



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

OCT 2 1987

MEMORANDUM FOR: B. Joe Youngblood, Chief
Operations Branch
Division of High-Level Waste Management
Office of Nuclear Material Safety and Safeguards

FROM: Frank A. Costanzi, Chief
Waste Management Branch
Division of Engineering
Office of Nuclear Regulatory Research

SUBJECT: COMMENTS ON HLW PERFORMANCE ASSESSMENT PROGRAM DOCUMENTS FROM
"TECHNICAL ASSISTANCE FOR PERFORMANCE ASSESSMENT," FIN A1165,
SANDIA

In your September 10, 1987 memorandum to me, you requested a review of the documents from the subject project on the following topics:

- 1) the identification and analysis of uncertainties associated with HLW repository performance assessments,
- 2) the development and implementation of a licensing assessment methodology, and
- 3) the identification and analysis of quantitative techniques for assigning probabilities of occurrence to potentially disruptive events and processes.

The document related to the first topic, "Scoping Document: Treatment of Uncertainties in the Performance Assessment of Geologic High-Level Radioactive Waste Repositories," provides a valuable perspective on the problem of dealing with uncertainties that benefits from Sandia's long experience in helping NRC develop methodologies for evaluating the performance of HLW repositories. The scoping document complements documents prepared under the NRC HLW research project, "Uncertainties in Assessment of Long-Term Collective Dose and Health Effects from Geologic Disposal of High-Level Waste," FIN A9041 (Oak Ridge National Laboratory). As a result of his review of the Statement of Work for FIN A1165, Dr. John D. Randall of my staff has sent Dr. Daniel A. Galson, FIN A1165's project manager, copies of reports and papers from FIN A9041.

The document on the second topic, an interim report for the licensing assessment methodology being developed under FIN A1165, provides a good summary of technical information needs that NRC should have fulfilled by the time that a licensing decision for HLW disposal has to be made. Because of the licensing assessment methodology's very strong emphasis on the quantitative aspects of NRC's assessment of DOE's compliance with 10 CFR 60, I suggest that the name "Licensing Assessment Methodology" be replaced with "Quantitative Aspects of Compliance Assessment."

8712140186 871022
PDR WMRES EXISANL
A-1165 PDR

127153
Project: WM-10, 11, 16
w/enc1
(Return to WM, 623-55)

WM Record Files: A-1165
LPDR w/enc1

H

With respect to Table 9 of the interim report on the licensing assessment methodology, NRC does not now have the capability to model the movement of brine inclusions or brine pockets. Although the NRC HLW research program is developing information on the movement of water and contaminants in saturated and unsaturated fractured media, it does not have the resources for establishing similar work on the movement of water and contaminants through salt. If DOE proposes a repository of HLW in salt, NRC could be in a position of not having an independent capability to assess DOE's claims about the effects of brine migration via inclusions or pockets on repository performance.

No document on the third topic listed above, assigning probabilities to potentially disruptive processes and events, was enclosed with your memorandum. I understand that this document is still being revised by Sandia.

Dr. Randall has reviewed the first two documents and his comments on them are enclosed with this memorandum. If you have any questions on these comments, please contact him at x37787.



Frank A. Costanzi, Chief
Waste Management Branch
Division of Engineering
Office of Nuclear Regulatory Research

cc: Daniel A. Galson, NMSS/DHLWM/OB

WMB Staff Comments on
HLW Performance Assessment Program Documents from
"Technical Assistance for Performance Assessment," FIN A1165, Sandia

Reviewer: John D. Randall, RES/DE/WMB

- 1) "Scoping Document: Treatment of Uncertainties in the Performance Assessment of Geologic High-Level Radioactive Waste Repositories," by Cranwell and Bonano

This document provides a valuable perspective on the problem of dealing with uncertainties that benefits from Sandia's long experience in helping NRC develop methodologies for evaluating the performance of HLW repositories. From this perspective, the authors discuss the HLW uncertainty problem in a very general way. The scoping document complements documents prepared under the NRC HLW research project, "Uncertainties in Assessment of Long-Term Collective Dose and Health Effects from Geologic Disposal of High-Level Waste," FIN A9041 (Oak Ridge National Laboratory). Many of the ideas discussed in this document are similar to those discussed in "Uncertainties Associated with Geologic Disposal of High-Level Radioactive Waste," Waste Management '82; "Uncertainties in Long-Term Repository Performance due to Effects of Future Geologic Processes," NUREG/CR-3832; and "Uncertainties in Geologic Disposal of High-Level Wastes -- Groundwater Transport of Radionuclides and Radiological Consequences," NUREG/CR-2506; all of which came from FIN A9041. Unlike this scoping document, the reports from FIN A9041 are not stated in terms of any computational methodology.

Specific comments on this document are given below.

<u>Page</u>	<u>Comment</u>
4	The section on "Computer Code Uncertainty" tries to do too much with too few words. This section mixes a discussion of extracting information from mathematical models by numerical methods with a discussion of computer programs that implement those methods. This section should be preceded with a section with a title like "Uncertainties Attributable to Procedures for Extracting Information from Mathematical Models." Topics covered should include exact solutions and numerical approximations to them, approximate solutions (such as the ones used in DNET), and numerical solutions. In connection with numerical solutions, the report can discuss truncation error (the difference between a differential equation and its numerical representation), stability of numerical algorithms, and convergence of the numerical solutions to exact solutions.
4	Line 4: Replace "truncation" with "roundoff".
4	Line 6: Replace the expression "imported numerical algorithms" with "canned computer programs" if that is what is meant.
4	Line 9: Replace "the latter" with "user error".

<u>Page</u>	<u>Comment</u>
4	Section 2.3, line 3: Insert "any necessary" before "computer".
6	<u>Scenario Probabilities</u> , lines 6 and 7: Replace "use analytical techniques and numerical models" with "have statistical and deterministic aspects".
7	Section 3.2, lines 8 and 9: Replace "these data are quite massive" with "there are many such data".
8	<u>Uncertainty in Mathematical Model</u> , line 2: Insert "mathematically" after "facility".
8	<u>Uncertainty in Mathematical Model</u> , line 4: Insert "often" after "The equations".
8	<u>Uncertainty in Mathematical Model</u> , line 10: Insert "mathematical" after "a".
8	<u>Uncertainty in Mathematical Model</u> , lines 10 and 11: Delete "as embodied in a computer code".
8	<u>Uncertainty in Mathematical Model</u> , paragraph 2, lines 3 and 4: Replace "accurate to the extent possible" with "realistic".
10	Line 1: Replace "Computer Code" with "Solution Procedures and Their Implementations".
10	Line 6: Insert "in solution procedures" after "uncertainties".
10	Line 9: Insert "faulty solution procedures and" before "computational".
10	Paragraph 3, line 1: Replace "is" with "provide".
11	Last paragraph, lines 3 and 4: Replace "computer model" with "mathematical model".
12	Next to last line: Replace "computer code" with "mathematical model".
13	The bullet items on this page lack stylistic consistency. Some of the items are complete sentences and some are not. Some have subjects and some do not. One style should be used for all of the bullets.
14	Line 1: Replace "A number of" with "Several".
14	<u>Stochastic Models</u> , line 1: Replace "reduce" with "reducing".
14	<u>Stochastic Models</u> , paragraph 2, first sentence: The definition of the <i>inverse problem</i> is not general enough. A good way to define an inverse problem is to compare it with a direct, or well posed, problem. In a direct problem, one is given a spatial domain and must predict dependent variables (e.g. head, concentration, or temperature) as a function of

Page

Comment

- space and time subject to given initial values of the dependent variables, given values of the dependent variables or their spatial derivatives on the boundary of the spatial domain, and given values of parameters (e.g. properties) that will control the spatial and temporal distribution of the dependent variables. In an inverse problem, one is given values of dependent variables over specified spatial and temporal domains and must determine one or more of the "givens" of the direct problem.
- 15 Line 5: Replace "are" with "is".
- 16 Line 1: Replace "nalysis" with "analysis".
- 17 Line 1: Replace "these are generic" with "the".
- 17 Line 2: Insert "have been described generally" after "models".
- 17 Line 4: Replace "methods" with "stochastic models".
- 17,18 The section on Interpolation Techniques would provide a good introduction to Stochastic Methods if it were moved to page 14 after the second paragraph.
- 18 Differential Analysis Techniques, line 9: Replace "analytically" with "exactly".
- 18 Differential Analysis Techniques, line 10: Replace "complex" with "complicated".
- 19 Third bullet: Replace "computer" with "mathematical".
- 19 Bullet items: See comment on page 13.
- 19 Before the paragraph beginning with "From the discussion", insert the title "Concluding Remarks".
- 20 Section 4, paragraph 3, lines 1 and 2: Replace "computer ... system" with "deterministic mathematical models".
- 20 Paragraph 3: This paragraph repeats material from Section 3. It could be shortened by making appropriate references to Section 3.
- 20 5th line from bottom: Replace "computer code" with "mathematical model".
- 21 Line 4: Define "computer calculus".
- 21 Section 5, paragraph 2, line 2: Replace "dependent" with "depending".
- 23 Line 2: Replace "treatment" with "estimation".

Page

Comment

23 Line 11: Replace "rely" with "relies".

2) Interim report for the licensing assessment methodology

The tables in this interim report provide a good summary of technical information needs that NRC should have fulfilled by the time that a licensing decision for HLW disposal has to be made. However, the licensing assessment methodology, as described here and in earlier documents from FIN A1165, places a very strong emphasis on the quantitative aspects of making HLW licensing decisions. Because of this emphasis, the title "licensing assessment methodology" is misleading because the qualitative aspects of licensing involving the extensive use of professional judgment are not given much consideration. A better title for this methodology would be "Quantitative Aspects of Compliance Assessment." Specific comments on this document are given below.

Item 5 on 1st page: Replace "rik" with "risk".

Item 8 on 1st page: Replace "engineered facility" with "disturbed zone".

Items a. - j. on 1st and 2nd pages: These items are not stylistically consistent. See the comment on page 13 of the "Scoping Document" discussed above.

Paragraph 2 of 2nd page: The first sentence implies that modeling will drive site characterization. Practical considerations in site characterization will impose limitations on what models are useful.

Paragraph 3 of 2nd page, line 1: Insert "of a performance assessment" after "components".

Paragraph 3 of 2nd page, line 3: Replace "and hopefully why" with "for what reasons".

Figure 1: The box on thermomechanical responses should be expanded to include all thermal, hydrologic, mechanical, and chemical couplings.

Table 2: The item on horizontal and vertical hydraulic conductivity should be replaced with an item on anisotropic hydraulic conductivity.

Table 3: Add an item on heat generation as a function of time.

Table 6: Add an item on stress corrosion cracking.

Table 8: Expand this table to cover all important thermal, hydrologic, mechanical, and chemical couplings.

Table 9: All of the items in this table are important to NRC's capability to analyze the performance of HLW repositories in salt. NRC does not now have the capability to model the movement of brine inclusions or brine

pockets. Although the NRC HLW research program is developing information on the movement of water and contaminants in saturated and unsaturated fractured media, it does not have the resources for establishing similar work on the movement of water and contaminants through salt. If DOE proposes a repository of HLW in salt, NRC could be in a position of not having an independent capability to assess DOE's claims about the effects of brine migration via inclusions or pockets on repository performance.

Table 11: Replace "Kd or Rd of overpack" with "Kd or Rd of packing material". Is it possible to obtain meaningful functional relationships expressing distribution coefficients as functions of Eh, pH, temperature and water chemistry?

Table 12: Delete item 6i.

Table 14, title: Replace "coded" with "programs".

Table 14, WASTE PACKAGE: Replace "ORIGIN" with "ORIGEN". The computer programs listed from ANISN-W through MAKSIMA-CHEMIST are not waste-package related programs.

Table 14, THERMOMECHANICAL RESPONSE: Delete SWIFT and SWIFT II. They have no mechanical aspects.

Table 15: The information in this table is out of date. I manage FIN A1266. The dates on FIN A2254 are wrong. The project ended in 1985. Brookhaven is the contractor for FIN A3237. FIN B0462 is still active. The project referred to as FIN B1380 is FIN A1380 and is managed by Timothy McCartin. I manage FIN B3046. FIN B6661 has been superceded by FIN D2012. FIN B7291 has been superceded by FIN D1662. FIN B8944 has been superceded by FIN D1674 and the Colorado State University is the contractor. Timothy McCartin manages FIN D1163. FIN's B5753 and D1672, on groundwater flow and contaminant transport in saturated fractured rocks and conducted by the University of Arizona, should be added to this table. I manage both projects.

WM DOCKET CONTROL
CENTER

'87 OCT 26 P4:02

WM-RES
WM Record File
A1165
SNH

WM Project 10, 11, 16
Docket No. _____

PDR
XPDR (B.A./S)

Distribution:

<u>Youngblood</u>	<u>Galson</u>
<u>Coplan</u>	

(Return to WM, 623-SS)

4244