NOV 19 1993

Mr. Dwight Shelor, Associate Director for
Systems and Compliance
Office of Civilian Radioactive Waste Management
U.S. Department of Energy, RW 30
1000 Independence Avenue
Washington, DC 20585

Dear Mr. Shelor:

SUBJECT: REVIEW OF U.S. DEPARTMENT OF ENERGY (DOE) STUDY PLAN "ANALYSIS OF WASTE PACKAGE RUPTURE DUE TO TECTONIC PROCESSES AND EVENTS"

On December 23, 1992, DOE transmitted the study plan, "Analysis of Waste Package Rupture Due to Tectonic Processes and Events" (Study Plan 8.3.1.8.2.1) to the U.S. Nuclear Regulatory Commission for review and comment. NRC has completed its review of this document using the Review Plan for NRC Staff Review of DOE Study Plans, Revision 2 (March 10, 1993). The material submitted in the study plan was considered to be consistent, to the extent possible at this time, with the revised NRC-DOE "Level of Detail Agreement and Review Process for Study Plans" (Shelor to Holonich, March 22, 1993).

A major purpose of the review is to identify concerns with studies, tests, or analyses that, if started, could cause significant and irreparable adverse effects on the site, the site characterization program, or the eventual usability of the data for licensing. Such concerns would constitute objections, as that term has been used in earlier NRC staff reviews of DOE's documents related to site characterization (Consultation Draft Site Characterization Plan and the Site Characterization Plan for the Yucca Mountain site). It does not appear that the conduct of the activities described in this study plan will have adverse impacts on repository performance and the review of this study plan identified no objections with any of the activities proposed.

In its letter of transmittal, DOE indicated that the study plan addresses Site Characterization Analysis (SCA) Comments 47, 48, and 59, but did not request closure of those comments. Although the staff believes that progress has been made toward resolution, the staff considers these comments to remain open. The staff's evaluation of how these comments were addressed in this study plan is provided in Enclosure 1.

As part of its study plan review, the NRC staff determines whether or not detailed comments or questions are warranted. The NRC staff's review of the subject study plan has resulted in the identification of seven comments and two questions (Enclosure 2). The enclosed comments and questions will be tracked by the NRC staff as open items similar to SCA comments and questions.

Although the objective of this study plan is to "provide the data necessary for an analysis and assessment of repository performance with respect to the possibility of tectonic processes and events adversely affecting the lifetime of

102.8 WM-11/1 NH16

the waste packages" (Study Plan, Page 6), the plan only considers 10 CFR 60.113 requirements ("anticipated processes and events"). Because this study plan does not appear to consider "unanticipated processes and events," the staff believes it considers only a subset of the concerns related to tectonics and waste package performance (Question 1).

In addition, the study plan appears to use a definition of "substantially complete containment" (SCC) that the staff believes is not acceptable (Comment 1). Although the letter of transmittal of this study plan did not reference SCA Comments 5, 44, and 80, the discussion of (SCC) in the study plan appears to related to these unresolved SCA Comments.

If you have any questions concerning this letter, please contact Charlotte Abrams (301) 504-3403 of my staff.

Sincerely,

Joseph J. Holonich, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

cc: R. Loux, State of Nevada
T. J. Hickey, Nevada Legislative Committee
J. Meder, Nevada Legislative Counsel Bureau
C. Gertz, DOE/NV
M. Murphy, Nye County, NV
M. Baughman, Lincoln County, NV
D. Bechtel, Clark County, NV
D. Weigel, GAO
P. Niedzielski-Eichner, Nye County, NV
B. Mettam, Inyo County, CA
V. Poe, Mineral County, NV
F. Sperry, White Pine County, NV
R. Williams, Lander County, NV
L. Fiorenzi, Eureka County, NV
J. Hoffman, Esmeralda County, NV
C. Schank, Churchill County, NV
L. Bradshaw, Nye County, NV

DISTRIBUTION

CNWRA	NMSS R/F	HLPD R/F	LSS
LPDR	ACNW	PDR	CENTRAL FILE
BJYoungblood, HLWM	JLinehan, HLWM	RBallard, HLGE	MFederline, HLHP
JHolonich, HLPD	On-Site Reps		

OFC	HLPD	HLGE	HLGE	HLGE	HLPD
NAME	CAbrams/dh	JTrapp	KMcConnell	RBallard	JHolonich
DATE	11/02/93	11/02/93	11/04/93	11/19/93	11/ /93

C = COVER E = COVER & ENCLOSURE N = NO COPY

g:\wprupt1 OFFICIAL RECORD COPY

the waste packages" (Study Plan, Page 6), the plan only considers 10 CFR 60.113 requirements ("anticipated processes and events"). Because this study plan does not appear to consider "unanticipated processes and events," the staff believes it considers only a subset of the concerns related to tectonics and waste package performance (Question 1).

In addition, the study plan appears to use a definition of "substantially complete containment" (SCC) that the staff believes is not acceptable (Comment 1). Although the letter of transmittal of this study plan did not reference SCA Comments 5, 44, and 80, the discussion of SCC in the study plan appears to be related to these unresolved SCA Comments.

If you have any questions concerning this letter, please contact Charlotte Abrams (301) 504-3403 of my staff.

Sincerely,

/s/

Joseph J. Holonich, Director
Repository Licensing and Quality Assurance
Project Directorate
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

cc: R. Loux, State of Nevada
T. J. Hickey, Nevada Legislative Committee
J. Meder, Nevada Legislative Counsel Bureau
C. Gertz, DOE/NV
M. Murphy, Nye County, NV
M. Baughman, Lincoln County, NV
D. Bechtel, Clark County, NV
D. Weigel, GAO
P. Niedzielski-Eichner, Nye County, NV
B. Mettam, Inyo County, CA
V. Poe, Mineral County, NV
F. Sperry, White Pine County, NV
R. Williams, Lander County, NV
L. Fiorenzi, Eureka County, NV
J. Hoffman, Esmeralda County, NV
C. Schank, Churchill County, NV
L. Bradshaw, Nye County, NV

DISTRIBUTION

CNWRA	NMSS R/F	HLPD R/F	LSS
LPDR	ACNW	PDR	CENTRAL FILE
BJYoungblood, HLWM	JLinehan, HLWM	RBallard, HLGE	MFederline, HLHP
JHolonich, HLPD	On-Site Reps		

*See previous concurrence

OFC	HLPD	E	HLGE*		HLGE*		HLGE*		HLPD	F
NAME	CAbrams/dh		JTrapp		KMcConnell		RBallard		JHolonich	
DATE	11/19/93		11/02/93		11/02/93		11/19/93		11/22/93	

C = COVER E = COVER & ENCLOSURE N = NO COPY

g:\wprupt1 OFFICIAL RECORD COPY

ENCLOSURE 1

REVIEW OF SCA OPEN ITEMS

Section 8.3.1.8 Overview of the postclosure tectonics program: Description of future tectonic processes and events required by the performance design issues

SCA COMMENT 47

The approach to incorporating data derived in the postclosure tectonics program into an assessment of whether performance issues related to the waste package and engineered barrier system (EBS) requirements 10 CFR 60.113(a) will be met is confusing and may result in inaccurate assessment of performance.

EVALUATION OF THE DOE RESPONSE

In general, Study Plan Section 3.2, Subsection Data input requirements for the analysis supplies the information as to what data are to be collected and what activities will feed into the assessment of the potential for disruption of the waste package and engineered barrier system.

There remains a question as to the relationship of Study Plan 8.3.1.8.2.1 to Study Plan 8.3.1.17.4.12, Activity 8.3.1.17.4.12.3 (Evaluate Tectonic Disruption Sequences), and Study Plan 8.3.4.2.4.3 (Mechanical Attributes of the Waste Package Environment). It appears that there may be a duplication of effort as the tectonic disruptive sequences addressed in Activity 8.3.1.17.4.12.3 should be the same sequences that are derived from Study Plan 8.3.1.8.2.1. In addition, the mechanical attributes of the waste package environment addressed in Study Plan 8.3.4.2.4.3 should be considered under Study Plan 8.3.1.8.2.1. The integration of these activities appears lacking; therefore, the interrelationship of this study plan with the other study plans listed needs to be better defined.

The NRC staff considers this comment still open due to apparent problems with integration.

Section 8.3.1.8	Overview of the postclosure tectonics program: Description of future tectonic processes and events required by the performance design issues
Section 8.3.1.8.2.1.4	Activity: Assessment of waste package rupture due to faulting
Section 8.3.1.17	Overview of preclosure tectonics: Description of tectonic and igneous events required by performance and design requirements
Table 8.3.1.17-3a	Design and performance parameters related to surface facilities and preclosure fault displacement
Section 8.3.1.17.2	Studies to provide required information on fault displacement that could affect repository design or performance

SCA COMMENT 48

The use of fault slip rates to determine the level of hazard posed to repository facilities by faults does not appear to be a conservative approach and may result in overly optimistic predictions about the effects of faulting on system performance.

EVALUATION OF THE DOE RESPONSE

This comment is primarily concerned with the use of slip rate calculations to determine the hazard of disruption of the waste packages and engineered barrier system.

On page 19 of Study Plan 8.3.1.8.2.1, it is recognized that there is uncertainty in projecting known faults, detecting new faults, determining if Quaternary offset has occurred along the various known faults, and determining if new faulting might occur during the period of performance. The staff does not consider that DOE has demonstrated that these various sources of uncertainty can be adequately assessed by using slip rate calculations.

As has been stated in Stock and others (1985), stress measurements at Yucca Mountain indicate that favorably oriented faults are in a state of incipient failure. The approach outlined within Study Plan 8.3.1.8.2.1 does not explain how this information will be factored into the analysis of the probability of displacement, along with the slip rate data.

It has not been demonstrated that displacements of less than 5 cm will not affect the canister performance.

There is no indication that the effects of repository thermal loading will be considered in the analysis.

The staff considers that the methodology proposed within this study plan may provide overly optimistic predictions of the effects of faulting on repository performance.

The staff considers this comment still open.

REFERENCES:

Stock, J.M., J.H. Healy, S.H. Hickman, and M.D. Zoback, 1985, Hydraulic fracturing stress measurements at Yucca Mountain, Nevada, and relationship to the regional stress field: Journal of Geophysics Research, Vol. 90, pp. 8691-8706.

REVIEW OF SCA OPEN ITEMS

Section 8.3.1.17 Overview of preclosure tectonics: Description of tectonic and igneous events required by performance and design requirements

SCA COMMENT 59

The information presented for the program of investigations for faulting does not allow the NRC staff to determine what investigations will actually be conducted. In addition, the sequencing of many geophysical and geologic activities related to faulting may lead to data collection activities that are inadequate to support assessments of performance and design bases.

EVALUATION OF THE DOE RESPONSE

This comment is primarily concerned with determination of what actual exploration programs will be conducted and the sequencing of these programs.

Although Study Plan 8.3.1.8.2.1 provides some information on exploration activities from which it will receive input, the study plan provides no actual description of the exploration activities themselves.

The staff notes that Figure 5-1, "Schedule showing planned completion dates of constraining data gathering activities," is out of date.

The staff considers this comment open.

ENCLOSURE 2

Section 2.1.1 Approach

COMMENT 1

The overall goal for the performance measure stated in this section is not consistent with DOE's response to Comment 5 of NRC's Site Characterization Analysis (SCA) and is not consistent with the requirements of 10 CFR 60.113 for substantially complete containment (SCC).

BASIS

In Section 2.1.1 of the Study Plan, DOE stated that "The performance goal for all modes of container failure is divided into two time intervals. The goal for the first 300 years after repository closure is that less than 0.05 percent per year of the total population of emplaced containers will fail. The goal for the interval from 300 to 1,000 years after repository closure is that less than 0.1 percent per year of the total population of emplaced containers will fail (SCP page 8.3.5.9-35)."

In the Site Characterization Plan (SCP), DOE stated its approach to comply with the SCC requirement of 10 CFR 60.113. In Section 8.3.5.9 of the SCP, DOE defined container "failure" (i.e., a breach large enough to allow air flow of .0001 atm-cubic centimeters per second into the container); presented goals for the maximum fraction of containers that "failed" in any given year (i.e., the goal for the first 300 years after repository closure is that less than 0.05 percent per year of the total population of emplaced containers will fail and the goal for the interval from 300 to 1,000 years after repository closure is that less than 0.1 percent per year of the total population of emplaced containers will fail); and presented goals for the annual release of radionuclides from the waste packages (i.e., 1 part in 1,000,000 for certain isotopes and 1 part in 100,000 of the current inventory for all other isotopes). In Section 8.3.5.9 of the SCP, DOE did not present any goal for the maximum cumulative "failures" and noted that "a value for the limit of cumulative failures will be determined as part of the container material studies and will be consistent with regulatory intent." However, in Section 8.3.1.8 of the SCP, DOE stated the overall goal for the cumulative failures was less than 5 percent in 300 years and less than 20 percent in 1,000 years and cross-referenced Section 8.3.5.9 of the SCP as the source of this goal.

In Comments 5, 44, and 80 of the SCA, NRC expressed reservations that DOE's goals in the SCP were not consistent with the SCC requirement, 60.113(a)(1)(ii)(A).

In its response to SCA Comment 5, DOE indicated that to satisfy the SCP radionuclide release goals, "breach during the containment period would be limited to 0.01% of the containers". In its response to the SCA Comment 44, DOE indicated that the goal stated in Section 8.3.1.8 of the SCP for the cumulative failures was in error and that Section 8.3.5.9 gave the overall design objective for the waste package program. In its response to SCA Comment 80, DOE discussed the basis for its radionuclide release rate goals for the containment period.

RECOMMENDATION

Reexamine the performance goals stated in Section 2.1.1 to assure that they are consistent with the requirements of 10 CFR 60.

REFERENCES:

DOE, 1988, Site Characterization Plan, Yucca Mountain Site, Nevada Research and Development Area, Nevada: U.S. Department of Energy DOE/RW-0199.

DOE, 1990, Responses to Nuclear Regulatory Commission (NRC) Site Characterization Analysis: U.S. Department of Energy, YMP/90-107.

NRC, 1989, NRC Staff Site Characterization Analysis of the Department of Energy's Site Characterization Plan, Yucca Mountain Site, Nevada: U.S. Nuclear Regulatory Commission, NUREG-1347.

Section 2.2.1 Activity 8.3.1.8.2.1.1 - Igneous Intrusion

Section 3.1 Activity 8.3.1.8.2.1.1 - Igneous Intrusion

COMMENT 2

The initiating event considered in this activity represents an incomplete description of magmatic events and, therefore, does not provide a suitable basis for determining compliance with the performance objectives.

BASIS

This comment reflects outstanding open items (Comments 1, 4, and 8) related to Study Plan 8.3.1.8.1.1. The concern that magmatic investigations were not considering a complete set of processes and events was raised during the review of Study Plan 8.3.1.8.1.1 in Comments 1, 4, and 8 (NRC, 1992). Comment 8 also raised concerns with the calculational methodology and the proposed use of the "disruption parameter." These comments related to Study 8.3.1.8.1.1 have not yet been resolved.

In Section 2.2.1 it is stated that the event being considered "... is similar to the one considered in investigation 8.3.1.8.1, but assumes that basaltic dikes or sills that might penetrate the repository do not feed a volcanic vent and do not directly result in releases at the ground surface." It is therefore recognized that the event being considered is only a subset of all events involving dikes or sills that might penetrate the repository.

As the objective of study 8.3.1.8.2.1 is to determine if the waste packages will be disrupted by tectonic activity, it makes no difference whether the igneous feature comes to the surface or not, but only whether such a feature could disrupt the waste package. The design and the analysis for 10 CFR 60.113 must consider a complete and comprehensive list of processes and events, not a subset.

In Section 3.1 it is stated that the principle source of information for this activity would come from Studies 8.3.1.8.1.1 and 8.3.1.8.1.2, and that the probability of an intrusion occurring will be derived from the probabilistic volcanic hazard analysis performed in Study 8.3.1.8.1.1.

RECOMMENDATION

Demonstrate how all relevant processes and events will be considered for the various design and performance requirements.

REFERENCES:

NRC, 1992, Letter from Joseph J. Holonich, NRC, to John P. Roberts, DOE, Subject: Results of the U.S. Nuclear Regulatory Commission Staff Review of Study Plan For Probability of Magmatic Disruption of the Repository.

Section 2.2.2 Activities 8.3.1.8.2.1.2, 8.3.1.8.2.1.3, and 8.3.1.8.2.1.4 - Faulting

COMMENT 3

The 5 cm performance parameter for faulting does not appear justified as it does not consider the effects on the waste package of secondary damage to the rock mass from fault events.

BASIS

Section 2.2.2 states that a value of 5 cm was selected as the performance parameter at which fault movement becomes significant over a 1,000 year-period, because, at this value, it is anticipated that the 7.6 cm air gap around the waste package would be partially closed and any additional displacement might result in an undesirable reduction of the air gap or possible waste package failure.

In Section 2.2.3 (Activity 8.3.1.8.2.1.5), it is recognized that earthquake induced ground motion occurring during the postclosure period could cause spalling or failure of the underground workings that could result in corrosion or mechanical failure of the waste package due to closure of the surrounding air gap or movement of the waste package in the emplacement hole.

Although there is the possibility of aseismic creep, earthquakes are caused by displacement along fault planes. Even along fault planes which may have total displacement less than 5 cm, there is normally earthquake ground motion. There appears to be no basis, therefore, for assuming that a displacement of a fault less than 5 cm will cause no undesirable reaction of the rock mass including spalling, raveling of the rock, and closure of the emplacement borehole.

It is recognized that there are two different failure mechanisms which could operate through faulting: 1) direct failure by shear and 2) indirect failure resulting from modification of the air gap. Modification of the air gap, no matter what the actual magnitude of direct fault movement, should be considered in performance assessment and design.

RECOMMENDATION

The design and performance assessment of the waste package should consider the effects of fault displacement less than 5 cm.

Section 2.2.2	Activities 8.3.1.8.2.1.2, 8.3.1.8.2.1.3, and 8.3.1.8.2.1.4 - Faulting
Section 2.2.3	Activity 8.3.1.8.2.5 - Ground Motion
Section 2.2.4	Activities 8.3.1.8.2.1.6 and 8.3.1.8.2.1.7 - Folding
Section 3.2	Activities 8.3.1.8.2.1.2, 8.3.1.8.2.1.3, and 8.3.1.8.2.1.4 - Faulting
Section 3.3	Activity 8.3.1.8.2.5 - Ground Motion
Section 3.4	Activities 8.3.1.8.2.1.6 and 8.3.1.8.2.1.7 - Folding

COMMENT 4

Calculations of the probability of faulting, ground motion, or folding in a repository should consider the effect of change in the stress field from repository induced loading.

BASIS

The definition of anticipated processes and events requires consideration of the perturbations caused by the presence of emplaced radioactive waste.

One of the major perturbations that should be considered for analysis of potential faulting, ground motion, and folding is the change in the stress field around the repository due to thermal loading.

This study plan contains no indication that these effects will be considered in the analysis of probability and effects of faulting, ground motion, and folding.

RECOMMENDATION

Demonstrate that the effects of repository induced loading, and the interrelationship of this loading to faulting, vibratory ground motion, and folding, have been considered in both the repository design and analysis of waste package failure.

Section 3.1 Activity 8.3.1.8.2.1.1 - Igneous Intrusion

COMMENT 5

The methodology used by Link and others (1982) appears to provide too simplistic a description of the dike emplacement process to adequately evaluate the potential disruption of the repository.

BASIS

The work of Link and others (1982) assumed that dike emplacement could be represented by a straight line intersecting a repository.

Work by the State of Nevada in Crater Flat (Smith and others, 1990) suggests that the disruption pattern is much more complex than a straight line.

Previous work in areas such as Pahute Mesa and Piaute Ridge, as described in Crowe (1990), also suggests that the straight line representation is overly simplistic.

The NRC staff notes, however, that the information presented within Link and others (1982) stated that under certain conditions up to 448 canisters could be contacted. The 8-9 value quoted within the text of this section is the average value from the Link report.

It is unclear from review of this study plan, or from review of study plan 8.3.1.8.1.1, how the area of the repository or the number of waste packages that could be affected would be simulated. The use of procedures such as that shown by Link and others (1982), appears to be insufficient as there is no indication that such representation adequately reflects the igneous processes in the area of the site.

RECOMMENDATION

Models that more accurately represent the geologic processes in the area of the site should be used in the analyses of waste package performance. In addition, when the effects of these processes are presented they should include the range in values, not just the average values.

REFERENCES

Crowe, B. M., 1990, Basaltic volcanic episodes of the Yucca Mountain region: Proceedings of the International Conference on High-Level Radioactive Waste Management, Las Vegas, Nevada, April 1990.

Link, R.L., Logan, S.E., Ng, H.S., Rockenbach, F.A., and Hong, K.J., 1982, Parametric studies of radiological consequences of basaltic volcanism: SAND81-2375, Sandia National Laboratories, Albuquerque, New Mexico.

Smith, E.I., Feuerbach, D.L., Nauman, T.R., and Faulds, J.E., 1990, The area of most recent volcanism near Yucca Mountain, Nevada: implications of volcanic risk assessment: Proceedings of the International Conference on High Level Radioactive Waste Management, Las Vegas, Nevada, April, 1990.

Section 3.2 Activities 8.3.1.8.2.1.2, 8.3.1.8.2.1.3, and 8.3.1.8.2.1.4 - Faulting

COMMENT 6

The study appears to not consider a full range of alternative methods for calculation of fault displacement hazard.

BASIS

Ongoing work by DOE (Spengler, 1992) demonstrates that the Ghost Dance fault in the Yucca Mountain area is best characterized by a complex zone over 600 feet wide, not by a simple, single fault strand.

On Page 21, it is suggested that analysis for fault hazard would be similar to that previously conducted by Subramanian (1989).

Although Link and others (1982) conducted a simplified calculation for a similar problem, the calculation by Link assumed a narrow dike which would equate to a narrow fault zone. Performing a similar calculation, with all assumptions the same except with a fault width of 600 feet, a much larger number of canisters would be at risk. Although it is unlikely that all canisters in such a fault zone would be contacted in a single event, the 8-9 average quoted on Page 22 is considered overly optimistic as that number does not appear to based on an accurate representation of geologic conditions at Yucca Mountain.

Although it is too early to judge the ability to detect faulting in the underground openings, the Subramanian methodology appears to be highly dependent on the ability to detect faults and assign a slip rate to these faults. As is pointed out in this section of the study plan, this information may be hard to obtain at the Yucca Mountain site. In addition, the NRC has expressed concerns previously (SCA Comment 48) on the use of slip rates in determining faulting hazard.

Methods in addition to those proposed should be investigated. For example, Coppersmith (1992) has used a methodology that has both similarities to an differences from the procedures used by Subramanian. This and other methods, should be evaluated to determine if they provide a better representation of the fault displacement hazard at Yucca Mountain.

RECOMMENDATION

In addition to the methodologies proposed within this study plan, alternative methodologies should be examined to evaluate faulting hazard at Yucca Mountain.

REFERENCES

Coppersmith, K.J., 1992, Seismic hazard studies for the Electric Power Research Institute, High-Level Waste Project: Presentation to the U.S. Nuclear Waste Technical Review Board Panel on Structural Geology and Geoengineering, January 22-23, 1992, Irvine, California.

Link, R.L., Logan, S.E., Ng, H.S., Rockenback, F.A., and Hong, K.J., 1982, Parametric studies of radiological consequences of basaltic volcanism: SAND81-2375, Sandia National Laboratories, Albuquerque, New Mexico.

NRC, 1989, NRC staff site characterization analysis of the Department of Energy's Site Characterization Plan, Yucca Mountain Site, Nevada: U.S. Nuclear Regulatory Commission, NUREG-1347.

Spengler, R., 1992, Recently acquired structural information along the Ghost Dance fault, in Trip Report for Midway Valley Site Visit - September 17 and 18, 1992: U.S. Nuclear Regulatory Commission memorandum from K.I. McConnell to R.L. Ballard, November 9, 1992.

Subramanian, C.V., Abrahamson, N., Hadjian, A.H., Jardine, L.J., Kemp, J.B., Kiciman, O.K., Ma, C.W., King, J., Andrews, W., and Kennedy, R.P., 1989, Preliminary seismic design cost-benefit assessment of the tuff repository waste handling facilities: SAND88-1600, Sandia National Laboratories, Albuquerque, New Mexico.

Section 1.3 Objective of the Study

Section 1.4 Regulatory Rationale and Justification

QUESTION 1

Investigation 8.3.1.8.2, of which this study is a part, does not appear to completely address the possible effects on the waste package from tectonic processes and events. What study plan will provide a complete set of the tectonic processes and events needed to be assessed for the design and analysis of waste package performance?

BASIS

The objective of the study, as stated in Section 1.3, is to provide the data necessary for an analysis and assessment of repository performance with respect to the possibility to tectonic processes and events adversely affecting the lifetime of the waste package by rupture or unacceptable deformation.

The goal of the activities, as stated in Section 1.4, is to provide information on those tectonic processes and events that should be considered "anticipated."

Although it is true that 10 CFR 60.113 requires analysis for anticipated processes and events, 10 CFR 60.112 requires analysis of the performance of the total system under both anticipated processes and events and unanticipated processes and events. In this total system analysis the possibility of tectonic processes and events adversely affecting the lifetime of the waste package by rupturing or unacceptable deformation, thus providing an accessible source term for flow and transport, must be considered.

The design of the waste package and engineered barrier system must consider, not only anticipated processes and events, but unanticipated processes and events, as well as such things as the design criteria of 10 CFR 60.130 - 135. Figure 8.3.1.8-4 (SCP Page 8.3.1.8-65) does not clearly demonstrate how unanticipated tectonic processes and events will be addressed in considering the effects on the waste package.

The staff notes that the objective of Activity 8.3.1.17.4.12.3 is to "... evaluate disruptive sequences involving faulting, folding, uplift, and subsidence, and volcanism that are of potential significance to design or performance of the repository" (SCP, Page 8.3.1.17-205). It appears that the information regarding tectonic processes and vents necessary to resolve all design and performance issues may be available from Activity 8.3.1.17.4.12.3.

RECOMMENDATION

Either modify this study such that both anticipated processes and events and unanticipated processes and events are considered, as necessary, in both the design and analysis, or identify in what other study plan such processes and events will be considered.

DOE, 1988, Site characterization plan, Yucca Mountain site, Nevada Research and Development Area, Nevada: U.S. Department of Energy, DOE/RW-0199.

Section 3.1 Activity 8.3.1.8.2.1.1 - Igneous Intrusion

QUESTION 2

In which study plan will the potential chemical effects associated with magmatic intrusion be considered?

BASIS

On Page 17 it is stated that the assessment will consider both the mechanical and thermal effects of an intrusion. There is no mention of the assessment of potential chemical effects.

During a magmatic intrusion, in addition to the corrosive effects of the magma itself, fluids can be introduced which would affect the rock mass, the waste package, and the engineered barrier system. The introduction of such fluids could have a significant effect on both design and performance.

RECOMMENDATION

Indicate in which study plan chemical effects from igneous intrusion will be addressed.

Section 2.2.3 Activity 8.3.1.8.2.1.5 - Ground Motion

Section 3.3 Activity 8.3.1.8.2.1.5 - Ground Motion

QUESTION 3

What is the magnitude range that will be considered for the multiple events that may cause failure to the corroded canister?

BASIS

On Page 31, Paragraph 4, it is stated, "Consideration of multiple seismic events may be a significant factor if these suggestions are implemented."

It is uncertain what the lower magnitude cut-off value will be in the analysis. The methodology must consider a sufficient range of multiple, low magnitude events to address performance concerns.

RECOMMENDATION

The type of analysis and the magnitude range used for the analysis should be provided.