



19 August 1988

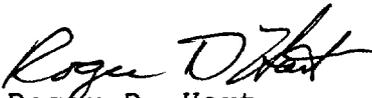
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"NRC Technical Assistance  
for Design Reviews"  
Contract No. NRC-02-85-002  
FIN D1016

Dear Naiem:

Enclosed is the draft of Itasca Document Review 006-01-63, "Technical Position on Post-Closure Seals in an Unsaturated Medium" (D. Gupta, Draft 3, July 1988). Please call me if you have any questions.

Sincerely,

  
Roger D. Hart  
Program Manager

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DRAFT

ITASCA DOCUMENT REVIEW

File No.: 006-01-63

Document Title: "Technical Position on Post-Closure Seals in an Unsaturated Medium" (D. Gupta, Draft 3, July 1988)

Reviewer: Itasca Consulting Group, Inc.  
(L. Lorig and J. Daemen)

Approved:

Date Approved:

Significance to NRC Waste Management Program

This technical position is of fundamental importance to the NRC as it provides guidance to DOE regarding design considerations for sealing in shafts, ramps, boreholes and the underground facility. The guidance provided in the technical position expands and clarifies the staff's position on Rule requirements in three areas: (1) design considerations, (2) site characterization and performance confirmation; and (3) performance analysis. As such, the technical position addresses a broad range of program concerns.

Summary

The technical position is divided into the following seven sections:

- 1.0 Introduction
- 2.0 Regulatory Framework
- 3.0 Technical Positions
- 4.0 Discussion
- 5.0 References
- 6.0 Appendix A: Glossary
- 7.0 Appendix B: Applicable 10CFR60 Regulations

The Introduction gives an overview of (1) the need for seals (and drainage) for a repository in an unsaturated medium, (2) the need to clarify the NRC staff position related to seals (and drainage), and (3) some concerns (e.g., uncertainties in evaluating longevity and long-term effective use of seals and drainage for the post-closure period) which form the basis for the NRC staff position. Section 2.0 lists the applicable Rule regulations in the areas of (1) design, (2) site characterization and performance confirmation and (3) performance analysis. Section 3.0 lists several design considerations in each of the three regulatory areas presented in Section 2.0, and Section 4.0 presents, in parallel, an expanded discussion for each of the positions listed in Section 3.0. Sections 5.0, 6.0 and 7.0 are self explanatory.

#### General Comments

The technical position appears to be specifically written to address the latest NNWSI design status. It is not clear to what extent the guidance can be extended to future designs. It might be advisable to (1) state in the introduction that this technical position is based on current design concepts, (2) reference the first four documents listed in Section 5.0, References, and (3) state that significant departures from current design concepts may be addressed in a follow-up technical position(s).

The document takes the position that "seal materials are not likely to have sufficient longevity to last for a period needed to meet the performance objectives" (p. 8, last paragraph), and "therefore seal effectiveness" should not be relied upon for the entire duration needed to meet the repository design objectives (p. 11, 2nd paragraph). This is a very strong position to adopt, and it is not clear how defensible it is.

It would be preferable if all excerpts from the Rule could be (1) quoted verbatim and designated by quotation marks, and (2) referenced to the Rule in a consistent fashion [e.g., Part 60.15(2) vs Subpart B, Section 60.15(2) vs Part 10CFR60.15(2)], This should eliminate any ambiguity.

It is not immediately obvious to the first-time reader that the list of discussion topics in Section 4.0 parallels exactly the list of design considerations in Section 3.0. It may be helpful to indicate this (perhaps at the beginning of Section 3.0).

The entire document should be screened carefully to find places where only "seals" are mentioned and where "drainage" might be included (see Specific Comments, below).

The document does not discuss the possible effects of major geologic changes, such as tectonic events or significant elevation of the groundwater table above its present location. Perhaps such discussions are beyond the scope of the document, but it may be helpful to point this out in the Introduction.

#### Detailed Comments

<u>Page</u>	<u>Comment</u>
1	<u>Table of Contents</u> — The Table of Contents and the text should be brought into agreement. For example, the following differences should be resolved:  (1) Table of Contents: Technical Position Text: Technical Positions  (2) Table of Contents: II. Site Characterization and Performance Confirmation <u>Testing</u> Considerations  Text: II. Site Characterization and Performance Considerations  (3) Table of Contents does not list Sections I, II, III, as in Section 3.0.  (4) Table of Contents does not list 2.0 subsections.  It might be helpful to use consistent notation for subsections (e.g., I, II, III vs 3.1, 3.2, 3.3).

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Comment

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1.0 INTRODUCTION

1st paragraph, 1st line — Omit "existing".

1st paragraph, 6th line — Replace "focussing" with "studying" or "investigating".

Add to this paragraph: "This technical position is aimed specifically at providing guidance with respect to sealing concepts as described by recent DOE publications (Case and Kelsall, 1987; Fernandez, 1985; Fernandez and Freshley, 1984; Fernandez et al., 1987).

2nd paragraph — Consider modifying the first two sentences of the second paragraph as follows: "In evaluating the need for seals in an unsaturated medium, the principal design goals should be to:

- (1) prevent significant amounts of surface or groundwater from reaching emplaced waste; and
- (2) prevent significant amounts of gaseous radionuclides from escaping through shafts and boreholes to the accessible environment.

The seal requirements can be reduced in part by:

- (1) limiting the amount of surface water which may enter boreholes, shafts and ramps;
- (2) selecting borehole, shaft and ramp locations and orientations which provide long flow paths from the emplaced waste to the accessible environment above the repository; and
- (3) maintaining the needed rate of drainage below the repository horizon level to allow waste to percolate down through the rock mass without contacting waste packages.

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Comment

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1.0 INTRODUCTION (continued)

4th paragraph, 5th line — Insert a period between "feasible" and "These".

5th paragraph, 2nd line — Switch "the" and "and" to read "and the".

Consider adding the following as the last paragraphs of Section 1.0, Introduction:

A fundamental dilemma arises for sealing in the unsaturated zone from the combined and potentially conflicting requirements of:

- (1) controlling (reducing) inflow of water toward the emplacement locations;
- (2) controlling (reducing) outflow of contaminated water from the emplacement area to the water table (and, ultimately, the accessible environment); and
- (3) controlling gaseous radionuclide releases.

NRC staff recognizes the potential benefits of allowing rapid drainage of uncontaminated water through the repository horizon in order to minimize the risk of water contacting waste packages. NRC perceives a potential conflict of leaving (or creating) enhanced drainage at any location below the repository horizon (i.e., within a main geological barrier and, particularly, within relatively close proximity to waste emplacement areas). The applicant will need to provide reasonable assurance that such drains cannot be expected to result in enhanced flow of contaminated water toward the water table (e.g., as a result of intrinsic anisotropy in the rock mass hydraulic conductivity or as a result of thermally-driven lateral water (steam) flow).

This technical position does not explicitly address the sealing implications of water table level changes. It is assumed that sealing performance analyses and performance requirements will include adequate consideration of credible future tectonic, geologic, geomorphological and geochemical processes and events that could affect seal performance requirements.

<u>Page</u>	<u>Comment</u>
4	<p><u>3.0 TECHNICAL POSITIONS</u></p> <p><u>I. DESIGN CONSIDERATIONS</u></p> <p><u>Point 6, 2nd line</u> — Capitalize "<u>seal</u>".</p> <p><u>Point 7</u> — Change the last sentence to: "Planning of borehole depths should take into consideration the potential adverse effects of creating pathways for water inflow to emplacement areas of gaseous releases and of outflow of contaminated water."</p>
5	<p><u>III. Performance Analysis Considerations</u></p> <p><u>Point 4, 1st sentence</u> — Add "and/or drainage" after "seals".</p>
6	<p><u>4.0 DISCUSSION</u></p> <p><u>I. DESIGN CONSIDERATIONS</u></p> <p><u>Point 2, 5th line</u> — Change "rain fall" to rainfall".</p> <p><u>Point 2, last sentence</u> — This sentence seems to indicate that drainage divides have little potential for flooding. However, flooding, for example, as a result of a debris dams may occur on a drainage divide if it is at a low elevation. It is suggested that the words "at drainage divides away from flow channels" be removed.</p> <p><u>Point 3, 2nd sentence</u> — Add "selected" before "method".</p>

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Comment

6        4.0 DISCUSSION (continued)

I. DESIGN CONSIDERATIONS (continued)

Point 4, 3rd sentence — Change this sentence to:  
"Drainage through the rock mass may initially be sufficient to avoid adverse impact on waste isolation. To assess if the drainage will remain sufficient to meet the long-term design criteria, it will be necessary to evaluate drainage capacity over an extended period of time."

7        Point 5, 5th sentence — Consider rewriting this sentence to read "Also, liner removal could change stresses in the shaft and ramp wall and could increase the shaft and ramp closure."

Consider adding another paragraph to the discussion:  
"In the post-closure period, the structural integrity of the liner (and rock reinforcement, if any) is important, as discussed above. However, the compatibility of emplaced material with any contacting water is possibly of more importance because of the potential for material dissolution and redeposition in rock pores. Therefore, it would be desirable that any emplaced materials, such as cement, aggregates and rock reinforcement components, be selected, in part, based on chemical compatibility in the post-closure period."

Point 7 — Consider removing the last sentence of this paragraph; it is not relevant to the position.

8        Point 7, 2nd paragraph on page, last sentence — Add "gaseous releases, and outflow of contaminated water".

Point 8, 1st sentence — Change to ". . . areas, and depths, all boreholes should be sealed . . .".

<u>Page</u>	<u>Comment</u>
6	<u>4.0 DISCUSSION (continued)</u> <u>I. DESIGN CONSIDERATIONS (continued)</u>
8	<u>Point 9</u> — Insert the following after "Therefore, these holes should be sealed.": "It is recognized that some such holes may improve drainage. If such effects are invoked as beneficial, it will need to be demonstrated (e.g., by performance analysis) that they cannot compromise the waste isolation capability of the site by, for example, facilitating outflow of contaminated water.  <u>Point 10, 3rd sentence</u> — Leave out "Alternatively,".  <u>Point 10, 4th sentence</u> — Replace this sentence with: "If seal performance is relied upon for an extended period of time, reasonable assurance must be provided that the seal material longevity is adequate to meet the performance requirements."
9	<u>II. SITE CHARACTERIZATION AND PERFORMANCE CONFIRMATION CONSIDERATIONS</u>  <u>2nd paragraph, 2nd line</u> — Replace "before" with "at the time of".
10	<u>III. PERFORMANCE ANALYSIS CONSIDERATIONS</u>  <u>Point 2, 2nd paragraph, last sentence</u> — Consider changing "would" to "may".
11	<u>Point 3, 1st sentence</u> — Change "ramp" to "ramps" in two places.  <u>Point 3, 3rd sentence</u> — Change this sentence to: "These seal components are likely to shrink and/or disintegrate with time and should only be relied upon for long-term performance to the extent that their long-term properties can be determined."

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Comment

4.0 DISCUSSION (continued)

III. PERFORMANCE ANALYSIS CONSIDERATIONS (continued)

- 11 Point 4, 2nd paragraph on page, 3rd sentence — Change this sentence to: "Therefore, seal effectiveness should only be relied upon if a comprehensive analysis of the future environment and changes at seal locations confirms with reasonable assurance that the required seal performance can be obtained."

5.0 REFERENCES — Add publication dates to the following references:

Case and Kelsall (1987)  
Fernandez (1985)  
Fernandez et al. (1987)

12 6.0 APPENDIX A: GLOSSARY

Consider the following:

- (1) expanding the source to read (Source: 10CFR60.2 Definitions);
- (2) adding a definition for accessible environment; and
- (3) directing the interested reader to 10CFR60.2 for additional definitions.