



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

May 7, 1999

Dr. B. John Garrick, Chairman  
Advisory Committee on Nuclear Waste  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

**SUBJECT: RESPONSE TO ADVISORY COMMITTEE ON NUCLEAR WASTE LETTER DATED APRIL 8, 1999, PROVIDING COMMENTS ON THE U.S. DEPARTMENT OF ENERGY'S VIABILITY ASSESSMENT FOR THE PROPOSED HIGH-LEVEL RADIOACTIVE WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA**

Dear Dr. Garrick:

I am responding to your letter of April 8, 1999, to the Chairman, providing the Advisory Committee on Nuclear Waste's (hereafter the Committee's) comments on the U.S. Department of Energy's (DOE's) Viability Assessment (VA) for the proposed high-level radioactive waste repository at Yucca Mountain, Nevada. The Committee raises important and complex questions that will take time to be adequately addressed by the staff. The proposed Part 63 is still undergoing public comment, so the staff will address the Committee's relevant recommendations by a preliminary response, in this letter, and by a more in-depth response to the Committee during the development and coordination of a draft final Part 63. We anticipate that the Committee will pursue its recommendations and evaluate the staff's response during the coordination of the draft final Part 63. We are providing, in this letter, a preliminary response to the Committee's recommendations relating to the content of the Yucca Mountain Review Plan (YMRP). The staff will, however, coordinate with the Committee as the staff develops the YMRP.

The staff's response to each of the Committee's recommendations is presented below. In addition, the staff's response to the Committee's comments on igneous activity is also presented.

**Recommendation 1.** The U.S. Nuclear Regulatory Commission (NRC) should require from DOE a "transparent" performance assessment (PA) that is sufficiently clear to determine the interrelationships among all modules of the system. Requirements for such a presentation can be incorporated into guidance or made part of the Part 63 rulemaking.

**Response 1.** The staff is committed to working with the DOE through prelicensing interactions to improve the clarity of the DOE's PA and to facilitate the staff's review of the license application (LA). Development of the YMRP will be an essential piece of this effort, where the staff outlines what it would find acceptable in any PA submitted by the DOE in support of an LA for Yucca Mountain. Satisfying the criteria in the YMRP provides one method by which the DOE could demonstrate compliance with the NRC's regulations. However, the DOE could also propose alternative ways of showing compliance. As the staff evaluates comments on Part 63, and makes changes, it will take into account the Committee's recommendation on requiring the DOE to have a transparent PA. The staff would have to consider any change, in terms of how prescriptive Part 63 should be, given the Commission's expectation of developing a more risk-informed, performance-based regulation.

11  
DFO3  
102

9905200185 990507  
PDR WASTE  
WM-11 PDR

99-91  
NRC FILE CENTER COPY

**Recommendation 2.** The NRC should require from DOE the traceable linkage of the supporting evidence (data and information packages) to the PA at the module level. Data references must be explicit and, preferably, have electronic links that can be followed easily. Inputs based on expert elicitation must be linked to the supporting evidence for the information provided to and by the experts. Requirements for such a presentation can be incorporated into guidance or made part of the Part 63 rulemaking.

**Response 2.** The evidence required to support the DOE's PA is one aspect of a high-quality LA. The DOE, as the applicant who would ultimately be responsible for the safety of the facility, must develop the information it believes is necessary to support the application. The NRC staff will evaluate the DOE application, and will determine if it acceptably demonstrates that the design of the repository meets the regulatory requirements. Information provided in the LA needs to be at a level sufficient for the NRC staff to reach conclusions on the acceptability of the facility. The staff agrees with the Committee that the LA should provide a clear reference to the supporting data needs.

The staff will continue to evaluate the form, detail, and need for developing additional guidance to facilitate development of a high-quality LA. Furthermore, the staff is aware of the DOE's development of an electronic technical database to address the traceability of data from site characterization to the total system performance assessment (TSPA). The staff will consider the Committee's recommendation as it evaluates the need to provide additional guidance in this area. We anticipate that the YMRP will include a discussion of staff's expectations regarding the necessary supporting information for the DOE PA.

**Recommendation 3.** The NRC should provide guidance in the YMRP on what constitutes sufficient supporting data, acceptable model assumptions and abstractions, and acceptable expressions of parameter uncertainty. The Committee recommends that the guidance not require DOE's "complete understanding," but rather reflects the philosophy that even simple approaches may be realistic as long as the full range of uncertainty is captured. The guidance should allow DOE and others to establish relatively clearly when enough data or model support has been attained. The guidance would be most useful if conditions for an acceptable risk exceedance were discussed.

**Response 3.** The staff is currently developing the YMRP and believes that it is incorporating the philosophy proposed by the Committee. We intend to brief the Committee on the YMRP in May. The YMRP will address supporting data, acceptable model assumptions and abstractions, and parameter uncertainty. Based on the current models and available data used by the DOE, the staff is endeavoring to provide guidance on the amount of data or model support required for specific subissues. As noted above, the level of detail provided in the LA needs to be sufficient for the NRC staff to determine if the facility meets the requirements in the regulations. Detailed supporting data needs to be developed by the DOE and made available for the NRC staff's consideration in its evaluation. However, not all of this information needs to be explicitly included in the LA.

The subject of an acceptable risk exceedance threshold is more appropriately considered in the Part 63 rulemaking than in guidance. The staff will address the Committee's recommendation to discuss the risk exceedance threshold, during the current Part 63 rulemaking.

**Recommendation 4.** The NRC staff should be prepared to evaluate engineering designs proposed by DOE. This step implies augmenting the NRC staff with engineers with geotechnical, engineered barrier, and waste package design experience. Part-time consultants with such design experience could be a valuable aid to NRC full-time staff in preparing for and evaluating the LA.

**Response 4.** One geotechnical engineer was added to the high-level waste program during a March 1999 reorganization. This has increased the number of full-time staff available to review the repository design. In addition, there are three staff on board and one being hired who have a materials engineering background, plus there is one chemical engineer currently working in the NRC's high-level waste program. The staff has approved augmentations to the Center for Nuclear Waste Regulatory Analyses (CNWRA) Operations Plans that include work related to engineering designs and the performance of engineered barriers. This work will be performed by consultants to the CNWRA. The staff believes that it has access — either on staff or through the CNWRA — to the experience required to review engineering designs proposed by the DOE. The staff is prepared to review engineering designs and evaluate them in the context of the requirements in the proposed Part 63. The staff will continue to evaluate whether its resources are sufficient to evaluate DOE's designs as they change.

**Recommendation 5.** The NRC should outline in the Part 63 rulemaking or guidance the steps in the licensing process between initial submission of the safety case and final closure of the repository. Particular attention should be given to the definition of "reasonable assurance" as applied to repository licensing. This definition will provide early guidance to the DOE and others on the level of completeness of design (data, model development, and confirmatory observations) that will be necessary at different phases of the project. The outline would provide guidance on the nature of the process but would not dictate how the licensing boards or the Commission would make decisions.

**Response 5.** The staff will address this recommendation as it develops the YMRP. The staff notes, however, that steps in the licensing process, from the submission of the license application through permanent closure, are identified in the proposed regulations at Part 63 and include flexibility that allow design changes after construction authorization.

**Recommendation 6.** The NRC staff is committed to developing further guidance on implementing the multiple-barriers approach required in Part 63. As part of this guidance development, the staff should identify clearly the attributes of defense-in-depth that apply to waste repositories in relation to a risk-informed strategy. In addition, DOE and NRC should develop approaches and methodologies that clearly and transparently identify the contributions of different barriers to the overall performance of the repository.

**Response 6.** At the direction of the Commission (Staff Requirements Memorandum [SRM] dated April 12, 1999, on SECY-99-074), the staff is developing a strategy that will outline the steps which can be taken to address more clearly the concept of repository defense-in-depth.

The strategy is scheduled to be completed in early June, and the staff intends to present this strategy at the Committee's June meeting. As it develops the strategy, the staff will ensure that any approach it takes is consistent with the long-standing Commission philosophy on what

constitutes defense-in-depth including the recent Commission white paper reiterating that philosophy.

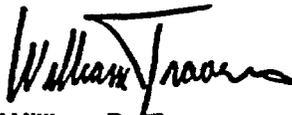
In addition, the staff intends to address the issue of defense-in-depth, including the use of multiple barriers, in the development of the YMRP. As part of the process of developing this guidance, the staff will evaluate approaches that could be used to demonstrate compliance with the requirements for multiple barriers.

**Technical Concerns About the VA.** The Committee disagrees with the staff's concern about the need for more work on igneous activity. The Committee has repeatedly asked the staff for analyses that justify the staff's concerns about volcanic activity as a major component of risk at Yucca Mountain, but has yet to see a detailed justification.

**Response.** The staff believes that to have an acceptable LA, uncertainty in the risk associated with volcanism needs to be adequately addressed by the DOE. DOE, to date, has not fully addressed the potential consequences of igneous activity disrupting the repository; therefore, the staff believes that additional work is necessary to develop an acceptable LA. With the current set of assumptions used in the NRC TSPA code, the dominant contributor to peak expected dose in the first 10,000 years is volcanism, because long waste package lifetimes limited doses from other pathways. The staff is critically evaluating its modeling of volcanism to confirm that it does not include excessive conservatism. The staff last presented its work on volcanism to the Committee in April 1997, and is prepared to present its current position on the risk associated with volcanic activity during the June ACNW meeting.

The staff appreciates the Committee's observations and recommendations on issues arising from its review of the DOE's VA. The Committee's recommendations will also be addressed in the comment resolution associated with the Part 63 rulemaking and development of the YMRP. The staff looks forward to discussing the disposition of the Committee's comments as these aforementioned activities develop.

Sincerely,



William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

constitutes defense-in-depth including the recent Commission white paper reiterating that philosophy.

In addition, the staff intends to address the issue of defense-in-depth, including the use of multiple barriers, in the development of the YMRP. As part of the process of developing this guidance, the staff will evaluate approaches that could be used to demonstrate compliance with the requirements for multiple barriers.

**Technical Concerns About the VA.** The Committee disagrees with the staff's concern about the need for more work on igneous activity. The Committee has repeatedly asked the staff for analyses that justify the staff's concerns about volcanic activity as a major component of risk at Yucca Mountain, but has yet to see a detailed justification.

**Response.** The staff believes that to have an acceptable LA, uncertainty in the risk associated with volcanism needs to be adequately addressed by the DOE. DOE, to date, has not fully addressed the potential consequences of igneous activity disrupting the repository; therefore, the staff believes that additional work is necessary to develop an acceptable LA. With the current set of assumptions used in the NRC TSPA code, the dominant contributor to peak expected dose in the first 10,000 years is volcanism, because long waste package lifetimes limited doses from other pathways. The staff is critically evaluating its modeling of volcanism to confirm that it does not include excessive conservatism. The staff last presented its work on volcanism to the Committee in April 1997, and is prepared to present its current position on the risk associated with volcanic activity during the June ACNW meeting.

The staff appreciates the Committee's observations and recommendations on issues arising from its review of the DOE's VA. The Committee's recommendations will also be addressed in the comment resolution associated with the Part 63 rulemaking and development of the YMRP. The staff looks forward to discussing the disposition of the Committee's comments as these aforementioned activities develop.

Sincerely,  
*Original signed by*  
**William D. Travers**  
William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

**DISTRIBUTION: G19990190 (CRC #: 99-0320)**

File Center	PUBLIC	HLWB r/f t/f	DWM r/f t/f	NMSS r/f	NMSS Off Dir r/f
PTressler	JMitchell	CPoland	RJohnson	JHolonich	EDO r/f
JHickey	KStablein	SBurns	ACNW r/f	MKnapp	SCollins
MVirgilio	RJohnson	SWastler	DBrooks	TMcCartin	EMerschhoff, RIV
CLui	JKotra	JTrapp			

DOCUMENT NAME: S:DWMLWBWRVALET4.WPD (\*see prev. concur.)

OFC	HLWB*	HLWB*	Tech. Ed.*	HLWB*	DWM*
NAME	JFirth/eb <sup>pr need</sup>	KMcConnell	EKraus	CWReamer	JGreeves
DATE	4/27/99	4/28/99	4/26/99	4/28/99	4/29/99
OFC	NMSS*	DEDA	EDC		
NAME	CPaperiello	FML/201a	WTravers		
DATE	5/3/99	5/4/99	6/7/99		

constitutes defense-in-depth including the recent Commission white paper reiterating that philosophy.

In addition, the staff intends to constitutes defense-in-depth including the recent Commission white paper reiterating that philosophy.

In addition, the staff intends to address the issue of defense-in-depth, including the use of multiple barriers, in the development of the YMRP. As part of the process of developing this guidance, the staff will evaluate approaches that could be used to demonstrate compliance with the requirements for multiple barriers.

**Technical Concerns About the VA.** The Committee disagrees with the staff's concern about the need for more work on igneous activity. The Committee has repeatedly asked the staff for analyses that justify the staff's concerns about volcanic activity as a major component of risk at Yucca Mountain, but has yet to see a detailed justification.

**Response.** The staff believes that to have an acceptable LA, uncertainty in the risk associated with volcanism needs to be adequately addressed by the DOE. In the TSPA-VA, the DOE did not adequately address the potential consequences of igneous activity disrupting the repository; therefore, the staff believes that additional work is necessary to develop an acceptable LA. With the current set of assumptions used in the NRC TSPA code, the dominant contributor to peak expected dose in the first 10,000 years is volcanism, because long waste package lifetimes limited doses from other pathways. The staff is critically evaluating its modeling of volcanism to confirm that it does not include excessive conservatism. The staff last presented its work on volcanism to the Committee in April 1997, and is prepared to present its current position on the risk associated with volcanic activity during the June ACNW meeting.

The staff appreciates the Committee's observations and recommendations on issues arising from its review of the DOE's VA. The Committee's recommendations will also be addressed in the comment resolution associated with the Part 63 rulemaking and development of the YMRP. The staff looks forward to discussing the disposition of the Committee's comments as the aforementioned activities continue.

Sincerely,

William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

DISTRIBUTION: G19990190 (CRC #: 99-0320)

File Center	PUBLIC	HLWB r/f t/f	DWM r/f t/f	NMSS r/f	NMSS Off Dir r/f
PTressler	JMitchell	CPoland	RJohnson	JHolonich	EDO r/f
JHickey	KStablein	SBurns	ACNW r/f	MKnapp	SCollins
MVirgilio	RJohnson	SWastler	DBrooks	TMcCartin	EMerschhoff, RIV
CLui	JKotra	JTrapp			

DOCUMENT NAME: S:\DWM\HLWB\JRFVALET4.WPD (\*see prev. concur.)

OFC	HLWB*	HLWB*	Tech. Ed.*	HLWB*	DWM*
NAME	JFirth/eb <sup>prf</sup> rsc	KMcConnell	EKraus	CWReamer	JGreeves
DATE	4/27/99	4/28/99	4/26/99	4/28/99	4/29/99
OFC	NMSS	DEDR	EDO		
NAME	CPaperiello <sup>WV</sup>	FMiraglia	WTravers		
DATE	5/13/99	4/ /99	4/ /99		

Dr. B. Garrick

5

of the YMRP. The staff looks forward to discussing the disposition of the Committee's comments as these aforementioned activities develop.

Sincerely,

William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

**DISTRIBUTION: G19990190 (CRC #: 99-0320)**

File Center	PUBLIC	HLWB r/f t/f	DWM r/f t/f	NMSS r/f	NMSS Off Dir r/f
PTressler	JMitchell	CPoland	RJohnson	JHolonich	EDO r/f
JHickey	KStablein	SBurns	ACNW r/f	MKnapp	SCollins
MVirgilio	RJohnson	SWastler	DBrooks	TMcCartin	EMerschhoff, RIV
CLui	JKotra	JTrapp			

**DOCUMENT NAME: S:\DWM\HLWB\JRF\VALET4.WPD (\*see prev. concur.)**

OFC	HLWB*	HLWB*	Tech. Ed.*	HLWB*	DWM
NAME	JFirth:eb <sup>Drf</sup> <small>read</small>	KMcConnell	EKraus	CWReamer	JGreaves
DATE	4/ 27 /99	4/28 /99	4/26/99	4/28/99	4/19/99
OFC	NMSS	DEDR	EDO		
NAME	CPaperiello	FMiraglia	WTravers		
DATE	4/ /99	4/ /99	4/ /99		

OFFICIAL RECORD COPY

Dr. B. Garrick

The staff appreciates the Committee's observations and recommendations on issues arising from its review of DOE's VA. The staff will continue to work with DOE to improve the transparency and clarity in the presentation of DOE's PA results, allowing for a more efficient review of DOE's LA, and will use IRSRs to provide DOE with feedback on the adequacy of data and models in particular subissues. The Committee's recommendations will be addressed more fully in the comment resolution associated with the Part 63 rulemaking and development of the YMRP. The staff looks forward to discussing the disposition of the Committee's comments as these aforementioned activities develop.

Sincerely,

William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

**DISTRIBUTION: G19990190 (CRC #: 99-0320)**

File Center	PUBLIC	HLWB r/f t/f	DWM r/f t/f	NMSS r/f	NMSS Off Dir r/f
PTressler	JMitchell	CPoland	RJohnson	JHolonich	EDO r/f
JHickey	KStablein	SBurns	ACNW r/f	MKnapp	SCollins
MVirgilio	RJohnson	SWastler	DBrooks	TMcCartin	EMerschhoff, RIV
CLui	JKotra	JTrapp			

*BJ*  
*4/28*

**DOCUMENT NAME: S:\DWM\HLWB\JRFVALET4.WPD (\*see prev. concur.)**

OFC	HLWB*	HLWB	Tech. Ed.*	HLWB	DWM
NAME	JFirth:/eb <sup>prf read</sup>	KMcConnell	EKraus	CWReamer <i>ew</i>	JGreeves
DATE	4/ 27 /99	4/ 27 /99	4/26/99	4/26/99	4/ /99
OFC	NMSS	DEDR	EDO		
NAME	CPaperiello	FMiraglia	WTravers		
DATE	4/ /99	4/ /99	4/ /99		

Dr. B. Garrick

to peak expected dose in the first 10,000 years was volcanism, because long waste package lifetimes limited doses from other pathways. The staff is critically evaluating its position to confirm that it does not have excessive conservatism in its modeling of volcanism. The staff last presented, to the Committee, its work on volcanism in April 1997 and is prepared to present its current position on the risk associated with volcanic activity at Yucca Mountain during the June ACNW meeting.

The staff appreciates the Committee's observations and recommendations on issues arising from its review of DOE's VA. The staff will continue to work with DOE to improve the transparency and clarity in the presentation of DOE's PA results, allowing for a more efficient review of DOE's LA, and will use IRSRs to provide DOE with feedback on the adequacy of data and models in particular subissues. The Committee's recommendations will be addressed more fully in the comment resolution associated with the Part 63 rulemaking and development of the YMRP. The staff looks forward to discussing the disposition of the Committee's comments as these aforementioned activities develop.

Sincerely,

William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

**DISTRIBUTION: G19990190 (CRC #: 99-0320)**

File Center	PUBLIC	HLWB r/f t/f	DWM r/f t/f	NMSS r/f	NMSS Off Dir r/f
PTressler	JMitchell	CPoland	RJohnson	JHolonich	EDO r/f
JHickey	KStablein	SBurns	ACNW r/f	MKnapp	SCollins
MVirgilio	RJohnson	SWastler	DBrooks	TMcCartin	EMerschhoff, RIV
CLui	JKotra	JTrapp			

**DOCUMENT NAME: S:DWMHLWBWRFALET4.WPD (see prev. concur.)**

OFC	HLWB	HLWB	Tech. Ed.*	HLWB	DWM
NAME	JFirth:SRF/feb <sup>prf</sup> read	KMcConnell	EKraus	CWReamer	JGreeves
DATE	4/27/99	4/ /99	4/26/99	4/ /99	4/ /99
OFC	NMSS	DEDR	EDO		
NAME	CPaperiello	FMiraglia	WTravers		
DATE	4/ /99	4/ /99	4/ /99		

Dr. B. Garrick

3

Sincerely,

William D. Travers  
Executive Director  
for Operations

cc: Chairman Jackson  
Commissioner Dicus  
Commissioner Diaz  
Commissioner McGaffigan  
Commissioner Merrifield  
SECY

DISTRIBUTION: G18990180

File Center	PUBLIC PAHL <i>rl</i> <i>vt</i>	DWM <i>rl</i> <i>vt</i>	NMSS <i>rl</i>	NMSS Dir <i>rl</i>	PTreasler
JMitchell, OEDO	CPotenz RJohnson	JHolonich	EDO <i>rl</i>	JHickey	WReamer
EMerschoff, RIV	KStablein	SBurns	ACNW	MKnapp	PNony
AThadani	SCollins MVirgilio	RJohnson	SWastler	DBrooks	JBiana
TMcCartin	CLui JKotra JTrapp				

DOC NAME: S:\DWM\PAHL\URF\ACNW\LET\IMPORT2.WPD  
SEE PREVIOUS CONCURRENCE

OFC	PAHL	PAI	Tech. Ed.	HLWB	DWM
NAME	JFirth:	KMcCennell	EKraus	CReamer	JGroves
DATE	4/ /99	4/ /99	4/21/99	4/ /99	4/ /99
OFC	NMSS	DEOR	EOO		
NAME	CPaperello	FMiraglia	WTravers		
DATE	4/ /99	4/ /99	4/ /99		

OFFICIAL RECORD COPY

8

due 4/26

# ACTION

## EDO Principal Correspondence Control

FROM: DUE: 05/03/99

EDO CONTROL: G19990190  
DOC DT: 04/08/99  
FINAL REPLY:

102

B. John Garrick  
ACNW

TO: Chairman Jackson

FOR SIGNATURE OF : \*\* GRN \*\*  
EDO

CRC NO: 99-0320 ✓

DESC: COMMENTS ON THE DEPARTMENT OF ENERGY'S VIABILITY  
ASSESSMENT FOR THE PROPOSED HIGH-LEVEL RADIOACTIVE  
WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA

ROUTING:  
Travers  
Knapp  
Miraglia  
Norry  
Blaha  
Burns  
Thadani, RES  
Collins, NRR  
Mitchell, OEDO  
ACNW File

DATE: 04/12/99

ASSIGNED TO: NMSS  
CONTACT: Paperiello

### SPECIAL INSTRUCTIONS OR REMARKS:

Prepare response to ACNW for EDO signature. Add  
Commissioners and SECY as cc's.  
*Please provide a draft to Johnson for review as ACNW contact.*  
USE SUBJECT LINE IN RESPONSE.

DWM Action  
Due to NMSS Director's Office  
By 4/28/99 (WLD)  
rec'd 4/14/99

~~ACTION~~ Reamer  
Due to ~~DOE~~ 4/29 4/26  
Director's Office

cc: Ceeves  
Kolench  
Johnson

4/15 Rec'd 4/19-20  
4/16





UNITED STATES  
**NUCLEAR REGULATORY COMMISSION**  
ADVISORY COMMITTEE ON NUCLEAR WASTE  
WASHINGTON, D.C. 20555-0001

April 8, 1999

The Honorable Shirley Ann Jackson  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Dear Chairman Jackson:

**SUBJECT: COMMENTS ON THE DEPARTMENT OF ENERGY'S VIABILITY  
ASSESSMENT FOR THE PROPOSED HIGH-LEVEL RADIOACTIVE  
WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA**

In this letter, the ACNW offers comments on the Viability Assessment (VA) of a Repository at Yucca Mountain, which was released by the U.S. Department of Energy (DOE) on December 18, 1998. The ACNW reviewed the primary VA reports, the technical basis document supporting the Total System Performance Assessment for the VA (TSPA-VA), the Repository Safety Strategy, and the most recent NRC Issue Resolution Status Reports. The Committee heard presentations on the VA from DOE representatives at its 105th and 106th ACNW meetings. In addition, the Committee heard a presentation from the NRC staff at the 106th meeting on its preliminary review comments on the VA. The Committee also had the benefit of observing presentations to the Commission on the VA by representatives of a variety of organizations and groups.

A summary of our recommendations follows. These recommendations can be implemented as part of guidance development or made part of the 10 CFR Part 63 rulemaking.

Recommendations

1. The NRC should require DOE to provide a total system performance assessment (TSPA) model of sufficient technical clarity (transparency) so that the staff can readily determine the interrelationships among all modules of the system. This recommendation could be implemented as part of the 10 CFR Part 63 rulemaking.
2. The NRC should require DOE to provide, in the license application (LA) data and information packages, the supporting evidence to the performance assessment (PA) at the module level. This recommendation could be implemented as part of the 10 CFR Part 63 rulemaking.

*9904190024 8PP*

REC'D BY SECY

9 APR 99 2:24

3. The NRC should provide guidance in the Yucca Mountain License Application Review Plan on what constitutes sufficient supporting data, acceptable model assumptions and abstractions, and acceptable expressions of parameter uncertainty.
4. The NRC staff should be prepared to evaluate engineering designs proposed by DOE. This evaluation will require additional NRC staff with geotechnical, engineered barrier, and waste package design experience.
5. The NRC should outline steps in the licensing process between initial submission of the safety case and final closure of the repository. This recommendation could be implemented as part of the 10 CFR Part 63 rulemaking or guidance development.
6. As part of guidance development for 10 CFR Part 63, the staff needs to identify explicitly the attributes of defense in depth (DID) that apply to waste repositories.

### Background

The ACNW framed its review within the overall context of Risk-Informed, Performance-Based Regulation. The foundation for licensing a repository for high-level radioactive waste and spent fuel is expected to be an Environmental Protection Agency standard based on risk (or dose) and a set of implementing NRC regulations (10 CFR Part 63 and other applicable regulations) and guidance.

Demonstrating compliance with the standard will be based principally on a PA that uses a risk-based performance measure (i.e., the expected dose to the average member of the critical group at a specified location). The results from the PA should be expressed as a risk curve (i.e., a complementary cumulative distribution function [CCDF], sometimes referred to as a risk exceedance curve), that shows the likelihood of exceeding different radiation dose levels. The PA, in principle, considers all reasonable mechanisms for failure of the repository to limit appropriately the dose of radiation to the critical group for the required time of compliance.

The VA offers the NRC a chance to assess how DOE's presentation of license supporting material may need to be improved to meet requirements of risk-informed, performance-based criteria in the regulation and how the NRC staff may have to adapt to be able to perform their mission efficiently and effectively. It is within this framework that the ACNW conducted its review.

The ACNW's review of the VA improved our understanding of DOE's approach for moving from the VA to the site recommendation and the LA for the Yucca Mountain repository. The objective of the review was to evaluate the technical capability, tools, and guidance that the NRC staff will need to conduct a defensible review of the Yucca Mountain LA.

The ACNW focused on the technical basis of the safety case made in the VA, including the ability of DOE to demonstrate the following:

- The design would limit the access of water to the waste packages;
- The waste packages (and cladding) will have long lifetimes relative to the compliance period;
- The release of radionuclides after canisters are breached would be slow;
- The transport of radionuclides in the unsaturated zone could be estimated;
- The transport and dilution of radionuclides in the saturated zone will provide significant buffering of doses; and
- The uptake of radionuclides by biota and the dose to humans could be represented in an acceptable way.
- In addition, to be credible, DOE must present a clear, integrated, probabilistic PA.

The ACNW believes that the most important issues are limiting water access to the waste packages and the need for DOE to present a clear, integrated, probabilistic PA. It is critical that considerable work be done on these issues before submitting a credible LA. The PA is the framework within which all of these issues are put in context for licensing decisionmaking; it is the logic engine for demonstrating the safety of the repository.

#### Observations and Recommendations

The ACNW is impressed with the improvements in-depth and presentation of the TSPA-VA over previous versions of TSPA. Continued improvements are necessary to make future TSPAs more credible. The description and PA of the geological repository system require much data and many assumptions combined into a complex set of models. The results shown in the VA are sufficiently opaque so that it is often difficult to make reasonable judgments on the adequacy of either the computations or their underlying database.

#### Observation

The presentation of the VA results continues to need major improvements. More emphasis is needed on a top-down presentation of the total model that clearly traces the critical path of the computation of the performance measure; namely, the radiation risk to a member of the critical group. The components of a traceable path of the radiation risk assessment that need greater visibility and discussion include the hierarchy of the total model, the model components (modules, interfaces, inputs, outputs, etc.), and clearer

visibility of the continuity and traceability of the performance measure calculation throughout the model.

The ACNW's goal of a top-down presentation is to reveal explicitly the connection and dependence between the performance measure and each component of the model (i.e., rainfall on the site, infiltration to the repository, waste package degradation, radionuclide mobilization, transport through the geosphere and the biosphere, and biological uptake). Refinements are needed in presenting the propagation of uncertainty from the component and subsystem level to total system results. To a certain extent, such results are buried in the VA, but they need to be made more visible to facilitate the mapping of component and subsystem performance to the overall performance of the repository. To be complete, the mapping must be performed in a probabilistic framework to display the role of uncertainty in the process. The Committee believes that employing such techniques will contribute greatly to increasing confidence in the TSPA as it evolves toward a licensing basis.

#### Recommendation

- 1) The NRC should require from DOE a "transparent" PA that is sufficiently clear to determine the interrelationships among all modules of the system. Requirements for such a presentation can be incorporated into guidance or made part of the 10 CFR Part 63 rulemaking.

#### Observation

In addition to improving the technical clarity of the PA, the linkages to the underlying supporting evidence must be presented in a way that facilitates review. The database and other supporting evidence for the VA are voluminous and include system (natural and engineered) reliability data, scientific literature, laboratory results, field studies, special analyses, the laws of physics, the principles of chemistry, the abstraction process, and the results of expert elicitation. A major contributor to technical clarity includes the process for choosing conceptual models because both information and models are major sources of analysis uncertainties.

Future TSPAs should provide the rationale for choosing conceptual models for each module, including the process of assembling the modules into the total system model. It is essential that future TSPAs also be specific about what has been synthesized from the various sources and that data and information packages be developed to facilitate the search for supporting information. This is especially true for the major contributors to the performance measures and the associated uncertainties. A special category of evidence comes from the process of expert elicitation. It is not enough to attribute a result to the judgment of an expert; it must be possible to examine the underlying evidence used by the experts in forming their judgments.

### Recommendation

- 2) The NRC should require from DOE the traceable linkage of the supporting evidence (data and information packages) to the PA at the module level. Data references must be explicit and, preferably, have electronic links that can be followed easily. Inputs based on expert elicitation must be linked to the supporting evidence for the information provided to and by the experts. Requirements for such a presentation can be incorporated into guidance or made part of the 10 CFR Part 63 rulemaking.

### Observation

The case for the safety of a geological repository over tens to hundreds of thousands of years cannot be expressed in absolute terms; as previously stated, the basis for measuring performance must be a risk curve. The ACNW is concerned that the inherent uncertainties in an analysis for such extended periods drive critics to demand that the most conservative assumptions, conceptual models, and parameters be selected at every juncture of the analysis. We very strongly disagree with such an approach. We believe that conservatism is appropriate in regulating nuclear facilities of all kinds, but the appropriate place for conservatism is in the choice of a probability of exceedance of a risk standard.

In the case of a PA for a geological repository, we believe that the analysis should be performed with as nearly realistic assumptions, models, and parameters as possible, including the uncertainty involved. The resultant CCDF derived from the PA would show explicitly the probability that a standard would be exceeded. Increased *conservatism* may be achieved by requiring that the probability of exceeding the standard be less than, say, 1 in  $10^6$  as opposed to a requirement that it be less than, say, 1 in  $10^3$ . Obviously, a licensing decision would not be based exclusively on the probability (i.e., the regulation is risk-informed rather than risk-based), but the decision about conservatism is made with the clearest view of the issues after the best information available has been used in an analysis.

### Recommendation

- 3) The NRC should provide guidance in the Yucca Mountain License Application Review Plan on what constitutes sufficient supporting data, acceptable model assumptions and abstractions, and acceptable expressions of parameter uncertainty. ACNW recommends that the guidance not require DOE's "complete understanding," but rather reflects the philosophy that even simple approaches may be realistic as long as the full range of uncertainty is captured. The guidance should allow DOE and others to establish relatively clearly when enough data or model support has been attained. The guidance would be most useful if conditions for an acceptable risk exceedance were discussed.

### Observation

The VA demonstrates that the ability to restrict the amount of water contacting the waste packages is a critical part of the safety strategy. The extreme importance of limiting the contact of water with waste has led to DOE's increasing emphasis on elements of the engineered barrier system; this would include all aspects of tunnel design as well as the canisters and their contents. The ACNW remains convinced that the NRC staff must acquire expertise in engineering design.

### Recommendation

- 4) The NRC staff should be prepared to evaluate engineering designs proposed by DOE. This step implies augmenting the NRC staff with engineers with geotechnical, engineered barrier, and waste package design experience. Part-time consultants with such design experience could be a valuable aid to NRC full-time staff in preparing for and evaluating the LA.

### Observation

In listening to presentations from DOE and to some concerns expressed by the NRC staff about the time required for evaluations, the ACNW believes that a potential exists for misunderstanding among the parties. DOE has indicated that some aspects of the repository design likely will change up to and beyond the submission of the LA. An adaptive design strategy is essential to achieve the best results. NRC must be prepared to allow design flexibility and probably will have to adopt a plan of phased licensing. The preclosure period is anticipated to range from 50 to 300 years. During this entire period, the waste will be in storage underground; under active, continuous surveillance; and will be fully retrievable. The final decision on the suitability of the repository for waste disposal will not be made until the end of the preclosure period. New materials, new technical methods, and new societal needs can be expected to arise in this period.

Certain design improvements, such as drift location, support type, waste package design, water diversion strategies, and chemically tailored backfill, are all possible during the preclosure period. Active (and natural) ventilation can be used to remove heat from the waste and reduce adverse thermal effects on the rock and waste package. Also, extensive data can be gathered during the preclosure period to reduce uncertainties in the predicted performance of the repository. On the one hand, it would be irresponsible not to allow such improvements in repository safety. On the other hand, NRC cannot approve the licensing of the repository if the LA and supporting information are not sufficiently well developed to allow the NRC to make a finding of reasonable assurance of safety. A serious evaluation of the competing needs of flexibility and design stability is required.

### Recommendation

- 5) The NRC should outline in the 10 CFR Part 63 rulemaking or guidance the steps in the licensing process between initial submission of the safety case and final

closure of the repository. Particular attention should be given to the definition of "reasonable assurance" as applied to repository licensing. This definition will provide early guidance to DOE and others on the level of completeness of design (data, model development, and confirmatory observations) that will be necessary at different phases of the project. The outline would provide guidance on the nature of the process but would not dictate how the licensing boards or the Commission would make decisions.

### Observation

DOE continues to develop methods for demonstrating defense in depth (DID). The ACNW remains convinced that the key requirement for DID in a repository is an analysis that clearly quantifies the contribution of multiple barriers, including the uncertainty associated with each barrier to the containment of radionuclides (see ACNW letter of October 31, 1997, "Recommendations Regarding The Implementation of the Defense-in-Depth Concept in the Revised 10 CFR Part 60"). In particular, the multiple barriers of the engineered system and the geological system must be shown to offer protection. We note that it would be imprudent to require a specific percentile contribution from either the geological or the engineered systems because this requirement could lead to impairment of overall performance. That is, if the geological system were required to contribute a certain fraction (say 50%) of the total performance, the applicant might degrade the design of the engineered system to boost the fraction of contribution from the natural system. The ACNW maintains that the appropriate way to judge the case for repository safety is to look at overall performance, as long as there is a clear, quantitative presentation of contributions of individual barriers.

### Recommendation

- 6) The NRC staff is committed to developing further guidance on implementing the multiple-barriers approach required in 10 CFR Part 63. As part of this guidance development, the staff should identify clearly the attributes of DID that apply to waste repositories in relation to a risk-informed strategy. In addition, DOE and NRC should develop approaches and methodologies that clearly and transparently identify the contributions of different barriers to the overall performance of the repository.

### Technical Concerns About the VA

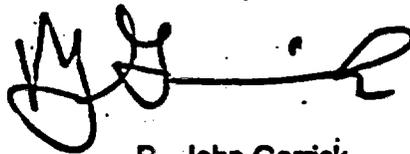
In general terms, the ACNW shares the staff's concerns on specific technical issues; that is, the adequacy of the database and models in the areas of seepage into drifts, corrosion of alloy-22, failure of fuel cladding, and dissolution of fuel. (The Committee presented details of some of these topics in its letter of September 9, 1998, on the "Issues and Recommendations Concerning the Near-Field Environment and the Performance of Engineered Barriers at Yucca Mountain.") The planned experiments by DOE on seepage into drifts are potentially important, as are continued experiments on corrosion and other phenomena. The ACNW also agrees that data are needed on the saturated zone between Yucca Mountain and Amargosa Valley for the sake of credibility.

ACNW disagrees with the staff's concern about the need for more work on Igneous Activity. The Committee has repeatedly asked the staff for analyses that justify the staff's concerns about volcanic activity as a major component of risk at Yucca Mountain, but has yet to see a detailed justification.

Summary

The Committee was impressed with the PA discussion contained in DOE's VA. The material was very professionally written in terms of both text and graphics. The Committee believes that a great deal of excellent work has been performed on the Yucca Mountain TSPA. Confidence in the results is seriously undermined, however, by TSPA's overwhelming size and complexity. ACNW hopes that the recommendations presented in this letter will assist in improving the credibility and transparency of future safety analyses.

Sincerely,

A handwritten signature in black ink, appearing to read 'B. John Garrick', with a long horizontal flourish extending to the right.

B. John Garrick  
Chairman