iodine-129; (6) to what extent the monitoring program will involve the use of highly sensitive and specific in situ sensors that telemeter the monitoring information to a central facility for analysis; and (7) the qualifications and training of the persons who will conduct the monitoring program in this period if they are different from those employed in the operational period.



6 SAFETY ASSESSMENT

6.1 Release of Radioactivity

6.1.1 Determination of Types, Kinds, and Quantities of Waste

The applicant should supply detailed projections of the quantities and physical, chemical, and radiological characteristics of the low-level wastes to be disposed of at the disposal facility. Waste projections under consideration include (1) waste delivered to the disposal facility during the operational period and (2) waste generated as part of closure activities. The applicant should provide sufficient information on the wastes projected to be disposed of at the disposal facility to allow for defensible modeling of potential radiological impacts associated with waste disposal and also to allow for determination of the applicant's plans to ensure sufficient availability of funds for closure.

Waste During Operational Life

At a minimum, the following information on waste characteristics should be provided:

- (1) An identification of the region of concern, that is, the States forming the compact.
- (2) A discussion of the potential for receipt of waste from outside the region of concern, as well as the conditions for such waste receipt.
- (3) An identification of the major individual waste streams that constitute the majority of the waste volume and activity. These waste streams should furthermore be identified in terms of specific waste-generating facilities (e.g., activated metals from a particular nuclear power plant).
- (4) An identification of the waste streams that constitute the remaining waste volume and activity. These waste streams may be identified in terms of typical waste streams generated by a number of generators (e.g., a waste stream consisting of low-activity trash generated by all hospitals in the region of concern).
- (5) Information on the physical, chemical, and radiological characteristics of each waste stream so identified in items 3 and 4 above. At a minimum this information should include (a) annual volumes, (b) waste class, (c) average concentrations of the principal radionuclides constituting the waste stream (including those listed in 10 CFR 61.55), (d) the chemical and physical form, (e) the presence of chelating agents, (f) packaging characteristics (e.g., whether the waste will be disposed in a high-integrity container), and (g) solidification agent. Descriptions of the chemical and physical form should provide information important to an estimation of release rates (e.g., whether the waste stream consists of activated metals, sealed sources, and ion-exchange resins).

- (6) For the information discussed above on waste volumes, an estimate of trends, for example, whether the waste stream will be generated at a constant annual rate, or only occasionally. Waste streams only expected to be generated at a future time (e.g., waste streams associated with decommissioning of a nuclear power plant) should be specifically identified.
- (7) For major generators, any plans to alter waste generation rates (e.g., changes in volume reduction, decommissioning plans) over the first 5 years of the operational life of the disposal facility.
- (8) A presentation and discussion of any limitations that will be imposed on waste receipt, form, packaging, or other characteristics that would influence assessments of disposal facility performance. Such limitations could potentially include limitations on total site inventories of radionuclides of concern (e.g., C-14, H-3, Tc-99, or I-129), or requirements on the structural stability of certain Class A wastes. These proposed limitations will be incorporated into disposal facility licenses as conditions of operation.
- (9) A summary of the total projected waste volume and activity for each year of the operational life.

Waste During Closure Period

The description of waste anticipated to be generated during closure operations should be sufficient to enable an independent staff assessment of potential closure costs and impacts. The waste description should thus provide information similar to that discussed in item 5 above.

6.1.2 Infiltration

The applicant should provide hydrologic infiltration values for input into the description of how disposal site covers will be designed to minimize, to the extent practicable, water infiltration and to direct percolating or surface water away from the waste (10 CFR 61.51(a)(4)). Furthermore, the applicant should provide infiltration values for input into the analyses of the long-term stability of the disposal site and the need for ongoing active maintenance after closure (10 CFR 61.13(d)). All data used to generate infiltration estimates should also be included. The applicant should also provide information for input into the projected groundwater mass transport of radionuclides from the waste disposal site.

The basis for the infiltration values should be described. For example, if no analysis was performed, and a value was simply chosen (for instance, a percentage of total rainfall), the applicant should defend the decision. If analyses were performed, the applicant should present a description of the conceptual model and the analytical or numerical methods used, including a discussion of the assumptions, boundary conditions, governing equations, documentation, verification, calibration, and justification that the analysis is adequately conservative or realistic. If a numerical code was chosen, but is described elsewhere in the SAR, it should be referenced. Results from the analyses should be in a format of volume of flux entering the system per annum, length of time between deep percolation events, and zones of potentially high percolation.

6.1.3 Radionuclide Release - Normal Conditions

The applicant should provide a reasonable, yet conservative, assessment of radioactivity release into each of the most significant radioactivity transport mechanisms for each of the five periods of concern in the life of the disposal facility. The most significant radioactivity mechanisms include groundwater, air, surface water, direct radiation, and biotic pathways. The five periods of concern include the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods. The information must be sufficient to enable an independent evaluation of the releases anticipated from the disposal facility. The information provided herein provides a source term for calculations of impacts (1) on offsite individuals based on normal facility conditions, and (2) on onsite individuals (custodial personnel) conducting normal activities during the active institutional control period.

Typical scenarios by which radioactivity may be released are listed in Tables 6.1 and 6.2. These scenarios are only for illustration, however, and the applicant should provide an analysis that identifies and quantifies the most significant scenarios based on the specific details of the site environment, the facility waste acceptance criteria, and the facility design and operating practices. Significant scenarios should include those that contribute at least 5% of the calculated impacts to an individual at the critical receptor point (see Section 6.1.6).

To the extent that calculations of radioactivity release are based on waste stream specific models, the applicant's assumptions and analyses for each individual waste stream should be defensible. Should the applicant propose to assume similar release models or parameter values for groups of waste streams, then an acceptable approach would be to assume the most conservative radioactivity release model or parameter values for all waste streams in the group. Use of other than the most conservative release model or parameter values should be justified by the expected distribution of the characteristics of individual waste streams forming the group.

In addition, if credit is taken for inhibition of radioactivity release due to special waste form, waste packaging (e.g., disposal within high-integrity containers), or disposal techniques, those waste streams that will be disposed of pursuant to these techniques should be identified. The influence of these special waste form, waste packaging, or disposal techniques should be quantified.

Relevant data for this section may be referenced in other sections of the SAR, such as:

- (1) Section 2.2, "Meteorology and Climatology", as it applies to the amount and temporal distribution of rainfall and design-basis events
- (2) Section 2.4.2, "Groundwater Characterization", as it applies to the characterization of the natural, unsaturated regime
- (3) Section 3.1, "Principal Design Features," as it applies to the engineered design of the cover system, including physical parameter quantification

Table 6.1 Typical scenarios - offsite impacts on individuals resulting from normal conditions

Scenario	Radiation*	Transport mechanism	Theoretical periods of concern**
(1) Doses to individuals near disposal site from parked waste delivery vehicles	g	None	0
(2) Doses to individuals near disposal site from site operations (e.g., hoisting liners using cranes)	g	None	0
(3) Airborne releases from contaminated surfaces such as buildings and grounds	a,b,g	Air	0,C,S,I,P
(4) Airborne releases from decomposing waste (e.g., methane gas, CO ₂)	b	Air	0,C,S,I,P
(5) Airborne dispersion of contamination unearthed by plants and animals	a,b,g	Air	0,C,S,I,P
(6) Airborne discharges from disposal cells (e.g., evaporate water collected in trenches or sumps)	b	Air	0,C,S,I
(7) Airborne dispersion of contamination associated with demolition activities	a,b,g	Air	C
(8) Waterborne releases from contaminated surfaces such as buildings and grounds	a,b,g	Surface water	0,C,S,I,P
(9) Waterborne dispersion of contamination unearthed by plants and animals	a,b,g	Surface water	0,C,S,I,P

See footnotes at end of table.

Table 6.1 (Continued)

Scenario	Radiation*	Transport mechanism	Theoretical periods of concern**
(10) Waterborne discharges from disposal cells (e.g., from trench sumps)	a,b,g	Surface Water	O,C,S,I,P
(11) Waterborne dispersion of contamination associated with demolition activities	a,b,g	Surface water	C
(12) Radionuclide leaching and migration	a,b,g	Groundwater	O,C,S,I,P
(13) Release through biotic pathways	a,b,g	Biota	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 6.2 Typical scenarios - impacts on onsite individuals during the active institutional control period

Scenario	Radiation*	Transport mechanism	Human access location
(1) Direct radiation impacts on individuals maintaining site during institutional control period	g*	None	Site surfaces
(2) Impacts on individuals due to dispersal of residual contamination	a,b,g	Air	Air above site surfaces
(3) Airborne releases from waste decomposition gases (e.g., methane gas, CO ₂)	b	Air	Air above site surfaces

*a = alpha; b = beta, g = gamma.

6.1.4 Radionuclide Release - Accidents or Unusual Operational Conditions

The applicant should provide information regarding the types, significance, and magnitudes of radioactivity release associated with accidents or unusual operational conditions. The information should be sufficient to enable an independent staff analysis of projected radiological impacts.

Identification of Accidents or Abnormal Operating Conditions

At a minimum, the applicant should provide the following information:

- (1) Identification and discussion of the principal accidental or unusual operational scenarios by which radioactivity may be released and result in impacts on offsite individuals. This discussion should first identify a complete spectrum of possible release scenarios, and then eliminate those that are bounded by other scenarios. This discussion should include justification as to the choice and ranking of possible scenarios. The intent is to go from a complete list of scenarios to those that are representative and bounding.
- (2) In the above discussion, the applicant may reference (a) generic information and analyses, (b) regulatory requirements that preclude certain scenarios from occurring or otherwise limit the release of radioactivity (e.g., in terms of the rate at which radioactivity is released or the period of time that the release rate occurs), and (c) proposed conditions of waste acceptance or facility design and operation that preclude certain scenarios from occurring or otherwise limit the release of activity.

Evaluation of Release

At a minimum, the applicant should provide the following information:

- (1) For each of the principal scenarios identified above, estimates of radioactivity release and event frequency that are reasonable, yet conservative. In so doing, the applicant may reference (a) generic information and analyses, (b) regulatory requirements that limit or bound the possible event frequency or magnitude of release, and (c) proposed conditions of waste acceptance or disposal facility design and operation that limit or bound the possible event frequency or magnitude of release.

Experience at other disposal facilities may also be referenced provided the relationship between other and proposed disposal operations is clear.

- (2) Information that enables quantification of the source term for the principal mechanisms by which radioactivity, once released, may be transferred from the disposal facility. These transfer mechanisms may include air and surface water pathways.

6.1.5 Radionuclide Transfer to Human Access Location

In these sections, the applicant should provide a reasonable, yet conservative, assessment of each of the most significant radioactivity transport mechanisms for each of the five periods of concern in the life of the disposal facility.

The most significant radioactivity transport mechanisms include groundwater, air, surface water, direct radiation, and biotic pathways. The five periods of concern include the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods. The information provided herein provides an analysis of the mechanisms by which releases reach human access locations, so that radiological impacts on individuals can be assessed (Section 6.1.6). The information must be sufficient to enable an independent evaluation of these transfer mechanisms. Both offsite individuals under normal facility conditions, and onsite individuals (custodial personnel) conducting normal activities during the active institutional control period need to be considered. Typical scenarios and their associated transfer mechanisms are listed in Tables 6.1 and 6.2.

6.1.5.1 Transfer Mechanism - Groundwater

Using previously cited hydrologic and geochemical information (Sections 2.4.2, 2.6, and 6.1.1 of the SAR), the applicant should calculate potential radionuclide concentrations transferred to human access locations, including real and hypothetical groundwater discharge points such as streams, wells, springs, and seeps located downgradient from the site. To allow for an independent assessment of the groundwater transfer, the applicant should provide all information needed to calculate radionuclide concentrations and groundwater travel time at appropriate distances downgradient from the site. This information should include a description of the conceptual model of the site groundwater flow system in relationship to the planned engineered design, physical and chemical input parameters used in the contaminant transport analyses, the mathematical models and methods used to calculate radionuclide concentrations, and the calculated results, including associated uncertainties in the methods and data. The following detailed information should be provided:

Conceptual Model of Groundwater Flow and Pathways

The applicant should provide a description of the conceptual model(s) of the physical environment and transport medium that describes the occurrence of groundwater movement in the saturated and unsaturated zones, and delineates all significant pathways for groundwater transport of radionuclides from the disposal units to the accessible environment (human access locations). The applicant should identify the nearest downgradient water users and the nearest municipal water supply relying on groundwater and describe the design features of the disposal site.

To conceptualize existing groundwater pathways, the applicant should summarize the regional groundwater flow system and its relationship to the site using the hydrologic characteristics and boundary conditions previously described in Section 2.4.2. The applicant should identify major hydrogeologic units and their stratigraphic relationships. For each hydrogeologic unit, the applicant should list hydrologic properties, radionuclide transport characteristics, flow directions and volumes of flow, hydraulic gradients, principal zones of recharge and discharge, all known groundwater-surface water interactions, known leakage between units, water table fluctuation zones, and known groundwater residence times.

The applicant's conceptual model should describe (narratively and pictorially) the principal saturated flow paths to the accessible environment. The applicant should use cross-sections and maps to indicate the principal flow paths and to include the saturated and unsaturated zones. Vertical and horizontal pathways should be discussed. The conceptual model should include a discussion of preferential pathways such as solution features, fault zones, or joint systems, if present. In addition, the conceptual model should include natural flow barriers, if present, such as fault zones or dikes, and engineered features designed to impede or disperse radionuclide migration.

The applicant should discuss the potential for significant changes in flow directions and fluxes under various hypothetical pumping schemes described in Section 2.7 of the SAR, and the site-specific conditions that could induce change.

Mathematical Models Used To Predict Radionuclide Migration

The applicant should describe the numerical and/or analytical model(s) used to simulate flow and transport through the saturated and unsaturated zones at the site and predict radionuclide concentrations transferred to appropriate access locations downgradient from the site. The applicant should describe and justify the type of model(s) used, the theoretical basis of each model, including underlying assumptions and physical and/or chemical laws considered, and model uncertainties and limitations. The procedures used to verify the codes and the methods for and results of model calibration should be described, including model validation techniques and sensitivity analyses. The applicant should provide information on the modeling procedures (strategies and methods) used in the analyses, and provide complete documentation of the computer code using NUREG-0856 as a guide.

Input Parameters Used for the Contaminant Transport Analyses

The applicant should list and support (justify) all input parameters used in the contaminant transport analyses, which include hydrologic, geochemical, and radionuclide release data presented in Sections 2.4.2, 2.6, and 6.1.1 of the SAR. Spatial and temporal variabilities of the parameters should be provided. Hydrologic parameters should include, but not be limited to, initial concentration distributions, saturated and unsaturated hydraulic conductivities, calculated groundwater velocities, hydraulic gradients, permeabilities, effective and total porosities, soil moisture characteristics, and dispersion and distribution coefficients for radionuclides of interest. The degree of reliance placed on hydrodynamic dispersion (based on dispersion coefficient) and retardation (based on distribution coefficient) to demonstrate acceptable dose limits should dictate the method needed to quantify these values (i.e., site-specific data vs data from literature) (see Section 2.6).

Results of the Contaminant Transport Analyses

The applicant should provide the results of the transport analyses (calculated radionuclide concentrations at real and hypothetical groundwater user locations and discharge points) in map and tabular form. The results of analyses should identify the maximum and minimum ranges and discuss the likelihood of predicted

concentrations because uncertainties in the data and analyses may preclude determining single concentration values. The applicant should perform a sensitivity analysis and provide the results in tabular or graphical form. The uncertainties of the result and any anomalous behavior of the modeling analyses and model outputs should be discussed.

6.1.5.2 Transfer Mechanism - Air

The applicant should describe the models, computer codes, and computational methods used to estimate the downwind atmospheric and surface concentrations of gaseous and particulate contaminants released from a low-level waste disposal site for both routine and accident conditions. These methods should be capable of calculations for waste geometries commonly found at low-level disposal sites (point, area, and volume sources, etc.). The applicant should clearly identify the computational methods used to quantify removal mechanisms and the wet/dry deposition rates used in the calculation of the surface area concentrations. This section should also contain an estimate of the airborne dispersion of contamination unearthed by invasive flora and fauna. The demographic information requested in Section 2.1.2 should be included to enable the staff to calculate values of the concentrations used in the estimation of population doses in the Environmental Report.

Airborne and surface concentrations should be reported (in graphical or tabular form) as normalized, time-integrated, annual-average concentrations for both radiological and nonradiological contaminants. For accident conditions, the models and assumptions used to estimate downwind concentrations that result from a puff release (such as during a fire) should be explicitly identified.

The meteorological parameters used in the models should be based on site-specific data collected from at least 1 year of air-quality monitoring. A discussion of the limitations and accuracy of these parameters for these calculations should be included. The kinds of meteorological data to be used for these calculations are given in Draft Regulatory Guide Task ES 401-4, "Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting," September 1985.

The projected concentrations for airborne pollutants and the surface depositions should be calculated

- (1) at the site boundary points for each of the 22.5° radial sectors centered on the 16 cardinal compass directions
- (2) at the location of the maximally exposed individual (off site)
- (3) at the nearest present and known future offsite receptors (i.e., residence, milk cow, milk goat, meat animal, and farm or vegetable garden larger than 50 m²) for each of the 22.5° radial sectors
- (4) for offsite individuals during the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods

- (5) for offsite individuals, which are the result of operational accidents or abnormal conditions during the operational period
- (6) for onsite individuals during the active institutional control period

6.1.5.3 Transfer Mechanism - Surface Water

Using previously cited hydrologic information (Section 2.4.1 of the SAR), the applicant should calculate potential radionuclide concentrations at human access locations (including surface water intakes, fishing areas, shorelines, and other water recreation areas) located in water bodies that could receive contamination from the site. To allow for an independent assessment of surface water concentrations, the applicant should provide all information needed to calculate radionuclide concentrations in surface water bodies. This information should include a description of the surface water flow system in relationship to the planned engineered design, physical and chemical input parameters used in the contaminant transport analyses for both the surface water and the source of contamination (e.g., contaminated site runoff), the mathematical models and methods used to calculate radionuclide concentrations, and the calculated results (including associated uncertainties in the methods and data).

The applicant should describe the conceptual model, addressing all significant pathways for surface water transport of radionuclides to the accessible environment. The applicant should identify the nearest use of surface water that could become contaminated and should describe any site features that could mitigate radionuclide releases to the surface water environment. Detailed maps and cross-sections should be provided.

The applicant should describe the numerical and/or analytical model(s) used to simulate flow and transport at the site and to predict radionuclide concentrations at affected surface water locations.

The applicant should describe and justify the type of model(s) used, the theoretical basis for each model, and the uncertainties and limitations of the model. The procedures used to verify the codes, and the results of model calibration should be described, including model validation techniques and sensitivity. The applicant should provide information on the modeling procedures (strategies and methods) used in the analyses and provide complete documentation of the computer code(s).

The applicant should list and justify all input parameters used in the contaminant transport analyses. Results of the transport analyses and radionuclide concentrations at surface water user locations and discharge points should be provided in map and tabular form. The results of analyses should represent the range of possible values and should discuss the likelihood of the predicted concentrations with regard to uncertainties in the data and analyses. The applicant should perform a sensitivity analysis and provide the results in tabular or graphical form. The uncertainties of the results and any anomalous behavior of the modeling analyses and model outputs should be discussed.

6.1.5.4 Other Transfer Mechanisms

The applicant should fully describe the transfer mechanisms in addition to groundwater, air, and surface water that contribute to scenarios having radiological impacts on individuals. These transfer mechanisms may include

attenuation of gamma radiation through air and offsite transfer of radioactivity through biotic pathways. An explanation of why transfer mechanisms were incorporated as part of the overall analyses should be included. If gamma attenuation or biotic pathways are not included, the applicant should explain why these transfer mechanisms were not included. The explanation should include simple, basic calculations to demonstrate that these transfer mechanisms contribute less than 5% of the total potential dose rate.

For all transfer mechanisms covered in this section, the applicant should fully describe and justify the mathematical models or analytical methods and data used. Data used from other parts of the SAR can be referenced.

Specific information that should be provided for gamma attenuation includes the description and validity of the mathematical methods used to describe buildup, shielding, and absorption effects; the model used to calculate external exposure to electrons; and the analytical methods used to simulate various source geometries (points, planar, volume).

6.1.6 Assessment of Impacts and Regulatory Compliance

This section provides a culmination of the analyses and information presented in Sections 6.1.1 through 6.1.5. In this section, the applicant should provide information that demonstrates compliance with regulatory limits for potential radiological impacts associated with the disposal facility. Specific impacts to be determined include those associated with (1) releases under normal conditions, (2) releases due to accidents or unusual operational conditions, and (3) normal activities by site custodial personnel during the active institutional control period.

An acceptable way to organize the information in this section is to first address calculations of radiological impacts on individuals and then address compliance with regulatory criteria.

Calculation of Radiological Impacts on Individuals

Calculations of radiological impacts on individuals have the potential for considerable complexity. Given this fact, it is recommended that the applicant organize the information presented herein so that it first addresses the overall scope of the analyses and then addresses the specific details of the analyses.

Analyses Scope. An acceptable way to organize the required information is to first identify the principal receptor points of concern (i.e., the principal human access locations), then identify the particular exposure media in which radioactivity is projected to be present, and finally to identify and confirm the principal uptake pathways. Rationale and discussion should be provided for assumed changes in receptor points, exposure media, and uptake pathways as a function of time.

The above three-stage hierarchy is illustrated in Tables 6.3 through 6.5 for releases resulting from normal operations. It should be noted, however, that the particular receptor points, exposure media, and uptake pathways that would be considered for a particular facility would be entirely dependent on the proposed design and operation of the facility, as well as on site environmental conditions. The examples illustrated in Tables 6.3 through 6.5 may therefore be incomplete or inapplicable.

Table 6.3 Typical receptor points (access locations) and exposure media

Receptor points	Possible exposure media	Comments
Site boundary	Air	a
	Well water	b
	Surface water (possibly)	c
	Gamma radiation	d
Nearest user of groundwater downgradient of site	Air	
	Well water	e
	Surface water (possibly)	e
Nearest community user of groundwater downgradient of site	Air	
	Well water	e
	Surface water (possibly)	e
Nearest surface discharge point (e.g., stream) for groundwater in downgradient direction from site	Air	
	Surface water	
Nearest surface discharge point (e.g., stream) for site runoff	Air	
	Surface water	
Nearest resident ^f	Air	
	Well water (possibly)	
	Surface water (possibly)	
	Contaminated biota	

- a. Determined for each of the 22.5° radial sectors centered on the 16 cardinal compass directions.
- b. Possibly not applicable until active and passive institutional control periods. See comment f.
- c. In the event that a surface water access location is at or near the site boundary.
- d. Determined during operational period at the site boundary near major onsite source of gamma radiation.
- e. Depending on site-specific conditions, the access location could be well water, surface water, or both.
- f. For the active and passive institutional control periods, the nearest resident should be assumed to be at the site boundary. Access locations to be considered should, at a minimum, include air, well water, and contaminated biota. Surface water use depends on site-specific conditions.

Table 6.4 Typical uptake pathways considered

Exposure media	Uptake pathways	
	Primary	Secondary
(1) Offsite air*	Inhalation (air) Direct radiation (air)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(2) Offsite air	Inhalation (air) Direct radiation (air) Ingestion (air)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(3) Offsite location	Direct radiation (operations)	
(4) Onsite air	Inhalation (air) Direct radiation (air)	
(5) Well water	Ingestion (water)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(6) Open water	Ingestion (water) Ingestion (fish) Direct radiation (immersion)	Inhalation (soil) Direct radiation (area) Direct radiation (air)
(7) Onsite soil during active institutional period	Direct radiation (volume) Direct radiation (area)	
(8) Contaminated biota	Ingestion (specific)	

*Note that dose assessment models based on the presence of contaminated air at a human access location would differ somewhat on the basis of whether one is addressing a chronic or a temporary exposure (e.g., as in a puff release of radioactivity).

Table 6.5 Descriptions of typical uptake pathways

Pathway	Description
Inhalation (air)	Uptake of radionuclides resulting from breathing contaminated air.
Inhalation (soil)	Uptake of radionuclides resulting from air contaminated from suspension and volatilization of contaminated surfaces.
Direct radiation (air)	Direct exposure to ionizing radiation based on immersion in a cloud of contaminated air.
Direct radiation (area)	Direct exposure to ionizing radiation based on standing on a contaminated surface.
Direct radiation (operations)	Direct exposure to ionizing radiation based on proximity to disposal facility during operations.
Direct radiation (volume)	Direct exposure to ionizing radiation from disposed waste as attenuated through disposal unit covers.
Direct radiation (immersion)	Direct exposure to ionizing radiation resulting from immersion in contaminated water.
Ingestion (air)	Uptake of contaminated plant food resulting from deposition of airborne contamination. This pathway could include consumption of deposited contamination (e.g., leafy vegetables) plus consumption of contamination resulting from root uptake pathways. In either case, radionuclide transfer to humans could occur via the following mechanisms: plant-to-human, plant-to-animal-to-human, and plant-to-animal-to-product-to-human.
Ingestion (water)	Uptake of contamination resulting from consumption and use of contaminated water. Water may be consumed directly, used for watering livestock, or used to irrigate plants. Transfer to humans via livestock mechanisms could include the following mechanisms: water-to-animal-to-human, and water-to-animal-to-product-to-human. Transfer to humans via plant irrigation could occur by mechanisms similar to those for the above ingestion (air) pathway.
Ingestion (fish)	Uptake of contamination resulting from consumption of fish and shellfish caught in open water.
Ingestion (specific)	Consumption of food in food chain initiated by contaminated biota.

For abnormal or unusual operational releases, at least two receptor points may be considered: the site boundary and the nearest surface discharge point (e.g., a stream) for site runoff. The exposure media of concern would at a minimum include air for the first receptor point and surface water for the second. For normal activities by the site owner during the active institutional control period, the receptor point is essentially the surface of the disposal facility. Exposure media of concern would at a minimum include contaminated onsite air and direct radiation.

Details of Analyses. Information addressed herein should at a minimum include the following:

- (1) Computational models and analytical methods for transfer of radioactivity through uptake pathways. Transfer models generally based on the methodology in Regulatory Guide 1.109 are acceptable, although specific parameters for inclusion in the model should be reviewed and replaced with updated or site-specific parameters as appropriate.
- (2) Assumptions for occupancy times, exposure periods, growing season, usage parameters, and physiological and metabolic parameters. In this regard, Regulatory Guide 1.109 may be used as a general reference. Updated or site-specific information should be used as appropriate.
- (3) Dose conversion factors for direct exposures to beta and gamma radiation, as well as acceptable dose conversion factors for exposure to internal organs due to ingestion and inhalation pathways. External beta/gamma exposures due to proximity to uniformly contaminated surfaces may be based on the methodology presented in NUREG/CR-1918, or methodology of equivalent sophistication, as may external beta/gamma exposures due to immersion in contaminated air. Exposures to internal organs due to ingestion or inhalation pathways should be based on the methodology in International Commission on Radiological Protection, Publication 30, or its equivalent.
- (4) Conceptual models and exposure scenarios.
- (5) A comparison of the compilation of site-specific data pertinent to pathways analyses with data obtained during the site characterization program.
- (6) Details of computer codes to determine impacts. (Such codes may be referenced.)
- (7) Information sufficient to ensure that the analysis includes all pathways of interest, that is, pathways that contribute at least 5% of the total potential dose rate at each receptor point of interest.

Compliance With Regulatory Criteria

The information presented herein should provide a comparison of the potential radiological impacts determined above with applicable regulatory criteria. At a minimum reasonable assurance should be provided regarding the following:

- (1) Potential normal offsite releases will be controlled so that impacts on individuals through the particular combination of pathways inherent at the access location of concern are within the limits specified in 10 CFR 61.41

and are furthermore reduced to levels as low as reasonably achievable. This should be shown to be valid during the operational, closure, observation and surveillance, active institutional control, and passive institutional control periods.

- (2) Potential impacts on offsite individuals as a result of operational accidents and abnormal occurrences will be controlled to levels as low as reasonably achievable, where the term "as low as reasonably achievable" is defined in 10 CFR 20.
- (3) Potential impacts on onsite individuals carrying out routine activities during the active institutional control period will be controlled so that they will not exceed the limits specified in 10 CFR 61.41 and are furthermore reduced to levels as low as reasonably achievable.

The applicant's assessments of compliance with the above criteria are not limited to numerical assessments of potential dose rates but may also include the applicant's commitments and proposed limiting conditions of operations, the applicant's proposed environmental monitoring and survey program, the ease in which operations can be adjusted to eliminate or mitigate potential releases of radioactivity, past environmental monitoring and disposal history at other disposal facilities, and the applicant's training and experience.

6.2 Intruder Protection

The applicant should provide information on the intruder protection measures that would be used to prevent an intruder from coming into contact with Class C waste after the institutional control period. The applicant should clearly identify the specific measures that will be used to provide the required protection. This protection may be provided by (1) placing the waste a minimum of 5 m below the top surface of the waste cover or (2) if the waste is placed at higher levels within the disposal unit, by designing and constructing an intruder barrier system with material that will provide protection against inadvertent intrusion for at least 500 years following site closure. The locations of the disposal unit excavations where Class C wastes are to be placed should be clearly identified on the site drawings, and the applicant should include sufficient details (configuration, depths) of waste placement and intruder protection measures on the engineering drawings.

The information on the intruder protection system should include (1) a discussion on waste handling and placement that is cross-referenced to Section 4.2, "Waste Handling and Interim Storage," with respect to the proper segregation procedures for Class C waste, and to Section 4.3, "Waste Disposal Operations," regarding waste emplacement, backfill, and covering operations, and (2) when Class C waste will be placed at depths less than 5 m below the top surface, an intruder protection analysis that will demonstrate with reasonable assurance that the proposed measures and materials will safely protect against inadvertent intrusion for the required period following institutional control. Information to be provided in the analysis should include the assumptions, data, and methodology used in the analysis, with particular emphasis on the long-term quality and durability aspects of the materials to be placed over the wastes. The basis for the results and conclusions of the analysis should be clearly identified, and the information should include supporting documentation (e.g., historical examples of longevity for similarly proposed materials) and important references.

The analysis should address the development of any potential adverse effects resulting from the occurrence of abnormal and/or accident events during the required 500-year period of performance.

The applicant should provide information on placement, backfill, and covers where Class C waste is to be placed in a disposal unit at depths at least 5 m below the top surface of the cover. This information should include the type of materials to be placed over the Class C waste and the field controls to be required for its placement. The information should indicate whether the materials above the Class C waste are to consist entirely of soil materials or a combination of Class B and stable Class A wastes overlain by a soil material cover.

6.3 Long-Term Stability

The applicant should present discussion, data, and stability analyses that provide reasonable assurance that there will be no need for ongoing active maintenance of the disposal site following closure. This demonstration should be based on quantitative analyses of active natural processes such as erosion, mass wasting, slope failure, settlement of wastes and backfill, infiltration through covers over the disposal areas and adjacent soils, and surface drainage of the disposal site.

In the stability analyses, the applicant should identify (1) the method, input data, and assumptions used for each process analyzed and (2) the assumed contributions of siting, design, use, operation, and closure if they affect long-term stability. The applicant should discuss the uncertainties of the results and any anomalous model behavior and analysis output.

6.3.1 Surface Drainage and Erosion Protection

The applicant should provide hydrologic analyses and design details of the site flood control system to demonstrate that the requirements of 10 CFR 61.23(e) and 61.44 are met. Those features that will provide protection against erosion and flooding during the postclosure period should be described in detail. The information and analyses presented should conclusively document that, in accordance with 10 CFR 61.44, the facility has been designed and sited and will be closed in such a manner that long-term stability can be achieved without the need for ongoing, active maintenance.

The applicant should provide detailed descriptions (plans, maps and cross-sections) of the site drainage system, including channels, erosion protection, trench caps, and diversion structures. The applicant should also provide detailed computations of peak flood flows, depths of flow, and velocities that constitute the bases for the design of protective features. Estimates of rainfall intensity, infiltration rates, times of concentration, hydrographs, etc., should be provided in sufficient detail to allow independent evaluations to be made of the design criteria and technical analyses.

Where applicable, results of testing of rock durability (to demonstrate the ability of the erosion protection to endure for long periods) should be provided.

6.3.2 Stability of Slopes

The applicant should provide information on the long-term stability aspects of the slopes of the proposed facility in accordance with the performance objectives and technical requirements of 10 CFR 61. The applicant should provide information on the long-term stability of all earth and rock slopes, both man-made and natural, whose failure under any of the conditions to which they could be exposed during the 500-year stability period of the facility could adversely affect the facility's meeting the performance objectives in Subpart C of 10 CFR 61. Slope stability evaluations should include information on (1) slope area characterization--investigations (borings, test pits, trenches, etc.); results of laboratory tests; design properties of fill borrow materials; and compaction criteria; and (2) slope stability--slope characteristics, design criteria, and stability analysis and results. If any of the information that should be presented in this section of the SAR is presented in other sections, it does not have to be repeated here, but the appropriate sections should be referenced. The scope and results of any additional investigations carried out for the slope stability evaluations should be presented in this section. The scope of such presentation for these additional investigations should be similar to that in Section 2.5.

Site and/or Slope Area Characterization

Information on the geotechnical characteristics of the site (Section 2.5) and information from any additional investigations at the slope areas should be the data base for the characterization of the slope areas. The information should include the following:

(1) Geology, Geochemistry, and Seismology of the Area

Information on these items presented in Sections 2.3 and 2.5 and applicable to the slope areas should be appropriately referenced. If additional investigations were carried out for the slope areas, they should be presented here. The scope of information on the above items for the slope areas should be similar to that in Section 2.5.

(2) Field Investigations

The information presented for the slope areas, either in this section or in other sections and appropriately referenced, should include the following:

- (a) plot plan(s) clearly showing the outline of the facility and the locations of all site explorations such as borings, probes, pits, trenches, seismic lines, and piezometers, and geologic profiles, with identification of the location of the slope areas selected for stability evaluation
- (b) an adequate number of profiles and cross-sections of the slopes showing the soil and rock layering
- (c) logs of borings, probes, pits, trenches, and geophysical investigations from the slope area in sufficient detail as described in Regulatory Guide 1.132.

(3) Testing and Soil Parameters

The information on both test results and soil parameters used in the slope stability evaluation, either in this section or in other sections and appropriately referenced, should include the following:

- (a) Description of test results and engineering properties of natural materials occurring in the slope areas and for the fill borrow materials proposed to be used in the stability analysis of the slope areas.
- (b) For slopes that are underlain by saturated cohesionless soils and/or sensitive clay, a description of sampling procedures and test results for all zones that could become unstable because of liquefaction or strain-softening phenomena.
- (c) Static and dynamic engineering properties of the soils with a demonstration that reasonable and conservative values were used in the design. This demonstration should explain how the developed data were selected for use in the stability analyses, how the test data are enveloped for design, and why the design envelope is conservative.

(4) Groundwater Conditions

Information on the groundwater conditions should include the following:

- (a) discussion of the range in groundwater conditions having an effect on the stability of the slopes of the proposed facility and the margins of safety against failure
- (b) analyses and evaluation of the potential for piping conditions
- (c) history of seasonal groundwater fluctuations and levels resulting from occurrences of design-basis events

(5) Borrow Materials

Information on the proposed fill borrow materials for the slope areas should include the following:

- (a) data and discussion supporting the suitability of the material for its intended use
- (b) adequate demonstration that the physical and shear strength soil and rock parameters recommended to be used in the slope stability analyses were based on appropriate tests performed on samples representative of the as-compacted condition
- (c) plans for restoration of the borrow area(s) to address any potential for adversely affecting the long-term performance of the disposal facility because of the borrow excavations

(6) Compaction and Quality Control

Information on compaction and quality control of fill materials should include detailed specifications on material selection, compaction criteria, placement moisture content, gradation of materials, and frequency of quality control tests.

Slope Stability

The information on slope stability (slope characteristics, design criteria, and design analyses) should be sufficient and appropriate to demonstrate the long-term stability of the facility slopes and any other slopes at the site whose failure could adversely affect the long-term performance of the disposal facility. The information should include the following:

(1) Slope Characteristics

- (a) a presentation of the characteristics of any excavation slope, natural slope, and/or embankment slope, including details on slope angles and foundation conditions
- (b) description and table summary of the static and dynamic engineering properties of the soil and rock that constitute the slope and foundation materials
- (c) a description of the groundwater and seepage conditions used in the stability analyses

(2) Stability Analyses

The presentation of the method of analyses and design criteria for the short-term and long-term stability of the slopes should show that representative and valid static and dynamic analyses were performed and that the factors of safety resulting from these methods of analyses are not less than 1.3 for short-term static stability conditions and 1.5 for long-term static stability conditions. The information presented should also include the following:

(a) Static Stability

For the static stability analyses, the following features should be described and assessed:

- the uncertainties with regard to the boundaries and properties of the several types of soil in the foundation and within the slope, the forces acting on the slope, and the pore pressures acting within the slope
- failure surfaces (slip circle, sliding wedge, etc.) corresponding to the lowest factor of safety obtained in the stability analyses for the anticipated conditions of loading (e.g., long-term, seismic, and flooding)

- the effects of the assumptions inherent in the method of analysis that was used on the resulting margins of safety

(b) Dynamic Stability

For the dynamic stability analyses, the following features should be described and assessed:

- The appropriateness of the typical cross-section of the slope analyzed and the soil parameters used in the analysis.
- The appropriateness of the method of dynamic stability analysis used. This may be decided on a case-by-case basis depending on the level of earthquake shaking, the types of soils in the slope, and the consequences of a seismically induced failure of the slope. The selection of the method of dynamic stability analysis should be adequately justified.
- Failure surfaces (slip circle, sliding plane, etc.) corresponding to the lowest factor of safety obtained in the analyses for the anticipated conditions of loading (e.g., long-term, seismic, and flooding).
- The effect of the assumptions inherent in the method of analysis that was used on the resulting margins of safety. The factors of safety calculated should be identified and will be evaluated on a case-by-case basis by the staff depending on the conservatism in the data base, design assumption, and method of analysis that was used.

(c) Liquefaction Potential

If the slope or foundation materials at the site of the facility are saturated, loose, cohesionless soils, then an analysis of the liquefaction potential of these materials is required for long-term stability considerations. The information should include the following:

- The method of analysis selected and the basis for its selection. The need for a detailed liquefaction analysis should be determined on a case-by-case basis and should consider the level of earthquake shaking, site stratigraphy, critical soil parameters (relative density, standard penetration test (SPT), percent fines, etc.), and the consequences of a liquefaction-induced failure.
- For the method of analysis used, the appropriateness of the soil parameters used in the liquefaction potential analysis should be adequately justified.
- The appropriateness of the computed factor of safety and its physical significance in the context of the method of analysis used should be explained.

6.3.3 Settlement and Subsidence

The applicant should address the long-term settlement and/or subsidence aspects of the proposed facility design in accordance with the performance objectives and technical requirements of 10 CFR 61. The settlement and/or subsidence of the individual disposal excavation caps and the disposal site should be evaluated to determine if the settlement and/or subsidence would adversely affect the facility's meeting the performance objectives in Subpart C of 10 CFR 61. Information on settlement and/or subsidence should include (1) the results of site characterization, details of disposal unit excavations and waste emplacement and backfilling during the operations phase, and details of disposal excavation cap design and construction; (2) modeling for the settlement analysis; (3) the uncertainties in the settlement analysis; and (4) commitments for remedial actions if settlement would adversely affect the facility's meeting its performance objectives. If any information that should be presented in this section of the SAR is presented in other sections, it does not have to be repeated here, but the appropriate sections should be referenced.

Site Data

(1) Site Characteristics

Information required to identify the areas potentially susceptible to settlement and the engineering properties of various materials needed for the evaluation of settlement should be presented in this section. The information on site characteristics, either by reference to appropriate sections of Sections 2.3, 2.4, 2.5, and 2.6 or by presentation of additional data in this section, should include the following:

- (a) Plot plan(s) clearly showing the outline of the facility and the locations of all site explorations with the location of the areas selected for settlement investigation.
- (b) Profiles and cross-sections of the areas selected for settlement evaluation, illustrating in appropriate detail the relationship of the proposed facility structures and components to the subsurface materials.
- (c) Logs of borings, probes, pits, and trenches considered in developing the stratigraphy used in the settlement analysis.
- (d) The description and test results for the engineering properties of materials underlying the site. Guidance is provided in Regulatory Guide 1.138 for soil testing. The properties of these materials must be supported by field and laboratory test records. The applicant should demonstrate that the parameters required for the settlement analyses were properly determined and that reasonable and conservative values were used in the analyses. The applicant should explain how the developed data were used in the analyses, how the test data are enveloped in design, and why the design envelope is conservative. A table indicating the values of the parameters used in the settlement analyses should be provided.

- (e) The groundwater conditions, as they relate to the settlement aspects of the proposed facility. This information should include discussion of critical cases of groundwater conditions and the range of fluctuation that were considered at the proposed facility; the presence of perched, artesian, or aquifer conditions and other significant hydrological conditions, if any; and the design-basis events that were addressed in the settlement analyses.

(2) Construction and Operations Phase Data

Construction and operations phase data that are relevant to the evaluation of settlement should include the following:

- (a) information and analyses to justify whether construction dewatering would be required and, if needed, information on the dewatering criteria (levels of water to exist, changes in pore pressures, and monitoring details)
- (b) information on the use of the materials excavated from the disposal units as either backfill in the disposal excavations or as a general fill at the site and information on where the materials will be stockpiled
- (c) detailed information on the proposed method for placing the waste containers in the disposal excavation and an estimation of the inter-container voids
- (d) specifications on the fill materials and their placement in the inter-container voids and details on how the fill materials will be placed to comply with the staff recommendations in Appendix A of SRP 4.3
- (e) design and construction details of the soil fill and the disposal excavation cap to be placed above the waste containers including detailed specifications and placement technique

Modeling

Information on modeling (characterization for the settlement analyses) should include the following:

- (1) Areas or locations (disposal excavation caps and the general area within the disposal site) selected for the evaluation of settlement. This should include the best, average, and worst conditions (from point of concern with settlement) at the site to enable an evaluation of the range of total and differential settlements at the selected locations. This selection should be based on representative site data.
- (2) Typical cross-sections, soil and rock layering, groundwater conditions, and the timing and sequence of loading (excavation/placement of fill, etc.) to be used in the analyses which should be representative of the site conditions and the applicant's plans for operating the disposal facility.

- (3) Proper justification for the design parameters for various materials (soil, rock, waste containers, backfill, disposal excavation cap materials, site fill, etc.) used in the settlement analyses. Analytical representation or modeling of items such as disposed waste (waste and containers degraded with time), partially saturated fill (because of assumed infiltration from the sides and top of the excavation or from leaching), and layered system cap should be provided.

Settlement Evaluation

Information on the evaluation of settlement should include the following:

- (1) Discussions of the problem and appropriate details of the method of analyses so that the staff can judge whether the method of analyses is applicable and commonly used in the engineering profession. The settlement evaluation should consider the sequence of loading and normal and abnormal design conditions. If a commercially marketed computer code for estimating settlement is used, the staff will likely accept its validity. If a new code or a proprietary code is used, the documentation supporting the validity of the code should be presented for staff review. The analyses should determine both instantaneous and time-dependent deformations to enable a determination of both total and differential settlements at various locations of the facility.
- (2) A detailed discussion should be provided on how the magnitudes of settlements calculated at the various specific locations have been used to estimate the magnitudes of differential settlement (on both a short- and long-term basis) and the potential for cracking of the disposal excavation cap and possible water infiltration. Estimation of the magnitude of the cracking or the area of openings or pathways for water infiltration should be presented with adequate justification. If the differential settlement is judged minimal and not severe enough to result in cracking of the disposal excavation cap, then the basis for this conclusion should be clearly given. A discussion on the conservatism in the settlement analyses and how the uncertainties in the various parameters are considered should be presented. The settlement evaluation should provide the necessary information so that the staff can evaluate the extent and effects of long-term settlement and infiltration, and the SAR should contain definitive statements with adequate justification that are supported by the analyses.

Remedial Action

Any proposal for future remedial actions at the facility to rectify the conditions and problems associated with unacceptable settlements, if necessary, should include a plan and a commitment to monitor the settlement. If excessive (more than that predicted or assumed in the design) settlements are observed, a commitment to conduct a study to determine the causes and prescribe remedial actions would be required. The commitment by the applicant to perform the required remedial action should be provided in the SAR.

7 OCCUPATIONAL RADIATION PROTECTION

The applicant should provide information on the methods to be used for radiation protection and on estimated occupational radiation exposures to operating and construction personnel during normal operation and anticipated operational occurrences (including disposal, maintenance, routine operational surveillance, inservice inspection, and calibration). The applicant should provide information on facility and equipment design, the planning and procedures programs, and the techniques and practices that will be used to meet the standards for protection against radiation of 10 CFR 20 and the guidance given in the appropriate regulatory guides, where the practices set forth in such guides will be used to implement NRC regulations. Reference to other sections for information needed in this section should be specifically made where required.

7.1 Occupational Radiation Exposures

Policy Considerations

The applicant should describe the management policy and organizational structure related to ensuring that occupational radiation exposures will be as low as is reasonably achievable (ALARA). This should include the applicable responsibilities and the related activities to be conducted by the management individuals responsible for radiation protection and the policy of maintaining occupational exposures ALARA. Policy with respect to designing and constructing the facility the ALARA policy as it will be applied to facility operations should be described.

Design Considerations

The applicant should describe (1) how experience with past designs and operating facilities was used to develop improved design for ensuring that occupational radiation exposures will be ALARA, (2) how ALARA design guidance (both general and specific) was given to the individual designers, (3) how the design is directed toward reducing the need for maintenance of equipment and reducing radiation levels and time spent where maintenance and other operational activities are required, and (4) any mechanisms that provide for design review by a competent professional in radiation protection such as the utility radiation protection manager.

The detailed facility design features for radiation protection and for ensuring that occupational radiation exposures will be ALARA should be covered in Section 7.3.

Operational Considerations

The applicant should describe the methods to be used to develop the detailed operational plans and procedures for ensuring that occupational radiation exposures will be ALARA, and how these operational plans and procedures will affect the design of the facility and how such planning has incorporated information from operating experience, other designs, etc. The applicant should describe

how operational requirements are reflected in the design considerations described in Section 7.1 and the radiation protection design features described in Section 7.3.

The applicant should provide the criteria and/or conditions under which various operating procedures and techniques for ensuring that occupational radiation exposures will be ALARA are implemented for all systems that will contain, collect, store, or transport radioactive liquids, gases, and solids (including, for example, handling and storage systems). The applicant should describe the means for planning and developing procedures for such radiation-exposure-related operations as maintenance and inservice inspections, in a manner that will ensure that the exposures will be ALARA, and any changes in operating procedures that would result from the ALARA operational procedures review.

7.2 Radiation Sources

The applicant should describe the sources of radiation that are the bases for the radiation protection design so that they can be used as input to the shield design calculation. Those sources that are contained in the equipment of the radioactive waste management systems should be described. Sources should be categorized according to isotopic composition or gamma ray energy groups, strength (curie content), and geometry, and the basis for the values should be provided. The location of the source in the facility should be specified so that all important sources of radioactivity can be located on plan layout drawings. For all the sources identified above, the models and parameters for calculating the source magnitudes should be provided. Additional details on (and any changes of) source descriptions that are used to develop the final shield design should be given.

7.3 Radiation Protection Design Features

Facility Design Features

The applicant should describe equipment and facility design features used for ensuring that occupational radiation exposures will be ALARA.

The applicant should provide illustrative samples of the facility design features used in the SAR design stage. The description should include those features that reduce the need for maintenance and other operations in radiation fields, reduce radiation sources where operations must be performed, allow quick entry and easy access, provide remote operation capability, or reduce the time required for work in radiation fields, and any other features that reduce radiation exposure of personnel. It should include the methods for reducing the production, distribution, and retention of activation products through design methods, material selection, water chemistry, decontamination procedures, etc. The location of sampling ports, instrumentation, and control panels should be provided.

The applicant should provide scaled layout and arrangement drawings of the facility showing the locations of all sources. The layout drawings should show the radiation zone designations, including zone boundaries for both normal operational and refueling outage conditions. Other sections should be referenced as appropriate. The layouts should show shield wall thicknesses; traffic patterns; and the locations of controlled access areas, personnel and equipment

decontamination areas, contamination control areas, the health physics facilities, airborne radioactivity and area radiation monitors, control panels for radwaste equipment and components, the onsite laboratory for analysis of chemical and radioactivity samples, and the counting room. The design-basis radiation level in the counting room during normal operation and anticipated operational occurrences should be specified. The applicant should describe the facilities and equipment such as hoods, glove boxes, filters, special handling equipment, and special shields that are related to the use of sealed and unsealed special nuclear, source, and byproduct material.

Shielding

The applicant should provide information on the shielding for each of the radiation sources including the criteria for penetrations, the materials, the method by which the shield parameters (cross-sections, buildup factors, etc.) were determined, and the assumptions, codes, and techniques used in the calculations. The applicant should describe special protective features that use shielding, geometric arrangement (including equipment separation), or remote handling to ensure that occupational radiation exposures will be ALARA in normally occupied areas. The applicant should indicate whether and, if so, how the guidance in Regulatory Guide 1.69 on concrete radiation shields and in Regulatory Guide 8.8 on special protective features was followed; if the guidance was not followed, the applicant should describe the alternative methods used.

Ventilation

The applicant should describe the personnel protection features incorporated in the design of the ventilation system. Those aspects of the design that relate to removing airborne radioactivity from equipment cubicles, corridors, and operating areas normally occupied by operating personnel and into effluent control systems should be described. Those aspects of the systems that relate to controlling the concentration of radioactivity in the areas mentioned above should be included. The applicant should provide an illustrative example of the air cleaning system design, including a sample layout of an air cleaning system housing showing filter mountings, access doors, aisle space, service galleries, and provisions for testing, isolation, and decontamination. The criteria established for the changeout of air filters and absorbers in the air cleaning system should be provided.

Area Radiation and Airborne Radioactivity Monitoring Instrumentation

The applicant should describe the fixed area radiation and continuous airborne radioactivity monitoring instrumentation and the criteria for its selection and placement.

The applicant should provide information on the auxiliary and/or emergency power supply and the range, sensitivity, accuracy, precision, calibration methods and frequency, alarm setpoints, recording devices, and location of detectors, readouts, and alarms for the monitoring instrumentation. Accident considerations and other needs for high-range instrumentation should be included. The applicant should provide the location of airborne monitor sample collectors and of sampling lines and pumps.

The applicant should describe the criteria and the methods for obtaining representative in-plant airborne radioactivity concentrations, including airborne radioiodines and other radioactive materials, from the area being sampled.

The applicant should describe the experience and qualification of the personnel responsible for the health physics program and for handling and monitoring radioactive materials.

Equipment, Instrumentation, and Facilities

The applicant should provide the criteria for the selection of portable and laboratory technical equipment and instrumentation for performing radiation and contamination surveys, for airborne radioactivity monitoring and sampling, for area radiation monitoring, and for personnel monitoring during normal operation and anticipated operational occurrences and under accident conditions. The instrument storage, calibration, and maintenance facilities should be described. The location of the health physics facilities (including locker rooms, shower rooms, offices, and access control stations), laboratory facilities for radioactivity analyses, protective clothing, respiratory protective equipment, decontamination facilities (for equipment and personnel), and other contamination control equipment and areas that will be available should be described and identified.

The applicant (1) should give the location of the respiratory protective equipment, protective clothing, and portable and laboratory technical equipment and instrumentation and (2) should describe the type of detectors and monitors and the quantity, sensitivity, range, and frequency and methods of calibration for all the technical equipment and instrumentation mentioned above.

7.4 Radiation Protection Program

The applicant should describe (1) the policy, methods, frequencies, and procedures for conducting radiation surveys; (2) the procedures and methods of operation that have been developed for ensuring that occupational radiation exposures will be ALARA, including the procedures used in inservice inspections, loading and shipping, normal operation, routine maintenance, and sampling and calibration that are specifically related to ensuring that radiation exposures will be ALARA; (3) the physical and administrative measures for controlling access and stay time in radiation areas; (4) the bases and methods for monitoring and controlling contamination of personnel, equipment, and surface; and (5) the radiation protection training programs.

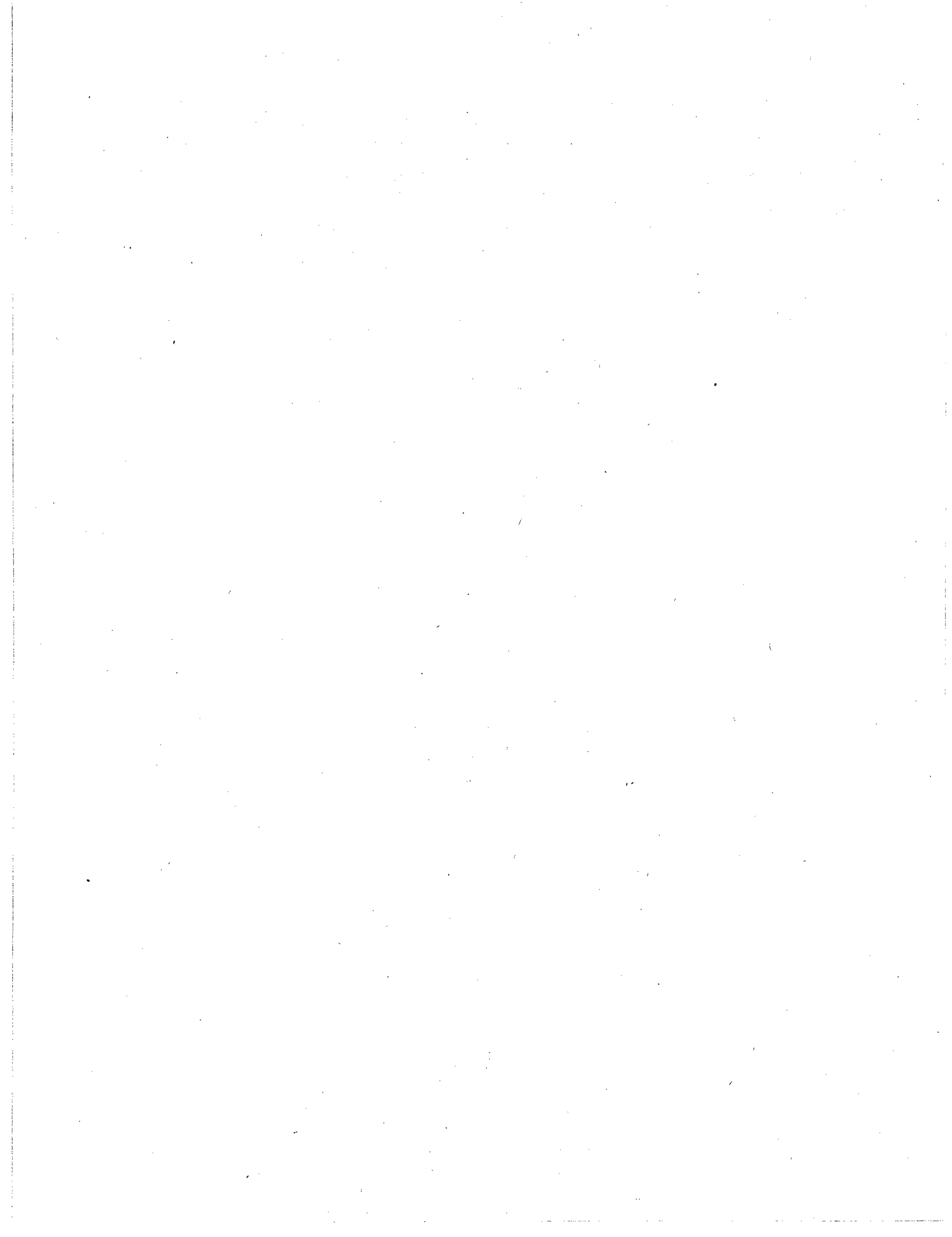
The applicant should describe (1) the methods and procedures for personnel monitoring (external and internal), including methods of recording, reporting, and analyzing results, and (2) the program for assessing internal radiation exposure (whole-body counting and bioassay), including the bases for selecting personnel who will be in the program, the frequency of their whole-body count and bioassay, and any nonroutine bioassay that will be performed.

Organization

The applicant should describe the administrative organization of the health physics program, including the authority and responsibility of each position identified.

The applicant should describe the methods and procedures for evaluating and controlling potential airborne radioactivity concentrations. Any requirements for special air sampling and the issuance, selection, use, and maintenance of respiratory protective devices, including training programs and respiratory protective equipment fitting programs, should be described.

The applicant should describe the method of handling and storing sealed and unsealed byproduct, source, and special nuclear material.



8 CONDUCT OF OPERATIONS

8.1 Organizational Structure

Preoperational Phase

The applicant should discuss its experience in the design and construction of waste management facilities and experience related to activities of similar scope and complexity. The applicant's management, engineering, and technical support organization, including organizational charts reflecting the applicant's current headquarters and engineering staff structure and planned modifications of and additions to this structure to reflect the added functional responsibilities associated with the addition of the facility, should also be described. These added responsibilities should be identified and should include the items listed under items (1) and (2) below:

(1) Design and Construction Responsibilities

The applicant should describe the implementation or delegation of the following areas of responsibility:

- (a) principal site-related technical and engineering work such as that related to meteorology, geology, soils, seismology, hydrology, demography, and environmental effects
- (b) design of facility and ancillary systems
- (c) review and approval of facility design features
- (d) site layout with respect to environmental effects and security provisions
- (e) development of sections of the SAR
- (f) review and approval of material and components specifications
- (g) procurement of materials and equipment
- (h) management of construction activities
- (i) quality assurance related to design and construction

(2) Preoperational Responsibilities

The applicant should describe the proposed plans for the management organization in regard to the following items of the initial test program:

- (a) development of plans for the preoperational testing of the facility

(b) development and implementation of staff recruiting and training programs

(c) development of facility maintenance programs

In regard to items (1) and (2) above, the applicant should specify how these responsibilities will be delegated and implemented within and from the headquarters staff and should identify the working or performance level and responsible organizational unit, including an estimate of the number of persons expected to be assigned to each of the various units with responsibility for the project. In addition, the applicant should show how the management staff will interact with the architect/engineer and how the applicant's staff will conduct the required review of contractor work.

The applicant should also describe the general qualifications and requirements in terms of numbers, educational background, and experience for identified positions or classes of positions, and the specific educational background and experience for assigned management and supervisory positions relative to items 1 and 2 above.

For positions or classes of positions that will have functional responsibilities other than those specified in the SAR, the expected proportion of time assigned to the other activities should be described. In addition, the early plans for providing technical support for the operation of the facility should be described.

The information should include a description of the specific activity (including scope) to be engaged in, organizational description and charts reflecting organizational lines of authority and responsibility for the project, the number of persons assigned to the project, and the qualification requirements for principal management positions related to the project. For the organization with extensive experience, a detailed description of this experience may be provided in lieu of a description of the organization and evidence of its technical capability. However, a specific description of how this experience will be applied to the particular project should be provided.

Operational Phase

The applicant (1) should provide organizational charts showing the corporate level management and technical support structure, including the relationship of that part of the structure responsible for waste disposal to the rest of the corporate organization, and a description of the specific provisions that have been made for technical support for operations and (2) should identify the organizational unit and any augmenting organizations, or other personnel, that will manage or execute any phases of the waste management program, including the responsibilities and authority of the principal participants.

The applicant should (1) identify in terms of numbers, the educational background and experience requirements for each identified position or class of positions providing technical support for facility operations and (2) include the specific educational background and experience for individuals in the management and supervisory positions that will provide support in the areas identified below.

The special capabilities of the support group for the operation of the facility should include

- (1) engineering (materials, soil mechanics, hydraulic, and structural)
- (2) engineering geology
- (3) health physics and radiation protection
- (4) maintenance support
- (5) operations support
- (6) quality assurance
- (7) training
- (8) safety review
- (9) fire protection
- (10) outside contractual assistance

8.2 Qualifications of Applicant

The applicant should provide the following:

- (1) An organization chart showing the title of each position, the minimum number of persons to be assigned to common or duplicate positions, and (if appropriate) the number of operating shift crews should be submitted.
- (2) The functions, responsibilities, and authorities of facility positions corresponding to the following should be given:
 - (a) overall facility management
 - (b) operations supervision
 - (c) operating shift crew supervision
 - (d) technical supervision
 - (e) radiation protection supervision
 - (f) maintenance supervision
 - (g) emergency supervisory structure
 - (h) quality assurance supervision (when part of the facility staff)

For each position, where applicable, required interactions with offsite personnel or personnel in positions identified in Section 8.1 should be described. Because such interactions include defined lines of reporting responsibilities, the following should also be described: (a) the line of succession of authority and responsibility for overall facility operation if unexpected occurrences of a temporary nature should occur and (b) the authority that may be delegated to operating supervisors and to shift supervisors, including the authority to issue standing or special orders.

If the facility contains or is planned to contain facilities other than those described in the SAR, this section should also describe interactions with the organizations operating such facilities. The description should include any proposed sharing of persons between the facilities, a description of their duties, and the proportion of time each person will routinely be assigned to the other facility.

- (3) The position titles of management staff members, the total number of people planned to man each shift, and the proposed means of assigning shift responsibility for implementing the radiation protection and emergency programs on a round-the-clock basis (if appropriate) should also be described.

- (4) The education, training, and experience requirements (qualification requirements established by the applicant for filling each management, supervisory, or radiation safety position in the operating organization above should be described. At the application stage, it is recognized that many details of the facility organization and staffing may not have been made final. This section should eventually provide evidence, in the form of personnel résumés, that the initial selections of persons to fill management and principal supervisory positions down through the shift supervisory level are acceptable.

8.3 Training Program

Scheduling and Training

The applicant should describe the training and retraining programs for the facility staff and the scheduling of these programs. The program descriptions should include the following:

- (1) the proposed subject matter of each course, the duration of the course (approximate number of weeks in terms of full-time attendance), the organization teaching the course or supervising instruction, and the position titles of the persons who will be taking the course
- (2) a commitment to conduct an onsite formal training program and on-the-job training so that the entire facility staff will be qualified before the initial receipt of radioactive waste
- (3) plans for conducting a position task analysis for all operating personnel, in which the tasks performed by the person in each position are defined and the training, in conjunction with education and experience, is identified to provide assurance that the tasks can be effectively performed
- (4) procedures for the orientation of incidental site visitors with regard to site safety and radiation protection
- (5) the proposed means for evaluating the effectiveness of the training program for all employees
- (6) any difference in the training programs for individuals on the basis of experience, which should be categorized as follows:
 - (a) no previous experience
 - (b) experience at facilities not subject to licensing
 - (c) experience at comparable facilities

The applicant should submit a chart showing the schedule for each part of the training program for each position or organizational unit identified in the SAR. The time scale should be relative to expected operation.

The applicant should show clearly to what extent the training program has been accomplished at the approximate time of the submittal of the application. Contingency plans for additional training should be described in the event operation is significantly delayed from the date indicated in the application.

The applicant should describe the plans for the retraining of facility personnel, identify the additional position categories on the facility staff for which retraining will be provided, and describe the nature, scope, and frequency of such retraining.

8.4 Emergency Planning

The applicant should demonstrate that plans have been established for responding to all credible accidents and emergencies of a radiological nature that are consistent with the proposed method of operations.

The applicant should demonstrate that the offsite release associated with the most credible accident that is consistent with the projected source term will yield an offsite dose equivalent of less than 0.01 rem to the whole body and 0.05 rem to the lungs.

If the maximum potential offsite releases yield dose equivalents greater than the above, the applicant should develop emergency procedures that include interaction with local and State authorities and appropriate notification of affected populations. Further, the applicant's emergency procedures should have been developed with the full knowledge, participation, and cooperation of such authorities and affected populations.

8.5 Review and Audit

Facility Operations Review

The applicant should describe the provisions for the facility operations staff's review of operational activities, the independent review of facility operations, and the independent assessment of activities pertaining to safety enhancement. Specific information should include the following:

- (1) the functioning of the onsite organization with respect to the review of proposed changes to systems or procedures and of unplanned events that have operational safety significance, including subject matter to be reviewed, organizational provisions for conducting the reviews (including personnel), and the documentation and reporting of review activities
- (2) the procedures and organization used to evaluate safety-related operational activities independent of the operating organization, including how and when such a program is to be implemented, subject matter to be reviewed, organizational provisions for conducting the review (including personnel), and the documentation and reporting of review activities
- (3) the provisions to perform independent reviews and assessments of facility activities, including the functions of the review group, organizational provisions for conducting the activities (including personnel), and the documentation and reporting of these activities

8.6 Facility Administrative and Operating Procedures

The applicant should describe the administrative procedures that provide control over activities that are important to the safe operation of the facility and the

procedures for operation that will ensure that routine operating, abnormal, and emergency activities are conducted in a safe manner. In general, detailed written procedures do not have to be included in the SAR; however, the applicant should provide general descriptions pertaining to the nature and control of the following procedures:

Administrative Procedures

- (1) procedures for review and approval
- (2) equipment control procedures
- (3) procedures pertaining to the control of maintenance and modifications
- (4) emergency planning procedures
- (5) temporary changes to procedures
- (6) procedures pertaining to standard orders to facility personnel, including authority and responsibility of key site personnel (site managers, assistant manager, and site radiological control and safety officer)
- (7) training and orientation procedures
- (8) procedures pertaining to access to control area(s)
- (9) quality assurance/quality control procedures

Operating Procedures

- (1) procedures for systems operation
- (2) waste receipt and inspection procedures
- (3) waste handling, storage, and disposal procedures
- (4) trench design and construction procedures
- (5) vehicle survey and release procedures
- (6) abnormal, temporary, and emergency procedures
- (7) instrument calibration and test procedures
- (8) facility maintenance procedures
- (9) environmental monitoring, sampling, and testing procedures

Because most of the information in this portion of the SAR is related directly to information in other portions of the SAR, the applicant should provide cross references as appropriate.

8.7 Physical Security

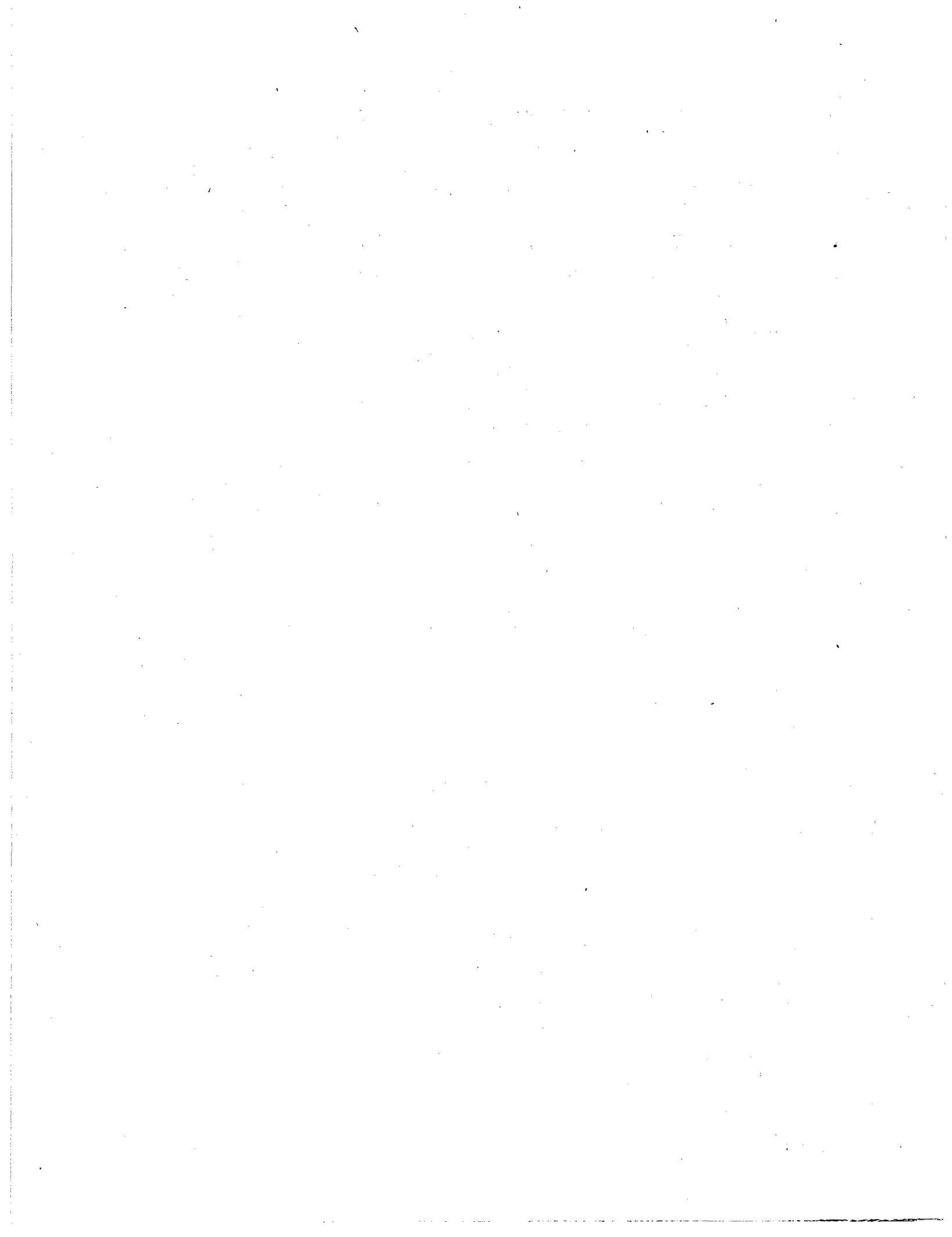
The applicant should provide the plans for implementing security measures relating to the layout of the facility and other design features and equipment arrangements intended to provide protection of nuclear materials against theft, tampering, or radiological sabotage.

The applicant should describe the comprehensive physical security program for the facility, including the physical security organization, access controls to

the facility, means of detecting unauthorized intrusion, provisions for monitoring access to controlled areas, communication systems related to security, intrusion alarm systems, arrangements with law enforcement authorities to provide assistance in responding to security threats, and response to unusual events. The implementation schedule for the physical security program should include diagrams, to approximate scale, displaying the following:

- (1) location of alarm stations
- (2) location of access control points to controlled areas
- (3) location of relevant law enforcement agencies and their geographical jurisdictions (on separate map to approximate scale)
- (4) interaction of facility operations staff with the security staff

The response capabilities of local law enforcement agencies during nonoperational hours should also be provided.



9 QUALITY ASSURANCE

To provide assurance that the design, construction, and operation of the proposed facility comply with applicable regulatory requirements and with the design bases specified in the SAR, it is necessary that a quality assurance (QA) program be established by the applicant. In this section of the SAR, the applicant should describe the QA program that will be established and executed during the design, construction, and operation of the facility. The QA program must be established at the earliest practical time consistent with the schedule for performing the activity to which it applies. If portions of the QA program have not been established at the time the SAR is prepared because the activity will be performed in the future, the description should also provide a schedule for implementation. The program should be based on the requirements of Appendix B to 10 CFR 50. The inspection and survey systems required by 10 CFR 50.55a, "Codes and Standards," may be used in partial fulfillment of these requirements to the extent that they are shown by the description of the QA program to satisfy the applicable requirements of Appendix B.

The information on the QA program for each of the major organizations that will execute the QA program should be provided (either separately for each organization or integrally for all organizations) according to the order represented in the following sections. This ordering of material is not intended to dictate the format of any QA Program Manual; that is left to the discretion of the applicant. It is recommended, however, that the description address each of the criteria in Appendix B in sufficient detail to enable the staff to determine whether and how all the requirements of the appendix will be satisfied in accordance with 10 CFR 50.34. Reference to appropriate portions of other sections of the SAR may suffice.

NRC regulatory guides and the U.S. Atomic Energy Commission documents entitled "Guidance on Quality Assurance Requirements During Design and Procurement Phase of Nuclear Power Plants" (WASH-1283), "Guidance on Quality Assurance Requirements During the Construction Phase of Nuclear Power Plants" (WASH-1309), and "Guidance on Quality Assurance Requirements During the Operations Phase of Nuclear Power Plants" (WASH-1284) contain guidance on acceptable methods of implementing portions of the QA program. Although these documents were developed for nuclear power plants, they do provide guidance that is applicable to a disposal facility.

Where a portion of the QA program to be implemented will follow the guidance provided by a regulatory guide, WASH-1283, WASH-1309, or WASH-1284, the program description may consist of a statement that the guidance will be followed for that portion of the QA program. When these documents are used in describing the QA program, the applicant should indicate how the guidance documents will be applied to portions of the QA program and should delineate the organizational element responsible for implementing various provisions of the respective guidance documents within each major organization in the project, including that of the applicant, the architect-engineer, the constructor, and the construction manager (if other than the constructor).

9.1 Quality Assurance During the Design and Construction Phase

Organization

The applicant should describe clearly the authority and duties of persons and organizations performing the QA functions of ensuring that the QA program is established and executed and of verifying that an activity has been correctly performed. The applicant should provide organization charts and functional responsibility descriptions that denote the lines of responsibility and areas of authority within each of the major organizations in the project, including those of the applicant, the architect-engineer, the constructor, and the construction manager (if other than the constructor). These charts and descriptions should present the structure of the QA organizations as well as other functional organizations performing activities affecting quality related to design, procurement, manufacturing, construction and installation, testing, inspection, and auditing with a clear delineation of their responsibility, authority, and relationship to corporate management. In addition, a single overall project organization chart should be included showing how the major organizations or companies working directly for the applicant on the project interrelate with one another.

The applicant should describe the level of management responsible for establishing the QA policies, goals, and objectives and the continuing involvement of this management level in QA matters. The following information should also be given: (1) the position title of the person who will have overall authority and responsibility for the QA program, (2) the position title of the person who will be responsible for the final review and approval of the QA program and related manuals, and (3) the qualification requirements for the principal QA and quality control positions.

The applicant should describe the measures that ensure that persons and organizations performing QA functions have sufficient authority and organizational freedom to (1) identify quality problems; (2) initiate, recommend, or provide solutions; and (3) verify implementation of solutions. The applicant should describe the measures that ensure that persons and organizations assigned the responsibility for checking, auditing, inspecting, or otherwise verifying that an activity has been correctly performed report to a management level so that this required authority and organizational freedom, including sufficient independence from the pressures of production, are provided.

Irrespective of the organizational structure, the applicant should describe how the individual or individuals with primary responsibility for ensuring effective implementation of the QA program at any location where activities subject to the control of the QA program are being performed will have direct access to such levels of management as may be necessary to carry out this responsibility. The applicant should indicate from whom the persons performing QA functions receive technical direction for performing QA tasks and administrative control (salary review, hire and/or fire, position assignment). The applicant should identify those positions or organizations that have written delegated responsibility and authority to stop work or control further processing, delivery, installation, or use of nonconforming items until proper disposition of the deficient item has been approved.

The applicant should describe how requirements will be imposed on contractors and subcontractors to ensure that individuals or groups within their organizations performing QA functions have sufficient authority and organizational freedom to effectively implement their respective QA programs.

The applicant should describe the extent to which it will delegate to other contractors the work of establishing and executing the QA program or any part thereof. The QA functions that are implemented within the applicant's QA organization and those that are delegated to other organizations should be clearly delineated. The method by which the applicant will retain responsibility for, and maintain control over, those portions of the QA program delegated to other organizations should be described, and the organization responsible for verifying that delegated QA functions are properly carried out should be identified. The applicant should identify major work interfaces for activities affecting quality and describe how clear and effective lines of communication exist between the applicant and principal contractors to ensure necessary coordination and control of the QA program.

Quality Assurance Program

The description of the QA program should cover each of the criteria in Appendix B to 10 CFR 50. The applicant should (1) describe the extent to which the QA program will conform to various provisions of regulatory guides that provide guidance on acceptable methods of implementing portions of the QA program and (2) identify the organizational element responsible for implementing these provisions. If the applicant elects not to follow the above guidance, the SAR should describe in detail equivalent to that furnished in the NRC guidance the alternative methods that will be used and the manner of implementing them and should indicate the organizations responsible for their implementation.

The applicant should identify the safety-related structures, systems, and components to be controlled by the QA program.

The applicant should describe the measures that ensure that the QA program is being established at the earliest practicable time consistent with the schedule for conducting activities affecting quality for the project. That is, the applicant should describe how the QA program is being established in advance of the activity to be controlled and how it will be implemented as the activity proceeds. Those activities affecting quality initiated before the submittal of the SAR, such as establishing information that must be included in the SAR, design and procurement, safety-related site testing and evaluation, and preparation activities should be identified in the SAR. The applicant should describe how these activities are controlled by a QA program based on Appendix B to 10 CFR 50.

The applicant should describe how the QA program is documented by written policies, procedures, or instructions and how it will be implemented in accordance with these policies, procedures, or instructions. The SAR should include a listing of QA program procedures or instructions that will be used to implement the QA program for each major activity such as design, procurement, and construction. The procedure list should identify which criteria of Appendix B to 10 CFR 50 are implemented by each procedure. If certain required procedures have not been established, a schedule for their preparation should be provided.

The applicant should summarize the corporate QA policies, goals, and objectives and should describe how disputes involving quality are resolved.

The applicant should describe the program that provides for adequate indoctrination and training of personnel performing activities affecting quality to ensure that suitable proficiency is achieved and maintained and how that program will ensure the following:

- (1) Personnel performing activities affecting quality are appropriately trained in the principles and techniques of the activity being performed.
- (2) Personnel performing activities affecting quality are instructed as to the purpose, scope, and implementation of governing manuals, policies, and procedures.
- (3) Appropriate training procedures are established.
- (4) Proficiency of personnel performing activities affecting quality is maintained.

The applicant should describe the qualification requirements for the persons responsible for ensuring effective implementation of the QA program of the applicant and of its major contractors.

The applicant should describe the measures that ensure that activities affecting quality will be accomplished under suitable controlled conditions, including (1) the use of appropriate equipment, (2) a suitable environment for accomplishing the activity (e.g., adequate cleanliness), and (3) compliance with the necessary prerequisites for the given activity.

The applicant should describe (1) the measures that ensure that there is regular management review of the QA program to assess its effectiveness and the adequacy of its scope and implementation and (2) the provisions for reviews by management personnel above or outside the QA organization to ensure an objective program assessment.

The applicant should describe the measures that ensure that its QA organization will (1) review and document agreement with the QA programs of the principal contractors and (2) conduct or have conducted audits of the contractors' QA program activities.

The applicant should provide a summary description of advanced planning that demonstrates control of quality-related activities including management and technical interactions.

The applicant should describe the provisions for maintaining the QA program description current.

Design Control

The applicant should describe the design control measures that ensure that (1) applicable regulatory requirements and design bases for safety-related structures, systems, and components are correctly translated into specifications, drawings, procedures, and instructions; (2) appropriate quality

standards are specified in design documents; and (3) deviations from such standards are controlled.

The applicant should describe (1) the measures that ensure that the review and selection for suitability of application are adequate for materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems, and components and (2) the provisions that ensure that standard commercial materials, parts, and equipment are also adequately reviewed and selected.

The applicant should describe (1) the program for applying design control measures to such aspects of design as stress and accident analysis, materials compatibility, and repair and (2) the measures for delineating acceptance criteria for inspections and tests.

The applicant should (1) describe the measures that ensure verification or checking of design adequacy, such as design reviews, use of alternative calculational methods, or performance of a qualification testing program under the most adverse design conditions; (2) identify the positions or organizations responsible for design verification or checking; and (3) should describe the measures that ensure that the verification or checking process is performed by individuals or groups other than those responsible for the original design, but who may be from the same organization.

The applicant should describe the measures for identifying and controlling design interfaces, both internal and external, and for providing coordination between participating design organizations.

The applicant should describe the measures that will be used to ensure that design changes, including field changes, are subject to the same design controls that were applied to the original design and are reviewed and approved by the organization that was responsible for the original design unless the originating organization designates another responsible organization.

Procurement Document Control

The applicant should describe the measures that ensure that documents, and changes thereto, for the procurement of material, equipment, and services, whether purchased by the applicant or the contractors or subcontractors, correctly include or reference the following as necessary to achieve the required quality:

- (1) applicable regulatory, code, and design requirements
- (2) quality assurance program requirements
- (3) requirements for supplier documents such as instructions, procedures, drawings, specifications, inspection and test records, and supplier QA records to be prepared, submitted, or made available for purchaser review or approval
- (4) requirements for the retention, control, and maintenance of supplier QA records

- (5) provision for the purchaser's right of access to the supplier's facilities and work documents for inspection and audit
- (6) provision for supplier reporting and disposition of items that do not conform to procurement requirements

The applicant should describe (1) the measures that clearly delineate the control responsibilities and sequence of actions to be taken in the preparation, review, approval, and issuance by competent personnel of procurement documents and (2) the measures that ensure that changes or revisions of procurement documents are subject to the same review and approval requirements as the original documents.

The applicant should describe the measures that ensure that (1) procurement documents require suppliers to have and implement a documented QA program for purchased materials, equipment, and services to an extent consistent with their importance to safety; (2) the purchaser has evaluated the supplier before the procurement order or contract is awarded to ensure that the supplier can meet the procurement requirements.

Instructions, Procedures, and Drawings

The applicant should describe the measures that ensure that activities affecting quality such as design, procurement, manufacturing, construction and installation, testing, inspection, and auditing are prescribed by appropriately documented instructions, procedures, or drawings and that these activities will be conducted in accordance with these documents.

The applicant should describe the system whereby the documented instructions, procedures, and drawings will include appropriate quantitative acceptance criteria (such as dimensions, tolerances, and operating limits) and qualitative acceptance criteria for determining that the prescribed activities have been satisfactorily performed.

Document Control

The applicant should describe the measures established to control the issuance of documents such as instructions, procedures, and drawings, including changes thereto, that prescribe all activities affecting quality. The description should cover control measures that ensure the following:

- (1) Documents are reviewed for adequacy (i.e., information is clearly and accurately stated) and are approved by authorized personnel for issuance and use at locations where the prescribed activity will be performed before the activity is started.
- (2) Means such as the use of updated master document lists exist to ensure that obsolete or superseded documents are replaced in a timely manner by updated applicable document revisions.
- (3) Document changes are reviewed and approved by the same organizations that were responsible for the original review and approval unless these are delegated by the originating organization to another responsible organization.

The applicant should identify the types of documents to be controlled and the group responsible for the review, approval, and issuance of documents and changes thereto.

Control of Purchased Material, Equipment, and Services

The applicant should describe the measures that ensure that material, equipment, and services purchased directly by the applicant or its contractors and subcontractors will conform to procurement document requirements. The SAR should describe the measures that provide, as appropriate, for the following:

- (1) evaluation and selection of sources of supply before the procurement order or contract is awarded
- (2) surveillance at the supplier's facility by the purchaser or its representative in accordance with written procedures during design, manufacture, inspection, and testing of the procured item or service to verify compliance with quality requirements
- (3) source and/or receipt inspection of procured items furnished by the supplier in accordance with written procedures and acceptance criteria
- (4) documented evidence at the site from the supplier that procured items meet procurement quality requirements such as codes, standards, or specifications; and measures established by the applicant to ensure that this documented evidence (a) is examined and accepted during source or receipt inspection, (b) is available at the site before installation or use of the procured item, and (c) will be retained at the facility
- (5) periodic verification of the supplier's certificates of conformance to ensure that they are meaningful

The applicant should describe the measures whereby the applicant or a designated representative will audit and evaluate the effectiveness of the control of quality-related activities of contractors and subcontractors at a frequency and extent consistent with the importance to safety, complexity, and quantity of the item or service being furnished.

Identification and Control of Materials, Parts, and Components

The applicant should describe the measures established to identify and control items such as materials, parts, and components, to prevent use of incorrect or defective items. The applicant should describe the measures that ensure that (1) that identification of the item (i.e., heat number, part number, serial number, or other appropriate marking) is maintained either on the item or on records traceable to the item and is verified, as required, throughout fabrication, erection, installation, and use of the item and (2) the method and location of the identification do not affect the function or quality of the item being identified.

Inspection

The applicant should describe the measures that ensure that a program for inspection is established and implemented by or for the organization performing

the activity to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity. The applicant should describe the measures that ensure that (1) inspection personnel are appropriately qualified and are independent of the individual or group performing the activity being inspected; (2) inspections or tests are performed for each work operation as necessary to verify quality; (3) indirect control by monitoring processing methods, equipment, and personnel is used if direct inspection of processed material or products is impossible or disadvantageous; and (4) both inspection and process monitoring are used when control is inadequate without both.

The applicant should describe the measures that ensure that (1) inspection procedures and instructions with necessary drawings and specifications are made available for use before the inspections are performed, (2) inspectors' qualifications or certifications are kept current, (3) replaced or reworked items are inspected in accordance with original inspection requirements, and (4) modified or repaired items are inspected by methods that are equivalent to the original inspection method.

The applicant should describe the system whereby appropriate documents will identify any mandatory inspection holdpoints that require witnessing or inspecting by the applicant or a designated representative and beyond which work may not proceed without the consent of the designated representative.

Test Control

The applicant should describe the measures that establish a test program that (1) identifies all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service; (2) is conducted by trained and appropriately qualified personnel in accordance with written test procedures that incorporate or reference the requirements and acceptance limits contained in applicable design documents; and (3) includes testing that will be performed under the construction permit.

The applicant should describe the measures that ensure that test procedures have provisions for ensuring the following:

- (1) All prerequisites for the given test have been met.
- (2) Adequate test instrumentation and equipment are available.
- (3) The test is performed under suitable environmental conditions and with adequate test methods.

The applicant should describe the system whereby test results are documented and evaluated to ensure that test requirements have been satisfied.

Control of Measuring and Test Equipment

The applicant should describe the measures established to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly identified, controlled, adjusted, and calibrated at specified periods to maintain accuracy within necessary limits. The applicant should describe the measures that ensure (1) that these devices are adjusted and calibrated against certified equipment or reference or transfer

standards having known valid relationships to nationally recognized standards or (2) that if no national standards exist, the basis for calibration is documented. The applicant should describe the measures that ensure that the error of calibration standards is less than the error of production measuring and test equipment.

The applicant should describe the provisions that will apply if measuring and test equipment is found out of calibration (1) for evaluating the validity of previous inspection or test results and the acceptability of items inspected or tested since the last calibration check and (2) for repeating original inspections or tests using calibrated equipment where necessary to establish acceptability of suspect items. The applicant should describe the measures that ensure the maintenance of records that indicate the calibration status of all items under the calibration system and that identify the measuring and test equipment.

Handling, Storage, and Shipping

The applicant should describe (1) the measures established to control the handling, storage, shipping, cleaning, and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration and (2) the measures for specifying and providing, when necessary for particular products, special protective environments such as inert gas atmosphere, specific moisture content levels, and temperature levels.

Inspection, Test, and Operating Status

The applicant should describe (1) the measures established to indicate by the use of markings such as stamps, tags, labels, routing cards, or other suitable means the status of inspections and tests performed on individual items of the disposal facility throughout fabrication, installation, and testing and (2) the measures that provide for the identification of items that have satisfactorily passed required inspections and tests.

Nonconforming Materials, Parts, or Components

The applicant should describe (1) the measures established to control materials, parts, or components that do not conform to requirements in order to prevent their inadvertent use or installation; (2) the measures that provide for, as appropriate, identification, documentation, segregation, disposition, and notification to affected organizations; (3) the measures that ensure that nonconforming items are reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

Corrective Action

The applicant should describe the measures that ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformance of items are promptly identified and corrected.

The applicant should describe how, in the case of significant conditions adverse to quality, the cause of the condition will be determined, corrective action will be taken to preclude repetition, and the problem with its determined cause

and corrective action will be documented and reported to appropriate management levels.

Quality Assurance Records

The applicant should describe the measures that ensure that sufficient records are maintained to furnish evidence of activities affecting quality and how such records (1) include at least the following: test logs; results of reviews, drawings, inspections, tests, audits, monitoring of work performance, and materials analyses; and such data as qualifications of personnel, procedures, and equipment; (2) identify the type of operation, the inspector or data recorder, the results, the acceptability, and the action taken in connection with any deficiencies noted; and (3) provide sufficient information to permit identification of the record with the item or activity to which it applies.

The applicant should describe the measures that ensure that records are identifiable and retrievable.

The applicant should describe the measures that establish requirements (consistent with regulatory requirements and responsibilities concerning record submittal and retention, security, and storage facilities) for protecting records from destruction by fire, flooding, tornados, insects, and rodents and from deterioration caused by extremes in temperature and humidity.

Audits

The applicant should describe its program and that of the principal contractors for conducting comprehensive planned and periodic audits to verify compliance with all aspects of the QA program and to determine the effectiveness of the program.

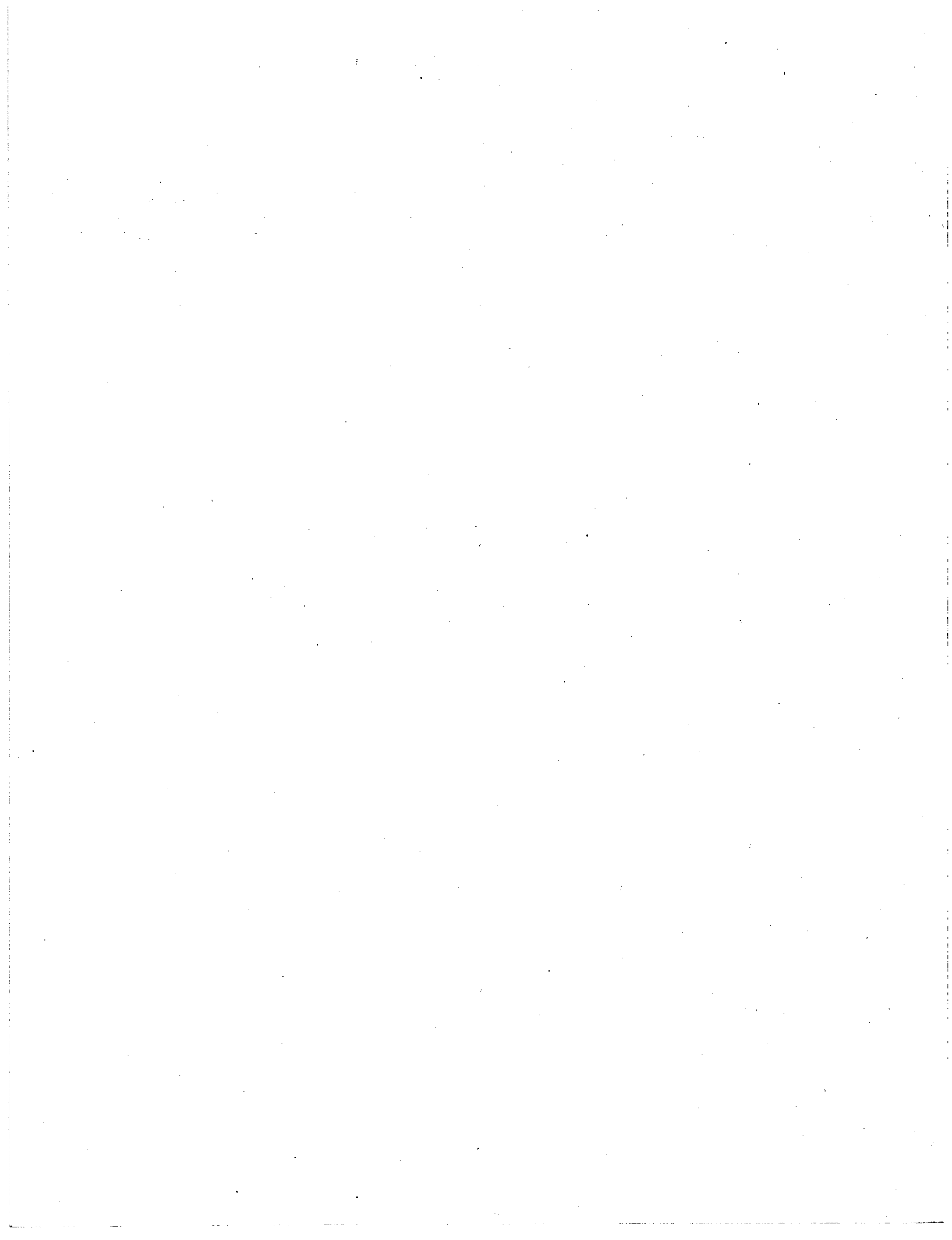
The applicant should describe the program features that cover the functions listed below and should identify the positions or organizations that will perform these functions.

- (1) external audits to be performed by the applicant and its principal contractors on their respective suppliers
- (2) internal audits to be performed by the applicant and its principal contractors within their respective organizations
- (3) the planning and scheduling of audits to ensure that they are regularly scheduled on the basis of the status and safety importance of the activities being performed and are initiated early enough to ensure effective quality assurance during design, procurement, manufacturing, construction, and inspection
- (4) conduct of audits in accordance with written procedures or checklists by appropriately trained and qualified personnel not having direct responsibility in the area being audited
- (5) documentation of audit results with review by management personnel responsible for the area audited and, where indicated, followup action taken, including re-audit of the deficient areas

9.2 Quality Assurance During the Operations Phase

The applicant should describe the QA program that will ensure the quality of all safety-related items and activities during the operations phase.

The description of the QA program should include the applicable information outlined in Section 9.1 except for those activities applicable only to the construction phase. The applicant should describe the QA program under the cognizance of the offsite and onsite QA organizations and should show that it addresses each of the criteria of Appendix B to 10 CFR 50. The description should delineate any significant differences in functional responsibilities between the offsite and onsite QA organizations.



10 FINANCIAL ASSURANCE

Financial Information

The applicant should provide (1) sufficient information to demonstrate that its financial qualifications are adequate to carry out the activities for which the license is sought and (2) other financial assurances covered in 10 CFR 61.61 through 61.63.

Financial Qualifications

Joint applicants should provide the information for each member of the group, according to each member's status and role. The status, role, and responsibilities of each member should be clearly defined.

An established entity should provide its latest published annual financial report, together with such current interim financial statements as are pertinent. If such a report is not published, the entity's balance sheet and operating statement covering the latest complete accounting year should be provided, together with all pertinent notes certified by a public accountant. Joint applicants should provide copies of joint ownership and operational agreements. The financial statements must be audited by a certified public accountant.

A newly formed entity should provide a statement of the company's assets, liabilities, and capital structure certified by a public accountant as of the date of the application. If the applicant is a subsidiary of, or otherwise related to, a parent company or other corporate affiliation, the annual financial report of that organization should be provided. If the applicant has ever filed for bankruptcy, the specific details should be provided.

Financial Assurances

The applicant should demonstrate that it either has the necessary funds or has reasonable assurance of obtaining the funds to cover the estimated costs of conducting all licensed activities over the planned operating life of the project.

The applicant should provide an estimate of the total construction cost of the proposed land disposal facility, including a statement describing the bases from which the estimate was derived. The estimate should be itemized by categories of cost in sufficient detail to enable the staff to evaluate it. It should indicate an estimate of the projected operating costs. All cost estimates should be backed by a detailed breakdown showing how the figures were derived. All assumptions should be stated.

An established entity should provide a statement of the general plan for financing the cost of the land disposal facility, which identifies the source or sources on which it will rely for the necessary construction funds (internal source such as retained earnings and depreciation accruals or external source

such as issuance of debt and equity securities). The applicant should indicate the relative degree to which each source of funds is expected to contribute to the total required funds. The projected overall capital structure of the applicant during construction of the land disposal facility should also be indicated. In the case of a joint applicant, the financial responsibilities of each party should be provided.

A publicly owned entity should submit excerpts from statutes, ordinances, or other legal authority that allow it to issue bonds or other forms of indebtedness and to take other actions necessary to finance the land disposal facility.

A newly formed entity should specifically identify the source or sources on which it will rely for the funds necessary to pay the cost of constructing the land disposal facility, and the amount to be obtained from each source. With respect to each source, the applicant should describe in detail the legal and financial relationships with stockholders, corporate affiliates, or other institutions on which it is relying for financial assistance. If the sources of funds relied on include parent companies or other corporate affiliates, the applicant should include information to support the financial capability of each such company or affiliate to meet its commitments to the applicant. This information should be of the same scope as would be required if the parent companies or affiliates were in fact the applicant.

The applicant should demonstrate that the requirements in 10 CFR 61.61 will be met.

Requirements for Funding Closure and Decommissioning

The applicant should demonstrate that the requirements in 10 CFR 61.62(a) through (g) have been met. Additionally, the party offering a guarantee must demonstrate that it has the legal authority to provide this kind of financial assurance in the State where the proposed low-level waste disposal site is located.

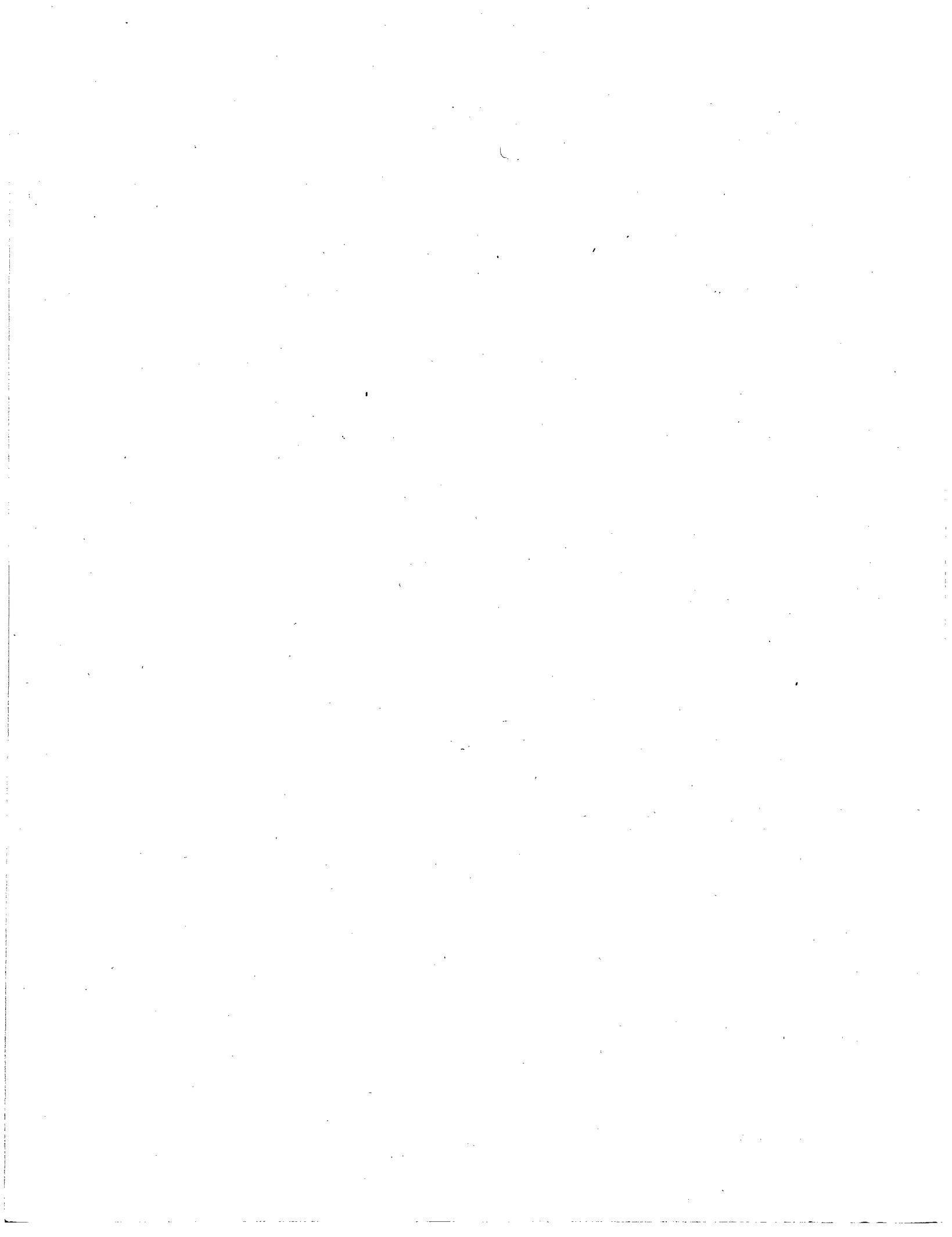
This section should also provide an estimate of the cost of disposal site closure and stabilization in accordance with its plan for site closure. The applicant should identify the source or sources for the funds necessary to pay the cost of decommissioning and closing the proposed facility. The applicant should provide a detailed breakdown, including an explanation of assumptions used in the cost calculations.

Detailed guidance is provided in the NRC Technical Position Paper, "Funding Assurances for Closure, Postclosure, and Long-Term Care of a Low-Level Waste Disposal Facility."

Other Information

If the waste to be received and disposed of at the facility (Section 2.11 of the SAR) contains special nuclear material (SNM) in quantities that are subject to the requirements of 10 CFR 73 or in quantities that are subject to the requirements of 10 CFR 70.24, the applicant will be required to describe the physical security measures to be used (10 CFR 73) and safety information on criticality (10 CFR 70). In determining whether the quantity of SNM contained

in the waste would be subject to either the requirements of 10 CFR 73 or 10 CFR 70.24, or both, the applicant shall consider only the quantities of SNM received and possessed, not the quantity that has been disposed of.



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

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NRC FORM 335 (2-84) NRCM 1102, 3201, 3202	U.S. NUCLEAR REGULATORY COMMISSION BIBLIOGRAPHIC DATA SHEET	1. REPORT NUMBER (Assigned by TIDC, add Vol. No., if any) NUREG-1199
2. TITLE AND SUBTITLE Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility	3. LEAVE BLANK	4. DATE REPORT COMPLETED MONTH YEAR January 1987
5. AUTHOR(S)	6. DATE REPORT ISSUED MONTH YEAR January 1987	8. PROJECT/TASK/WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Division of Waste Management Office of Nuclear Material Safety and Safeguards U.S. Nuclear Regulatory Commission Washington, DC 20555	9. FIN OR GRANT NUMBER	11a. TYPE OF REPORT b. PERIOD COVERED (Inclusive dates)
10. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) SAME AS ABOVE		
12. SUPPLEMENTARY NOTES		
13. ABSTRACT (200 words or less) <p>The Standard Format and Content of a License Application for a Low-Level Radioactive Waste Disposal Facility, NUREG-1199, discusses the information to be provided in the Safety Analysis Report and establishes a uniform format for presenting the information required to meet the licensing requirements for land disposal of radioactive waste as required by 10 CFR 61.</p> <p>The use of the Standard Format will (1) help ensure that the Safety Analysis Report (SAR) contains the information required by 10 CFR 61, (2) aid the applicant in ensuring that the information is complete, (3) help persons reading the SAR to locate information, and (4) contribute to shortening the time required for the review process.</p> <p>The Standard Format and Content (NUREG-1199) ensures that the information required to perform the review is provided, and in a usable format while the Standard Review Plan, NUREG-1200, defines the technical review process. These documents provide assurance that NRC can review and process a license application within 15 months and meet the requirements of Section 9(1) and (2) of P.L. 99-240, the Low-Level Radioactive Waste Policy Amendments Act (LLRWPA) of 1985.</p>		
14. DOCUMENT ANALYSIS - a. KEYWORDS/DESCRIPTORS license application low-level waste disposal facility standard format and content of a license application	b. IDENTIFIERS/OPEN-ENDED TERMS	15. AVAILABILITY STATEMENT Unlimited 16. SECURITY CLASSIFICATION <i>(This page)</i> Unclassified <i>(This report)</i> 17. NUMBER OF PAGES 18. PRICE

SPECIAL FOURTH-CLASS RATE
POSTAGE & FEES PAID
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PERMIT No. G-67

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NUCLEAR REGULATORY COMMISSION
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