

U.S. NUCLEAR REGULATORY COMMISSION
DRAFT GENERIC TECHNICAL POSITION
ON
DESIGN INFORMATION NEEDS
AT THE TIME THE SITE
CHARACTERIZATION PLAN IS SUBMITTED

ENGINEERING BRANCH
DIVISION OF WASTE MANAGEMENT

September 1984

8506060149 841116
PDR WMRES EXISANL
A-1755 PDR

Table of Contents

1.0 Introduction

2.0 Technical Position

2.1 Kinds and Level of Detail of Design Information for the Site Characterization Plans (SCP)

3.0 Discussion of Design Information Needs for the SCP

3.1 General Design Criteria for the Geologic Repository Operations Area

3.2 Additional Design Criteria for Surface Facilities in the Geologic Repository Operations Area

3.3 Additional Design Criteria for the Underground Facility

3.4 Barriers Important to Waste Isolation

3.5 Design Process for the SCP

3.6 Uncertainty

3.7 Quality Assurance

4.0 Summary

5.0 References

Figure 1 Basic NRC Health and Safety Responsibilities in Repository Licensing

Appendices

A. Public Law and Regulatory Framework

B. Definition of Terms

**DRAFT GENERIC TECHNICAL POSITION ON
DESIGN INFORMATION NEEDS AT THE TIME
THE SITE CHARACTERIZATION PLAN IS SUBMITTED**

1.0 Introduction

The Nuclear Waste Policy Act of 1982 (NWSA) and 10 CFR Part 60 require that the Department of Energy (DOE) submit Site Characterization Plans (SCP) to the Nuclear Regulatory Commission (NRC). The SCP must include a conceptual repository design that takes into account likely site-specific requirements in sufficient detail to allow an assessment of the site characterization program in connection with the submittal of Site Characterization Plans. Regulatory Guide 4.17 (Ref. 1), entitled "Standard Format and Content of Site Characterization Reports for High-level Waste Geologic Repositories," provides supplemental guidance on the format and content for SCP submittal. Appendix A provides the statutory requirements for the conceptual design at the time of SCP submittal.

This Generic Technical Position is intended to identify the kind of, and the level of detail of, design information needed at the time of SCP submittal. This is intended to ensure that the Site Characterization Plan will provide sufficient design information for the NRC to assess the completeness and adequacy of the site characterization program for the proposed repository. In the past, some of the documents that have been submitted to NRC, called "conceptual designs" or "design studies," have not always reflected the unique performance requirements (see figure 1) that a repository must meet, as stated in 10 CFR Part 60. The NRC has reviewed the Site Characterization Report (SCR) for the Basalt Waste Isolation Project (1982) and has prepared a Draft Site Characterization Analysis (Ref. 2) of the SCR for the Basalt Waste Isolation Project (1983). This document contains good examples of guidance on what design information the NRC needs in the SCP.

The NRC recognizes that design information needs will vary somewhat from site to site. In this technical position, we have attempted to identify generic guidance that the NRC has developed for all candidate sites in the various media. More detailed site specific guidance will be provided to DOE by NRC, in accordance with the Procedural Agreement between the NRC and the DOE, identifying guiding principles for interface during Site Investigation and Site Characterization (Morgan-Davis agreement) and the Site Specific Procedural Agreement.

This Generic Technical Position is organized as follows. Section 1, "Introduction," discusses the public law and regulatory framework for design information needs and explains the intent of this technical position.

Section 2, "Technical Position," is the technical position covering the type and level of detail needed in design information at the SCP stage. Section 3, "Discussion of Design Information Needs for the SCP," discusses in more detail what design information NRC needs, based on 10 CFR 60. Section 4, "Summary," summarizes this Generic Technical Position and Section 5 lists references.

2.0 Technical Position

2.1 Kinds and Level of Detail of Design Information for the SCP

Information on a design of a repository should be provided in sufficient detail to allow the NRC to make a determination about the completeness and relevancy of planned site characterization activities. The types of information that are needed by NRC cover aspects of the design and the site that contribute to meeting the performance objectives and design criteria of 10 CFR 60 (see figure 1).

Specifically, the SCP submitted should include the following information on the design of a geologic repository: a) the bases for the design, b) information detailed enough to permit an evaluation of whether the right kinds and amounts of tests and analyses to be performed during site characterization will be adequate; and (c) information on whether the suitability of the site will be compromised by the facilities that will be constructed for site characterization.

3.0 Discussion of Design Information Needs for the SCP

This discussion focuses on what types of design information NRC needs when the DOE submits the SCP. The intent of this discussion is to make sure the SCP specifically addresses design information which will require unique site specific characterization information needs. If standard designs which have been used successfully for other nuclear facilities (e.g. waste handling for surface facilities) are used, then site specific site characterization plans may not be needed. Early identification of design issues which require site specific characterization is needed to evaluate testing needs at the time of SCP submittal. All of the design details need not be contained in the SCP, but the documents containing the relevant design information should be referenced and available to the NRC before the SCP is submitted.

3.1 General Design Criteria for the Geologic Repository Operation Area

3.1.1 "Radiological Protection" 60.131.a

The DOE should state, in general, how the geologic repository design will limit radiation exposures within the limits required in 10 CFR Part 20. The DOE should identify site characterization plans needed to meet these limits.

3.1.2 "Structures, Systems, and Components Important to Safety" 60.131.b

The first step in the analysis of the various systems, structures and components of the geologic repository should be to analyse which of these could result in a release, if they fail to perform their intended function, of a dose commitment of 0.5 rem or greater, at or beyond the nearest boundary of the unrestricted area, at any time until the completion of permanent closure (i.e., important to safety, as defined in 10 CFR 60.2).

The DOE should identify and give the bases for which structures, systems and components of the repository have been determined to be important to safety, or identify their plans to do this in the SCP. If a system is considered important to safety, then the site characterization information needs should integrate the following items as a minimum into the SCP: protection against dynamic effects of equipment failure and similar events; protection against fire and explosions; emergency capabilities; redundant utility services; inspection; testing and maintenance; criticality control; instrumentation and control systems; compliance with mining regulations; and shaft conveyances.

3.2 Additional Design Criteria for Surface Facilities in the Geologic Repository Operations Area

3.2.1 "Design Criteria for the Surface Facility" 60.132

A general description and layout for the waste handling facilities (surface) should be given along with the procedure for handling and retrieval of wastes. Site characterization information needs for the following items should be integrated into the SCP: surface facility ventilation; radiation control and monitoring; waste treatment facilities and any foundation investigation plans for the surface facilities.

3.3 Additional Design Criteria for the Underground Facility

3.3.1 "Design Criteria for the Underground Facility" 60.133

The SCP should include a general description and layout, and rationale for the design of the subsurface facility. The design should also include the proposed location of shafts, the depth of host rock, and geometry and orientations of underground openings. Also, the materials that comprise the engineered barrier system should be included in the SCP, as well as a description of their properties, function and a rationale for their use. A discussion of possible disruptive events (e.g., water inflow, earthquake, rock burst etc.) should be included as well as their effect on geologic repository operations and integrity. Site characterization information needs should be integrated into the SCP for the following items; flexibility of design, retrieval of waste, control of water and gas, stability of underground openings, rock support systems, rock excavation, underground facility ventilation, and thermal loads. A rationale stating how these items will be integrated into the design should also be included in the SCP.

3.4 Barriers Important to Waste Isolation

The SCP should include a description of barriers important to waste isolation which must be designed to allow the repository to meet the performance objectives of 10 CFR 60 (60.113) "Engineered Barrier System." This section requires that containment be substantially complete for not less than 300 years nor more than 1,000 years after permanent closure, and the release rate of radionuclides from the engineered barrier system, following the containment period, shall not exceed one part in 100,000 per year of the inventory present at 1,000 years. The SCP should also provide preliminary numerical values for the performance requirements of the engineered barrier system components and the rationale for their selection (i.e., specify the provisional allocation of performance of individual components of the engineered barrier systems that are necessary to assure that the geologic repository, as a whole, meets overall performance requirements). The specification of numerical performance requirements for the engineered barrier system components is necessary to enable evaluation of whether the planned testing and characterization of these components will be adequate. Thus, identification of preliminary performance requirements is an essential foundation which should underlie a sound site characterization program. Additional guidance on the methodology for determining compliance with 10 CFR 60, for both the natural and engineered system, is provided in the NRC Generic Technical Position on Licensing Assessment Methodology for High-Level Waste Geologic Repositories (Ref.3).

The SCP should also include a description of any borehole and shaft seal designs. Boreholes and shaft seal materials and placement methods should be discussed. It is especially important to describe plans for any exploratory shafts and to provide assurance that site characterization activities will not compromise the site or design.

3.5 Design Process for the SCP

A single, comprehensive geologic repository operations area design must be identified to help establish specifically how much information will be needed to: 1) evaluate the design development process; and (2) support the performance assessment, as required in 10 CFR 60. The design process for the geologic repository operations area should also identify any alternative design concepts considered by DOE which allow for: (a) uncertainties in site parameters; (b) flexibility to make trade-offs between sub-system components; and (c) the inter-relationship between system/components, to determine the performance of the overall repository facility or components of the system; and d) the rationale for the preferred and alternative design concepts. Documents supporting the design concepts should also be referenced in the SCP.

The design activities and resulting design documents should be accomplished and prepared in accordance with established Quality Assurance requirements for design control.

3.6 Uncertainty

The SCP and follow-up design process should identify and allow for current uncertainties in site or other parameters, and in models which may influence, for example, reliability and confidence in the containment performance of the waste package. That is, the design must allow for a reasonable bounding of a range of conditions where there is uncertainty. As stated in the Draft Site Characterization Analysis for BWIP (Ref. 2), preliminary sensitivity analyses should be performed to evaluate parametric changes on system or component performance. Plans for bounding design parameters and for performing preliminary sensitivity analyses should be identified in the SCP.

3.7 Quality Assurance

DOE should discuss in the SCP, what Quality Assurance (QA) program is in place and how it is implemented. The NRC has prepared (Ref. 4) the document "Draft NRC review plan: Quality Assurance Programs for Site Characterization of High Level Nuclear Waste Repositories," which identifies what part of the DOE QA program the NRC will review.

4.0 Summary

The purpose of this technical position is to provide guidance to the Department of Energy on what information the NRC needs regarding geologic repository design at the time of SCP submittal. A discussion of NRC information needs in evaluating the adequacy and completeness of the Site Characterization Plans with respect to investigative activities of a candidate site for a high level waste geologic repository has been included.

The information on design that is required in the SCP may vary somewhat from site to site. This technical position has attempted to identify generic guidance that the NRC has developed to date, for all candidate sites in the various media.

More detailed site specific guidance will be provided to DOE in accordance with the procedural agreement between the NRC and the DOE, identifying guiding principles for interface during site investigation and site characterization (Morgan-Davis Agreement), and the Site Specific Procedural Agreement.

Design information needs at the license application stage will be much more detailed than what is required at the time of SCP submittal. The information needed at the time of a license application will be discussed in a future technical position.

5.0 References

1. NRC Regulatory Guide 4.17, "Standard Format and Content of Site Characterization Reports for High Level Waste Geologic Repository," July 1982.
2. Draft Site Characterization Analysis for the Site Characterization Report for the Basalt Waste Isolation Project, NUREG-0960, March 1983.
3. Draft Generic Technical Position on Licensing Assessment Methodology for High Level Waste Geologic Repository, July 1984.
4. NRC Review Plan: Quality Assurance Programs for Site Characterization of High Level Nuclear Waste Repository, June 1984.

FIGURE 1
BASIC NRC HEALTH SAFETY RESPONSIBILITIES IN REPOSITORY LICENSING
 (Related Primarily to Design)

AREAS OF RESPONSIBILITIES

PRE-CLOSURE PERIOD

POST-CLOSURE PERIOD

AREAS OF RESPONSIBILITIES	PRE-CLOSURE PERIOD		POST-CLOSURE PERIOD
	OPERATION	RETRIEVAL	CONTAINMENT/ISOLATION
<u>Radiological Safety</u> Geologic Repository Operations Area			<u>10 CFR 60/EPA STD.*</u>
- Restricted Area Normal Operation	← 10 CFR 20 →	← RETRIEVAL →	o Release to the accessible environment shall be less than the limits specified by EPA STD.
Accidents	← No directly applicable limit →		o Waste package to meet containment period of less than 300 years not more than 1000 years.
- Unrestricted Area Normal Operation	← EPA STD. (25 mrems/yr) ← 10 CFR 20 & 10 CFR 60.111 →		o Engineered System to meet 10 ⁻⁵ release rate.
Accidents	← 10 CFR 60.2 (500 mrems per event) →		o 1000 yr. groundwater travel time to accessible environment.
<u>Other Supporting Requirements</u>			<u>Support for Meeting EPA STD and Performance Objectives</u>
	← Assure Ability to Retrieve 10 CFR 60.111(b) →		o Maintain integrity of the waste package.
	← Maintain Stable Openings 10 CFR 60.133(e) →		o Assure construction-related effects (e.g., subsidence, fracturing) do not result in significant transport pathways.
<u>Non-Radiological Safety</u> (Protection of Workers from injury and death)	← Concerns such as covered in MSHA/OSHA Regulations →		

*See 10 CFR 60 for further details.

Appendix A

PUBLIC LAW AND REGULATORY FRAMEWORK

This NRC Technical Position is guided by the Nuclear Waste Policy Act, 10 CFR Part 60, and supplements Regulatory Guide 4.17 (Standard Format and Content of Site Characterization reports for High-Level Waste Geologic Repositories).

Nuclear Waste Policy Act of 1982 (NWPA)

The NWPA states in Section 113(b) "that before proceeding to sink shafts at any candidate site, the secretary (i.e., DOE) shall submit for such candidate site to the Commission and to either the Governor and legislature of the State in which such candidate site is located, or the governing body of the affected Indian tribe on whose reservation such candidate site is located, as the case may be, for their review and comment ... C) A conceptual repository design that takes into account likely site-specific requirements."

Nuclear Regulatory Commission Final Rule (10 CFR 60)

10 CFR 60 states in 60.11 (a)(6) "that a site characterization report must contain a description of the site characterization program including ... (ii) a conceptual design of a geologic repository operations area appropriate to the named site in sufficient detail to allow assessment of the site characterization program, with respect to investigation activities which address the ability of the site to host a geologic repository and isolate radioactive waste, or which may affect such ability." (Revision of this provision, to conform to the statutory language is currently under consideration).

The design criteria for a geologic repository are given in 10 CFR 60.130-135. The criteria for performance confirmation are given in Subpart F, 10 CFR 60.140-142 and the criteria for Quality Assurance are given in Subpart G, 10 CFR 60.150-152.

Regulatory Guide 4.17

Regulatory Guide 4.17 (Standard Format and Content of Site Characterization Reports for High-level Waste Geologic Repositories) states that information on the conceptual design of a repository is needed to allow an assessment of the site characterization program, since a substantial amount of the information generated during site characterization will directly relate to the progressive development of a repository design for the site. This document is presently being updated to allow for changes made by the NWPA.

Appendix B

DEFINITIONS

Alternative Design Concepts - Concepts other than those shown in the comprehensive geologic repository design that may be integrated into the repository and still allow the performance objectives of 10 CFR 60 to be met.

Conceptual Design of a Repository - means a design of a repository appropriate to the named site in sufficient detail to allow assessment of the site characterization program with respect to investigative activities that address the ability of the site to host a repository and isolate radioactive waste or that may affect such ability.

Confidence - The probability that the predicted reliability estimate will be achieved.

Design Bases - Information which identifies the specific functions to be performed by the structure, system, or component of a geologic repository and the specific values or assumptions chosen for controlling parameters as bounds for design and supporting rationale.

Design concepts - a conception of a part of the design of a geologic repository (e.g., Vertical emplacement of waste package)

Design Process - An iterative process of developing a repository design from preliminary stages where the level of uncertainties in design inputs is high, to a final stage, where the level of uncertainties is low enough to meet established performance criteria.

Interim Performance Requirements - Quantified reliability and confidence requirements for the engineered system of a repository (e.g., requirements for a waste package).

Models - A representation of a process, component, or system.

Reliability - The probability that a system or component, when operating under stated environmental conditions, will perform its intended function adequately for a specified period of time, under Specified Environmental Conditions.

Sensitivity Analyses - An analysis in which one or more parameters are varied, to observe their effects on the performance of a system, or some part of it.

Such an analysis requires definition of a system, the ranges of parameters over which the system is to be investigated, and the characteristics of the system which is to be observed.

Site Characterization: - The program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the range of those parameters of a particular site relevant to the procedures under 10 CFR 60.

Site Characterization Plan - A general plan for site characterization activities for a candidate site for a high-level waste repository, as required in the Nuclear Waste Policy Act.

System or Component Performance - How each element or a combination of all elements of the engineered barrier system of the repository contributes to meeting the numerical performance objectives set forth in 10 CFR 60.113.

Uncertainties - A qualitative or quantitative term referring to the confidence in a system's or component's reliability.