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MAR 2 9 1985

PJ/85/03/25

MEMORANDUM FOR THE RECORD

FROM: Philip S. Justus, Section Leader
Geology-Geophysics Section
Geotechnical Branch
Division of Waste Management, NMSS

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT COMMENTS ON YUCCA MOUNTAIN CONCURRED ON BY BEN RICE

On Friday, March 15, Ben Rice concurred on a major and detailed comment package that he prepared in response to DOE's Yucca Mountain site draft Environmental Assessment. We worked on this together. In the March 20th revision of these geology comments on the Yucca Mountain draft EA, I referred to Mr. Rice's "previous concurrence." The attachment to this memorandum is Mr. Rice's "previous concurrence", the March 15th package, transmitted to the file herewith.

/s/

Philip S. Justus, Section Leader
Geology-Geophysics Section
Geotechnical Branch
Division of Waste Management, NMSS

Enclosure:
As stated

WM Record File 102.5
WM Project 11
Docket No.
PDR ✓
LPDR ✓
Distribution:
(Return to WM, 623-SS)

OFC	WMGT					
NAME	PJustus				1025/3	
DATE	85/03/29					

623

Specific Comments

An expanded discussion of the five basic premises regarding use of the unsaturated zone at Yucca Mountain is needed. This discussion should include: (1) a discussion of characteristics of the Paint Brush Tuff that make it a major buffer diverting recharge away from the Topopah Spring; (2) a discussion of potential increase in flux through the Toponah Spring assuming future pluvial climate; the magnitude of reduction in residence time with credible flux increases; (3) a discussion of the requirement for free drainage as a required condition for use of the unsaturated zone—this discussion should stress that the natural drainage (through fractures in the Toponah Spring) limits the time available for waste dissolution should fracture flow ever occur, (4) and a discussion of possible perching of ground water on the Calico Hills unit and its potential effect on a repository.

Throughout the EA the authors go to great lengths to explain why the ground water adjacent to the site is not likely to be used for irrigation. Yet, no one can rule out future use for village or town water supply. However, since ground-water travel time from the repository to the accessible environment is not the major "safety feature" of this site, why not acknowledge that the water may well be used, but that radiological safety is still assured by the combination of: (a) low flux; (b) low solubility of waste and of nuclides; (c) engineered barriers; (d) sorption; and (e) dilution of vadose flow by water in the zone of saturation.

Page 7 - The proposed nuclear waste repository site is several miles from Death Valley National Monument. Therefore, based on present information, we believe that there is little potential for adverse impact to Death Valley should a repository be located at Yucca Mountain. However, we will continue to monitor developments relative to this site to insure that Death Valley receives adequate consideration and protection.

Page 7, paragraph 2 - Under THE SITE, states that "...as shown in Figure 3, the rocks in the province can be divided into four groups...." Figure 3 does not show this. The four groups are not shown until figure 2-3 appears. Figure 3 should be revised to be compatible with the text.

Page 12, paragraph 1 of the Executive Summary contains the following statement "An archeologist will supervise the collection of artifacts in the areas directly affected by site-characterization activities and where sites cannot be avoided or adequately protected." Indicate by what authority this will be done and whether the State Historic Preservation Officer (SHPO) has been consulted and has agreed to mitigation procedures.

Page 15, 6.2, Summary of site evaluations against postclosure guidelines.

The statement that the climate in the region has not changed in the last 2 million years is incorrect and any assumptions made on that point are suspect.

Page 2-5, section 2.1 Regional Setting of Yucca Mountain - It is stated in the EA that the Yucca Mountain site is in the Alkai Flat-Furnace Creek Ranch ground-water basin at a position midway between the Ash Meadows and Oasis Valley basins. The EA goes on to indicate that the Alkai Flat-Furnace Creek Ranch basin discharges at seeps in Alkali Flat and possibly at springs in Death Valley. The EA should specifically address how such springs relate to Death Valley National Monument.

Page 2-14 - 1,500 meters (m) to 1,600 m = 4,920 ft to 5,250 ft, not 5,000 ft to 5,300 ft.

Page 2-14 - An estimated depth of 1,500 m to 1,600 m to the top of the granite did not come from Snyder and Oliver (1981) who say (p. 1) "...the existence of relatively high or low density intrusive body in these rocks cannot be confirmed or denied." The reevaluation mentioned in the EA was made elsewhere than in the 1981 report.

Page 2-15, line 2 - First exploratory hole was actually drilled to 2501 ft (762 m) (Spengler et al., 1979, p. 1) the statement, "...drilled more than 600 m (2000 ft) deep," is inadequate.

Page 3-5, section 3.2.1, paragraph 1 Change line 13 to: "...at a depth of about 1,250 m (4102 ft) in drill hole UE-25 P#1 (figure 6-2) about 25 km (1.5 mi) east of the Yucca Mountain area." Delete following sentence listing 3,000 m (10,000 ft) depth.

Page 3-5 - Possible heat-induced dehydration of zeolite is not mentioned. This could affect the site rating. For the salt sites, thermally induced brine migraton must be a concern, but is not mentioned.

Page 3-12, paragraph 2, last sentence - Change to "...three drill holes (USWG-1, USWG-S, and USWH-1) have been drilled to 1,829 m (6,000 ft) without reaching the base of the volcanic rocks."

Page 3-20 - The ground-water flow analysis is based on a very low rate of infiltration. The final EA should address the potential effects of higher infiltration rates on ground-water flow times.

Page 3-24, paragraph 1, last line - Change "east" to "west."

Page 3-26, section 3.3.1, paragraph 1, Surface Water - The statement that annual precipitation averages about one third of the potential evapotranspiration is incorrect. Annual precipitation may be about 0.5 ft, and potential evapotranspiration is between 6 and 8 ft per year. The ratio would be closer to one tenth.

Page 3-27, paragraph 1, figure 3-11 - Add (town) beneath AMARGOSA VALLEY, use open headed arrows to contrast with water flow arrows.

Page 3-30, paragraph 2 - First two sentences contain an incorrect statement. Yucca Mountain was not placed within the Ash Meadows ground-water basin by Ike Winograd and Bill Thordarson (1975). Their Plate I clearly shows Yucca Mountain to be 4-6 mi west of the Ash Meadows basin and within their Oasis Valley-Forty Mile Canyon ground-water basin.

Page 3-31 - The comments with regard to groundwater and projected water use do not identify the possible impacts of site development and contamination on the water supply for Ash Meadows National Wildlife Refuge, which is located about 25 miles from the Yucca Site. The refuge supports approximately 20-25 endemic species, many of which are or will be listed as endangered. The water supply for this refuge is a series of springs which are believed to be discharging from the deep carbonate aquifer. The adjacent Devils Hole National Monument, which was established to protect the Devils Hole pupfish, is believed to be connected to the same deep carbonate water source. These water sources could be impacted by site testing development.

We have conducted studies of the deep carbonate aquifer as a water source for southern Nevada. ("Deep Carbonate Aquifer Study, Special Report," September 1984, Bureau of Reclamation, Lower Colorado Region.) Underground aquifer data is very limited; and definitive conclusions on connected groundwater reservoirs are difficult to draw. Studies to date are more a survey of what is not known than what is known. Because of the uncertainties on this extensive groundwater system, we recommend additional data be acquired on the deep carbonate aquifer as well as overlying and adjacent groundwater systems. Detailed studies are needed for the springs of Ash Meadows National Wildlife

Refuge and any other users or potential users of this segment of the deep carbonate aquifer. In addition, we recommend the Department of Energy initiate consultation in accordance with Section 7 of the Endangered Species Act when this new groundwater data becomes available.

Page 3-31, paragraph 2 - Add after the second sentence as follows: In 1981 estimates from LANDSAT images indicated that about 3,000 acres were being irrigated in the Amargosa Desert south of Amargoa Valley. If an average application of water of about 5 ft is assumed, then irrigation pumpage can be estimated to have been about 15,000 acre-feet in that year. The amount of water used for domestic purposes is not known.

Page 3-41 - The statement that "no plant or animal...is an official candidate for listing under the Endangered Species Act of 1973" is incorrect. Both the Mojave fishhook cactus (Sclerocatus polyancistrus) and the desert tortoise (Gopherus agassizii) were designated as category 2 candidate species in notices of review published in the Federal Register (Vol. 47:5454 and Vol. 48:53640). Category 2 comprises taxa which available information indicates may be appropriate for listing, but for which additional data is needed before such a determination can be made definitively. Information gathered on these species during site investigations as part of the environmental impact process should be made available to the U.S. Fish and Wildlife Service, the Nevada Department of Wildlife, the Bureau of Land Management, etc. Additionally, the Northern Nevada Native Plant Society and the Desert Tortoise Council should be sent appropriate data.

Page 3-47 3.4.5 The project is visible from US 95. The mountains have more aesthetic value than the flat lands. A discussion of visability and view shed analysis would be appropriate.

Page 3-47 - Regarding archeology we cannot provide substantive comment at this time. In order to do so, we require copies of the archeological reports on the Yucca Site. Comments on the adequacy of those documents can be provided within 20-30 days of receipt by the Regional Director, Western Region, National Park Service 450 Golden Gate Avenue, P.O. Box 36063, San Francisco, California 94102 (telephone: FTS 556-4196). Further technical assistance relative to cultural resource matters can also be obtained at this location.

Page 3-47 - The final EA should reference the planning and procedural steps of legislative mandates in the compliance process.

While this page gives a superficial and general summary of what was accomplished in literature review and general survey, the results of the 1984 test excavations are not discussed. The significance of the sites and eligibility for listing on National Register of Historic Places or the eligibility criteria should be presented in the final EA.

Page 3-47 - No consultation with the Nevada State Historic Preservation Officer or the Advisory Council for Historic Preservation is indicated. The EA needs to indicate whether a Memorandum of Agreement (MOA) with the State Historic Preservation Officer been developed and finalized to indicate the compliance actions the Department of Energy intends to take. It would be useful to include such an MOA in the appendices to the final EA.

This page also indicates that "extensive" field surveys have been conducted. The field methodology and intensity of survey should be described in the final EA.

Three bibliographic items (Pippin and Zerga 1983; Pippin et al. 1982; and Pippin 1984) are referenced on this page. However, Pippin and Zerga are not listed in the bibliography. This discrepancy should be resolved in the final EA.

We are told that 178 prehistoric sites have been identified and classified, according to presumed function, into five site types; however, the final EA should mention their significance and which sites may or may not qualify for nomination to the National Register.

Historic resources are not addressed beyond noting that evidences of historic mining, ghost towns, early Mormon settlements, etc. (145 sites) are located outside the NTS or YMTS area.

Page 3-57- Figure 3-20 shows that the proposed railroad line between Dike Siding and Mercury appears to Cross Desert National Wildlife Refuge. This is not consistent with the established refuge objectives, and we recommend that this railroad line be moved out of the refuge to closely parallel Highway 95.

Additional conflicts could occur with identified wilderness study areas on this refuge. Corn Creek Springs, also on the refuge, appears to be in the approximate alignment of this proposed railroad. This spring contains the endangered Pahrump killifish Empetrichthys latos, not identified in this draft EA. Again, this area should be avoided.

Page 4-12, last paragraph - Waste water should not be disposed on or adjacent to Yucca Mountain. Infiltration may seep back into the workings complicating interpretations. All sewage should be disposed far to the east or west of the site.

Page 4-24, 4.2.1.1.3, Land Use - The description of the uses of the public lands should be expanded to actually detail these uses.

Pages 4-29 and 4-30 - Four prehistoric sites are noted in the vicinity of the power line as significant but again there is no discussion about the National Register, eligibility procedures and criteria, or how the opinion of significance was determined.

Page 4-30 - The text states: "Consequently, it was decided that the systematic collection of cultural remains at all four archeological sites would adequately mitigate these potential adverse impacts... Surface collections were conducted during 1984 and a report is being written concerning the findings." The authors of the report should be identified. The final EA should divulge under what consultation/authority the collections were made.

Paragraph 3 indicates that other sites will be avoided or salvaged. The significance of these sites should be described and eligibility determinations be made by the Nevada State Historic Preservation Office.

Consultation with the SHPO and Advisory Council, specified at 36 CFR 800, should be undertaken and the results of the consultation documented in the final EA.

Chapter 5 - We have serious reservations of the impact analysis in this Chapter. To be specific, throughout Chapter 5, impact analysis is generalized and uses general terms of "standard impacts" without any degree of specificity. For example, probable impacts on housing are acknowledged (page 5-99, paragraph 5.4.3.1 without any discussion of the social consequences of anticipated housing shortages. This deficiency is evident throughout Chapter 5. (See discussions on Education, Water Supply, Sewage Treatment,

etc. on page 5-99 to 5-101.) Anticipated generalized impacts are identified but no analysis of impacts has been presented. (This omission should be corrected in the final EA.)

Page 5-10 - The discussion of medical care facilities is considerably less than adequate and totally ignores any possibility of, or discussion of, a major accident involving radioactive waste either at the site or in the adjacent communities. A discussion of what demands this type of accident would place on existing or proposed medical facilities is needed.

More attention needs to be given to the health and safety aspects in terms of impacts on adjacent communities, perhaps a worst case scenario in terms of social consequences is needed. The communities need to be alerted to the full range of impacts in order to make informed, reasoned judgments. Chapter 5 is not of much assistance in this regard except in a very generalized way. Since the document acknowledges in the Summary of Environmental Effects on page 5-110, paragraph 5.5, that "Although all possible effects of locating a repository at Yucca Mountain will be subject to further study should the site be selected for site characterization, Table 5-57 indicates that not enough is presently known about five possible effects to evaluate their potential significance", specifically (3) the effect on cultures and lifestyles, would indicate that to meet NEPA requirements a worst case analysis should be done.

Page 6-66 - 6-72 Environmental Quality (10 CFR 960.5-2-5) - This section of the EA provides an analysis of siting criteria 10 CFR 960.5-2-5(c)(3) (Potentially Adverse Condition) and 10 CFR 960.5-2-5(d)(3) (Disqualifying Condition) which relate to environmental impacts of the repository and protection of components of the National Park System. With respect to Death Valley National Monument, the analyses in the EA are limited strictly to the impact of increased use of the Monument by construction workers and employees of the repository. Based on the regional ground-water flow pattern and the possibility of ground-water flow from the repository area to springs in Death Valley (see pages 2-5 and 3-28), the EA should address potential impacts to the resources of Death Valley National Monument if an accidental release of radionuclides from the repository to the regional ground-water system was to occur.

Page 6-72, 1st paragraph - Devils Hole is a warm spring not a hot spring.

Page 6-115, Table 6-15 -Department of Energy finding for ii should begin: "...Hydraulic gradient is downward...."

Page 6-123, paragraph 3, last sentence -Since the Paintbrush nonwelded unit is highly friable, the likelihood of open fractures forming (to permit increased flux) is highly unlikely, in any event.

Page 6-129, paragraph 1, lines 12-17 - Some confusion exists here. The sentence beginning on line 2 discusses movement along the Tiva Canyon-Paintbrush nonwelded unit, while the second sentence jumps to the Paintbrush nonwelded unit-Topopah Spring contact. We believe some text has been omitted.

Page 6-131 - Change "130 m (7,700 ft)" to "130 m (427 ft)."

Page 6-134, paragraph 1, sentence 1 - Even though the alluvium is coarse grained and "undesirable for agricultural use," the EA should not rule out future use of the water for a townsite.

Page 6-136 - Change "0.2 millimeter per year (mm/yr) (0.05 inch per year (in./yr))" to ".02 mm/yr (.008 in./yr)."

Page 6-140, paragraph 1, Evaluation - "Small changes in water table." The rise of 130 m (427 ft) computed by John Czarneck (paragraph 2, line 9) is not a "small" change.

Page 6-163, Table 6-24 - If the solubility of these elements is temperature dependent, the temperatures that correspond with these values should be shown.

Page 6-181 - Coefficient of thermal expansions of welded turf is not "...low when compared with values for other common rock types." Excepting salt, welded tuff is the highest of the six rock types listed in table 6-27. Suggest "The values for the thermal conductivity and the coefficient of thermal expansion of welded tuff are comparable with those of other common rock types, save for salt. Salt, in contrast, has both a higher thermal conductivity and a much higher coefficient of thermal expansion."

Page 6-174 - Potentially adverse condition no. 2—Is it established that there is no need to worry about dehydration of zeolite in tuff at the Nevada Test Site (NTS)?

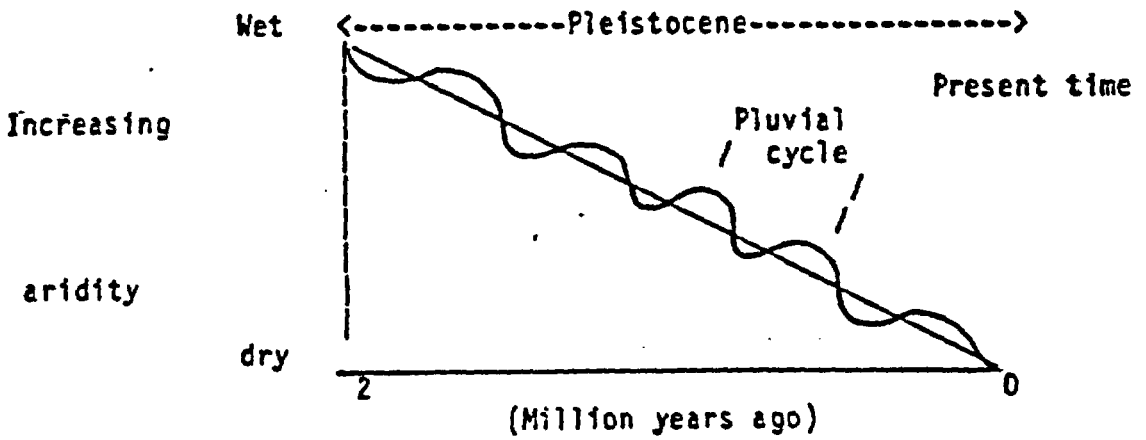
Page 6-182, Conclusion - Change to: "The coefficient of thermal expansion and the thermal conductivity are intermediate...."

Page 6-189, paragraph 2, lines 13-15 - Shouldn't line 15 read "resulting in an increase in travel time?" (Now reads "decrease.")

Page 6-196, paragraph 1, lines 6-8 - Change "...evidence of older lakes at higher elevations" to "evidence of older lake shorelines at higher elevations."

Page 6-196, paragraph 1, complete - Change the two references to "Winograd and Doty (1980)," to "Winograd and others (1985)." While the reference to "Winograd and Doty (1980)" is correct elsewhere in the EA, in this paragraph it is incorrect. That is, "Winograd and Doty (1980)," do not discuss uplift of the Sierras as responsible for increasing aridity during the Quaternary; but, "Winograd and others (1985)" indeed do so. The new reference is: Winograd, I. J.; Szabo, B. J.; Coplen, T. B.; Riggs, A. C.; and Kolesar, P. T.; 1985, Two-million-year record of deuterium depletion in Great Basin ground waters: Science, v. 227, pp. 519-522.

Same paragraph, last two sentences—No contradiction is present. "Winograd and others (1985)" are talking about a long term of increasing aridity through the Quaternary, whilst the Lahonton record is simply one of superimposed pluvials. See sketch.



Paragraph 3, line 6 - Change to "6 to 7°C (11-13°F)."

Page 6-200, last full paragraph - This paragraph warrants an illustration to clarify the spatial relationship. Furthermore, the relationship of geological evidence on water table stands (presence of vitric pumice 120 to 250 meters above the present water table) and hydrologic (mathematical) calculations (130 m. above the present water table) should be the fully discussed. The two types of approaches should be compared and evaluated in the discussion.

Page 6-214, paragraph 1, lines 3-5 - Delete sentence—no reason to expect such a result.

Page 6-224, paragraph 2, lines 4-6 - Change to: "there is suggestive evidence that...surface faulting may have accompanied the volcanism."

Page 6-225, line 2 - 150 km inaccurate. Rogers et al., 1977, table 1, p. 1589, lists a distance of 145 km to Owens Valley from the site (36°50'N, 116° 14.5'W). The site is 19 km east of the repository site (Exploratory shaft site used as ground zero).

Page 6-226, Evaluation, line 5 - The intermountain Seismic Zone, as shown on figure 3-9 (p. 3-20 of EA) is at least 300 km (185 mi) easterly from the repository site not 240 km (150 mi) as stated here.

Page 6-226, lines 8-10 - Owens Valley earthquake here said to be in Nevada Seismic Zone which is stated to be 160 km (100 mi) west of the site (line 4). Our comment on p. 6-225 showed that by Rogers' 1977 report the Owens Valley quake was about 126 km westerly from site, not the 150 km shown on p. 6-225. In addition Rogers' 1977 report lists a magnitude of 8.5 (table 1) for the Owens Valley quake, rather than the smaller generalized magnitude listed on p. 6-226.

Page 6-230, paragraph 1, lines 7-8 - Delete phrase "...and probably do not retain fault scarps for more than 1 to 2 million years." (See next comment for rationale.)

Page 6-232, paragraph 2 - Delete paragraph. This material was deleted from Carr's manuscript on regional structural setting of Yucca Mountain (now published as USGS Open-File Report 84-854) and should not be used in the EA.

In brief, the basis for the recurrence interval used in paragraph 2 is not defensible. It is based on a petrographic correlation of a basalt ash found in one of the fault zones exposed in a fault trench with a 1.1 million years basalt cinder cone dated by K-Ar. The correlation, by Bruce Crowe, has recently been disavowed by him. Saying he cannot tell whether the trench ash is the 1.1 million years basalt or a 0.24 million years basalt (which means that the trench ash may not correlate with either of these dated basalts). Beyond this, it is not at all clear that the age of the ash, whatever it may be, yields the age of last faulting, or any faulting. However, the 1.1 million years age was accepted as the basis of indirect geologic reasoning, thus permitting the conclusion that scarps can be preserved for 1.1 or 1.2 million years.

From this it is assumed in paragraph 2 that the 135 scarps represent all the magnitude 6.5+ or greater earthquakes in the last million years in the 100 km radius region. It has been agreed that the USGS should not try to defend this thesis. (The above reasoning explains the rationale for deleting the statement about 1 to 2 million years old fault scarps on p. 6-230).

Page 6-233, paragraph 4, lines 6-7 - Delete statement of earthquake probability. See comments on p. 6-232 for justification.

Page 6-234, paragraph 4, lines 5-6 - Change to: "three major earthquakes have occurred historically within 210 km (130 mi) of the site." (See p. 6-225 for data.)

Page 6-236, paragraph 2, lines 1-2 - Add (Lipman and McKay, 1965).

Page 6-237, Table 6-34, column 2, last paragraph Potentially Adverse Conditions - While "There is no credible potential for the use of water resources for agriculture...." there is the potential for use of this water for future townsites. Further qualification is in order for the area immediately east of Yucca Mountain. (See General Comments.)

Page 6-242, lines 3-6 - Again, the potential exists for municipal use of water immediately east of Yucca Mountain.

Page 6-243, Evaluation 2 - It does not matter what future pumping in Jackass Flats might or might not do, because in the "safety analysis" the saturated zone plays a minor role. Either the unsaturated zone provides adequate protection or the site is unsuitable.

Page 6-256, paragraph 1, line 2 - Add (Christiansen and Lipman, 1965).

Page 6-283 - Possible igneous activities should be mentioned.

Page 6-286, paragraph 3, last 3 lines - Personal communication should probably be attributed to A. M. Rogers.

Page 6-288, paragraph 2, lines 6-8 - Personal communication should agree with that listed above on p. 6-286.

Page 6-289, paragraph 5, lines 14-18 - Delete two sentences on return periods based on fault scarp data.

102.5

Encl. to memo to Record from Gustavson - 3/29/85

YUCCA MOUNTAIN MAJOR COMMENTS

COMMENT 1 -- FAULT ACTIVITY

Guideline on Tectonics (10 CFR 960.4-2-7): (d) Disqualifying Condition

Guideline on Preclosure Tectonics (10 CFR 960.5-2-11): (a) Qualifying Condition, (b) Favorable Condition; (c) Potentially Adverse Conditions 2, 3

The preclosure and postclosure tectonics guidelines (960.5-2-11 and 960.4-2-7, respectively) require that the nature and rates of tectonic processes, such as faulting, be evaluated for their impacts on repository construction, operation and performance. In the evaluation of faulting and the potential for ground motion due to seismicity at Yucca Mountain, the DOE has made the unsupported assumption that active faulting is not present at Yucca Mountain. The DOE has utilized this assumption in its findings on 960.4-2-7(d), that the evidence does not support disqualification of the site on the basis of likely loss of waste isolation due to fault movement related to ground motion; and in its findings on 960.5-2-11(c)(2 and 3), that potentially adverse conditions related to the possibilities of ground motion in excess of reasonable design limits or of higher magnitude earthquakes than predicted from historical seismicity are not present.

RJR

To assess the potential for future fault activity at Yucca Mountain, an analysis of the local stress environment and its relationship to the regional tectonics is necessary (see comment 3-5). The DOE has incorporated an analysis of data from DOE investigators (Carr, 1984) on regional tectonics into their assessment of Yucca Mountain fault activity. From this, the DOE finds that "At present, a preliminary conclusion can be made that the north-trending faults at Yucca Mountain should be considered potentially active (emphasis added) even though the absence of fault scarps and the near absence of seismic activity suggest that they are not active." (page 6-226, 2nd paragraph) (see comment 6-126). The NRC is concerned because the DOE makes findings "Under the assumption that the Yucca Mountain faults are not active,..."(emphasis added) (pages 3-21, paragraph 2; 6-231, paragraph 4; 6-286, paragraph 2; 6-288, paragraph 3; and 6-289, paragraph 3).

The potential for future activity of faults at Yucca Mountain should be the basis of estimates of seismic activity and associated ground motion at the site. Ground motion estimates are needed in the evaluation of the preclosure tectonic guidelines 960.5-2-11(a); 960.5-2-11(b); 960.5-2-11(c)(1), (2), and (3); and the postclosure tectonic guideline 960.4-2-7(d). The DOE has provided

values for maximum ground acceleration at the Yucca Mountain site on the order of 0.4g assuming the Yucca Mountain faults are inactive. If the faults at Yucca Mountain are assumed to be active, then the maximum expected ground acceleration would be significantly higher than 0.4g (see comment 6-151). This may have an impact on some of the findings under those guidelines that require ground motion estimates.

The DOE should consider whether the assumption that Yucca Mountain faults are inactive is warranted or conservative in light of the presently available data and to incorporate those considerations into a re-evaluation of the findings with respect to guidelines 960.4-2-7(d), 960.5-2-11(c)(2 and 3), and other guidelines mentioned above as appropriate.

COMMENT 2 -- VOLCANISM/HYDROTHERMAL ACTIVITY

Guideline on Tectonics (10 CFR 960.4-2-7): (b) Favorable Condition

To make a finding with regard to Guideline 960.4-2-7(b) requires that the probability for disruption of the repository by igneous intrusion and associated hydrothermal activity be estimated for the 10,000 year post-closure period. The mean probability estimate presented in the draft EA is not supported by the information provided in the draft EA or in the supporting references. Furthermore, the determination does not take into account geologic controls, such as fault zones, and the potential for hydrothermal activity.

The favorable condition under 960.4-2-7 requires that there be less than one chance in 10,000 (1.0×10^{-4}) of releases of radionuclides to the accessible environment due to igneous activity over the first 10,000 years after closure. In the draft EA (page 6-222, paragraph 3) and the supporting reference (Crowe et al, 1982) the range of probabilities for basaltic eruptions at Yucca Mountain for a 10,000 year period is given as 3.3×10^{-6} to 4.7×10^{-4}. The DOE concludes that "the mean value of this range is less than one chance in 10,000 over the next 10,000 years" but does not provide the mean value or how it was determined. In the absence of such information, and considering that the range of probabilities provided in the draft EA extends to as high as 4.7×10^{-4} chances in 10,000 of volcanic eruptions in the next 10,000 years, it appears that the favorable condition may not be met at Yucca Mountain.

In addition, DOE investigators (Crowe et al, 1982) state that their values are solely statistical and do not incorporate geologic controls such as fault zones

(preferential pathways). The draft EA fails to discuss these limitations or to factor such considerations into its probability estimates.

The probability of hydrothermal activity, which is often associated with volcanic activity is also not considered in the draft EA. There are several lines of evidence that suggest hydrothermal systems have existed and may possibly still exist in the Yucca Mountain region: elevated water temperatures in boreholes around Yucca Mountain (p. 3-22); high temperature zeolites in tuff units at Yucca Mountain (p. 6-161); and potential hydrothermal deposits (travertine and opal) in fault zones on either side of Yucca Mountain (trip report, Rice, 12/28/84). A feature of hydrothermal activity such as upward-moving warm or hot groundwater migrating along fractures which may intersect the repository, poses potential problems for waste isolation capabilities of the repository. It should be noted that in 1979 the DOE eliminated the Wahmonie site on the NTS from consideration partly due to warm springs deposits and hydrothermal alteration (draft EA, page 2-14) (see comment 6-XX).

The DOE should reconsider its finding with respect to Guideline 960.4-2-7(b) in light of the above observations. In addition, the DOE should consider presenting a more thorough discussion of the probability of disruption of the repository at Yucca Mountain by igneous activity, including: (1) why the mean probability is an appropriate approach to addressing the guideline; (2) the mean probability value and how it was determined; and (3) the limitations and uncertainities in that determination due to exclusion of certain geologic features from the determination; ~~and (4) the effects on that determination of~~ factoring in the potential for hydrothermal activity at Yucca Mountain.

THE DOE SHOULD ALSO CONSIDER →

← WHILE ADDRESSING THIS GUIDELINE.

COMMENT 3 -- GROUNDWATER TRAVEL TIME CALCULATIONS

Guideline on Geohydrology (10 CFR 960.4-2-1): (d) Disqualifying Condition

Guideline on Geohydrology (10 CFR 960.4-2-1): (b) Favorable Condition 1

Guideline on Geohydrology (10 CFR 960.4-2-1): (b) Favorable Condition: 5 (iii)

The DOE has concluded that the evidence does not support a finding that the site is disqualified under the condition that groundwater travel time is less than 1,000 years (960.4-2-1(d)) and that the favorable condition of a 10,000 year travel time (960.4-2-1(b)(1)) is present because the calculated pre-waste-emplacement travel time exceeds 20,000 years. Furthermore, the DOE

BJS/PHIL'S CONCURRENCE COPY of 3/15/85 DO NOT DISCARD

EXECUTIVE SUMMARY

E-1

Section 2.2.2, Grouping of Sites by Geohydrologic Setting, Page 5, Paragraph 4

The term "dry unsaturated zone" is used. "Dry" has no precise meaning and may convey a misconception to non-technical readers. Suggest the term "dry" be omitted because water saturations (see, for example, page 2-5, paragraph 3) are greater than zero.
(Jeffrey Pohle 1/23/85)

E-2

Section 5, Regional and Local Effects of Repository Development, Page 13, Last Paragraph

This paragraph provides an explanation of the types of transportation effects from increased commuter traffic and the hauling of supplies and radioactive waste. The second sentence states that radiological risks result from routine waste shipments, but there is no mention of radiological risk from transportation accidents.
(Cooke/2/8/85)

E-3

Section 6.3.3, Ease and Cost of Siting, Construction, Operation, and Closure, Page 17, Last Paragraph

This paragraph makes the assertion that there is "adequate vertical flexibility for designing and constructing the repository" at Yucca Mountain. In reviewing the cross-sectional diagrams by Scott (1984), it appears that there is marginally adequate flexibility in the vertical direction. The location of the repository has a maximum of 30 meters of upward flexibility (as constrained by the disqualifying condition under erosion, 10 CFR 960.4-2-5) and minimal downward flexibility due to increases in lithophysal cavity percentage and the basalt vitrophyre of the Topopah Spring Member.

Since the potential for variations in stratigraphy exists in the welded portions of the Topopah Spring Member and because adverse structural features may be encountered during repository construction, vertical flexibility will be necessary in order to provide the necessary space for waste disposal. The NRC suggests that the DOE consider "~~marginally adequate" flexibility at Yucca Mountain rahter than simply "adequate~~".
(Rice 2/1/85) PROVIDING INFORMATION TO ESTABLISH THAT THERE IS ADEQUATE FLEXIBILITY FOR DESIGNING AND CONSTRUCTING THE REPOSITORY.

EXECUTIVE SUMMARY REFERENCES

Scott, R.B., and J. Bonk, 1984. Preliminary Geologic Map of Yucca Mountain, Nye County, Nevada, with Geologic Sections, USGS-OFR-84-494, Open-File Report, U.S. Geological Survey, Denver, Colo.

CHAPTER 2

2-1

Section, Introduction, Page 2-1, Paragraph 4

This paragraph refers to Figure 2-1 for the location of the Yucca Mountain Site. 10 CFR Part 60 defines "site" as the location of the controlled area. Paragraph 2 on page 3-4 indicates that the land parcel under consideration includes the underground facilities, the surface facilities and the controlled area for the repository. Therefore, it is not clear if the area delineated on Figure 2-1 as the Yucca Mountain site represents the complete, estimated controlled area as defined in 10 CFR Part 60.

Both Preclosure and Postclosure Guidelines on Site Ownership and Control (10 CFR 960.5-2-2 and 960.4-2-8-2, respectively) as well as 10 CFR 60.121 (Requirements for Ownership and Control of Interests in Land) require areal delineation of the controlled area for complete evaluation. This is particularly pertinent to 10 CFR 60.121(b) and 10 CFR 60.121(c) which consider additional controls outside of the controlled area to prevent adverse human actions that could significantly reduce the geologic repository's ability to achieve isolation. The EA should be revised to include delineation of the controlled area.
(Jeffrey Pohle 1/17/85)

2-2

Section 2.1, Regional Setting of Yucca Mountain, Page 2-6,Figure 2-3a

Understanding the deeper structures beneath Yucca Mountain is an important part of evaluating the geologic stability of the area. Although cross sections shown in Figure 2-3a are schematic, they do not show the buried caldera beneath Yucca Mountain and Crater Flat as is indicated in Figure 3-3 on page 3-7. The DOE should consider modifying these figures to be consistent with others presented in the Draft EA.
(Rice 2/1/85)

2-3
2-4

Section 2.3, Evaluation of the Yucca Mountain Site Against the Disqualifying conditions of 10 CFR Part 960, Page 2-52, Paragraph 3

Many factors, both geological and geomechanical, within a complex fracture dominated flow system impart measurable and unquantifiable uncertainties into travel time calculations. For example, the last sentence does not consider the key role of the "hydraulic connection" of the matrix with the fracture system, the adsorption capabilities of the matrix and fracture coatings or skin, or the areal changes in hydraulic gradient. It should be noted that uncertainties in

CHAPTER 3

3-1

Section 3.2.1.1, Caldera Evolution and Genesis of Ash Flows, Page 3-9, Paragraphs 1 through 3

The DOE's discussion of the genesis of tuff at Yucca Mountain contains several inaccurate statements. The draft EA states that ash flows, after coming to rest, compact and weld together under their own weight and heat, forming the rock type known as welded tuff. Ash flow tuffs, however, are not always welded. Many small ash flow deposits contain unwelded, partially welded, and densely welded members within a single or compound cooling unit. See for example the Yucca Mountain Member of the Paintbrush Tuff, page 3-10. BOR

DISCUSSION OF THE ... ON

Vitrophyre is a dense black glassy rock in which the glassy fragments have completely coalesced (welded) eliminating all pore space. The DOE states that this type of rock often occurs at the top and base of an ash flow. The vitrophyre zone or zone of dense welding does not occur at the top of an ash flow and only rarely at the bottom of flows emplaced at high temperatures (Smith, 1960, Page 154-155). Rapid cooling by the atmosphere or earth results in a vitric non- to partially welded tuff. Most single ash-flow cooling units have a nonwelded top and bottom (Smith 1960, p.154).

The DOE implies that ash falls form rock units known as bedded tuff. Bedded tuffs generally imply that volcanic material has been reworked, i.e., eroded and redeposited, after the initial deposition and may have originated as either an ash fall or an ash flow, or both, prior to erosion and redeposition: for example see Maldonado and Keother (1983, page 58). Ash falls are the more common source material for bedded material because of their nonwelded nature. However, ash falls can be identified and are commonly listed in USGS lithologic descriptions as such: for example see Maldonado and Koether (1983, Page 66). ~~Accurate portrayal~~ of the tuff units is essential to evaluation of the ~~geology and placement of the repository.~~ STABILITY OF THE TUFFS FOR CONSTRUCTION OF A REPOSITORY. (Rice 2/1/85)

THOROUGH UNDERSTANDING →

3-2

Section 3.2.1.4, Tuffaceous Beds of Calico Hills, Page 3-11, Paragraph 2

Information contained in the report on USW G-2 indicates that the statement "it thickens to nearly 306 m (1000 ft) to the north (drill hole USW G-2)" is inaccurate. Maldonado and Koether (1983) report that the Calico Hills member is only 288.7 m thick at USW G-2. It appears that the thickness was rounded off to 1000 feet and then converted to meters. The indicated thickness of 306 meters implies an accuracy that is not warranted and should be revised. (Jeffrey Pohle 1/23/85)

3-3

Section 3.2.1.5, Crater Flat Tuff, Page 3-12, Continuing Paragraph 1

The report by Maldonado and Koether (1983) on USW G-2 indicates that the Tram member is 104 m thick at USW G-2; where as this paragraph stated that the Tram member is 154 to 327 m thick. This paragraph should be revised to consider all available data.
(Jeffrey Pohle 1/23/85)

3-4

Section 3.2.2, Structure, Page 3-13, Figure 3-4

Figure 3-4 shows major strike-slip fault zones in Nevada and California. ~~Several~~ problems ~~with~~ this figure have been identified and are listed below.

First, the draft EA does not adequately discuss the nature of faults presented in this figure, therefore their potential seismic hazard to the site cannot be evaluated. For example, a strike-slip fault approximately 80 km long is shown at a distance of 15-20 km southwest of the site. The fault's age, activity, and seismic hazard to the site is not discussed for possible impact on the seismotectonic characterization of the site.

Secondly, this figure also implies that the Walker Lane fault zone is much narrower than other authors show (Carr, W.G., 1974, Figure 1, Carr, 1984, Figure 3, and Smith, 1980, Figure 3). This is significant in view of the statement on page 3-14, paragraph 2, where it is acknowledged "...that seismic activity and surface displacements have occurred during this century within the Walker Lane shear zone." It is important to show the maximum width and extent of the Walker Lane fault zone in order to illustrate the maximum potential extent of seismic activity associated with this zone.

~~Finally, Tonopah is located approximately 35 miles east of its actual location on this figure~~. The DOE should consider ~~redrafting~~ this figure accurately, for their discussion of regional structure in the Yucca Mountain geologic setting.
(Rice 2/1/85)

3-5

Section 3.2.2, Structure, Page 3-14, Paragraph 2

~~The draft EA states that movement has occurred along the Walker Lane fault zone within the last century. Carr (1984) suggests that movement along the Walker Lane in the vicinity of the candidate area ceased about 10 my ago. North of Tonopah, this fault zone is considered active (Slemmons, et al., 1977). The draft EA implies that displacements at Yucca Flat and Pahute Mesa indicate the Walker Lane fault zone is still active in the vicinity of the candidate area~~. Discussion in the draft EA is limited to Yucca Mountain and does not take into account ~~for~~ nearby faults or faulting styles (e.g. the left-lateral offsets in the Spotted Range-Mine Mountain structural zone southeast and east of the

ACTIVITY IN THE WALKER LANE FAULT ZONE 3 NORTH OF TONOPAH (SLEMMONS, ETAL., 1977), AND THE FAULTS IN YUCCA FLAT AND PAHUTE MESA).

site). ~~False impressions of simplicity~~ of the regional stress regime ~~are given by~~ RESULTS FROM the brevity and limited scope of the discussions.

OVER SIMPLIFICATION

The DOE should consider presenting a complete discussion of the regional and site-specific seismotectonic regimes at and around Yucca Mountain. This discussion is needed to adequately assess the seismic ~~risk to~~ HAZARD AT the repository site.
(Rice 2/1/85)

BJR

3-6

Section 3.2.2, Structure, Page 3-14, Paragraph 4

Identification of structural features at Yucca Mountain should be provided to assess the feasiblity of a potential waste repository site. The draft EA mentions an area of very closely spaced faults that trend northeast. There is no discussion or reference to these features. Figure 3-8 shows several areas of closely spaced faults in the central block. However, these trend north-northwest. The DOE should consider defining the nature of these northeast trending faults, identify them in Figure 3-8, and discuss how they relate to other faults at Yucca Mountain.
(Rice 2/1/85)

BJR

3-7

Section 3.2.2, Structure, Page 3-19, Paragraph 1

The first sentence in this paragraph suggests that lateral displacement occurs on northwest trending faults only north of the repository area. YET, evidence of lateral displacement, in the form of slickensides, occurs south of WELL G-2 in both WELLS G-1 (Spengler, et al., 1981, pages 40-41) and UE 25 a-1 (Spengler et al., 1979, page 29). G-1 is within the repository block and UE 25 a-1 is located approximately 500 m east of the block. THE DOE SHOULD CONSIDER DISCUSSING LATERAL DISPLACEMENT ON FAULTS WITHIN THE REGION OF THE SITE IN ADDITION TO THOSE NORTH OF THE SITE.

BJR

The sentence also infers the horizontal movement occurs on northwest trending faults. This is no where explicitly stated in Maldonado and Koether (1983). They indicate "...the lateral component could possibly be related to an ancient (pre 18 M.Y.) northwest-trending right-lateral fault zone Carr (1982) that may be present in Yucca Wash (Fig. 5) approximately 1 km north of the drill site." This would appear an unlikely origin in view of the subsequent deformation southern Nevada has undergone in the last 18 million years and the generally accepted face that slickensides indicate only last motion along faults.
(Rice 2/1/85)

3-8

Section 3.2.2, Structure, Page 3-19, Paragraph 2

Dating of fault activity, especially on major block-forming faults, is crucial for determining the past tectonic activity and the potential future activity within the Yucca Mountain geologic setting.

The absence of Timber Mountain tuff on high-standing blocks can occur as the result of geologic processes other than non-depostion on topographically high standing fault blocks. The most obvious one is erosion subsequent to faulting. Ekren et al. (1968) offer evidence that the topography was "very subdued during the eruption of the Timber Mountain tuff." Under this scenario, large block forming faults could have occurred after, rather than before, the deposition of the Timber Mountain tuff. Thus, the initiation of significant faulting may be several million years more recent than implied in this report.

BJR

The DOE should consider all viable hypotheses for the ~~dating~~ AGE DETERMINATION of major structural features in the Yucca Mountain region in evaluating past tectonic activity.
(Rice 2/1/85)

3-9

Section 3.2.2, Structure, Page 3-19, Paragraph 2

The Draft EA states that trenches across faults with small degraded scarps (THE DATING OF MATERIALS GATHERED FROM VERY SMALL) within 10-20km of the site, show "no unequivocal" evidence that movement has occurred in the last 40,000 years. This statement is ambiguous ~~and inaccurate~~. AND MAY BE MISLEADING.

BJR

There are several specific concerns that arise from this statement. ~~First,~~ the term "no unequivocal" ~~can be interpreted to mean "equivocal"~~, and would imply that there are ~~two or more~~ interpretations of fault movement. ~~Secondly, 10 to 20 kilometers from the site is a fairly wide range for examining faults in the Yucca Mountain geologic setting. This is particularly important since~~ the Bare Mountain fault lies approximately 15 kilometers to the west of the site and, portions of the Rock Valley fault zone lie within 20 kilometers of the site, both of ~~which~~ which have had Holocene (10,000 year old) movement. ~~And finally,~~ degraded scarps represent the surface expression of predominantly dip-slip or oblique-slip movement on faults. No reference is made to the possibility of pure strike-slip fault movement that ~~that~~ would not produce a fault scarp on the surface, ~~but~~ would ~~indeed~~ produce surface displacement.

IS CONFUSING
MULTIPLE
CAN
PERHAPS LESS THAN 40,000 YEARS.
ALSO,
THERE ARE FAULTS WITHIN 10-20 KILOMETERS OF THE SITE THAT DISPLAY MOVEMENT IN THE LAST 10,000 YEARS
THE [redacted] EXISTENCE OF FAULTS WITHOUT SCARPS [redacted] AFFAIRS TO HAVE NOT BEEN CONSIDERED.

The DOE should consider re-phrasing the statement referenced above to be very specific about the location of the faults being discussed, the accuracy of the dating of the faults, and the nature of movement on these faults.
(Rice 3/9/85)

3-10

Section 3.2.3, Seismicity, Page 3-19, Paragraph 3

Defining the seismic nature of the geologic setting is an integral part of assessing the Yucca Mountain site as a potential waste repository. The seismic activity along the northeast-trending left-lateral Pahranagat shear zone, the Mine Mountain, Rock Valley, and Frenchman Flat fault systems, ~~which is shown in Rogers et al (1983), Figure 9~~, is not discussed, although these are the most seismically active areas in the vicinity of the repository site (SOME OF ROGERS, et al., 1983). The DOE should consider including these potentially active fault zones in the assessment of the seismic nature of the Yucca Mountain geologic setting. (Rice 2/1/85)

BJR 2/1/85

3-11

Section 3.2.3, Seismicity, Page 3-19, Paragraph 3

~~3-11~~

In this section, the DOE states that "Yucca Mountain lies in an area of relatively low historical seismicity, just south of the Southern Nevada East-West Seismic Belt" (SNEWSB). This is schematically illustrated in Figure 3-9 (Page 3-20) of the Draft EA. ~~There is concern over what~~ THE basis ~~was~~ used to define the southern boundary of the SNEWSB ~~and why the Yucca Mountain site is excluded~~. IS NOT PRESENTED IN THE DRAFT EA.

The SNEWSB is characterized by seismicity in a region where north-south-trending normal-fault blocks are transected by east to southeast-trending zones of lateral faulting (Smith, 1978). Insufficient data or discussion is presented to evaluate whether THE southern boundary of the SNEWSB ~~can be~~ HAS BEEN PROPERLY delineated and the site be excluded from this seismic belt. Two seismicity maps of the area around the NTS (Rogers, et al., 1981, Figure 7 and Rogers, et al., 1983, Figure 9) show a scatter of seismicity, with local areas of more concentrated seismic activity. From these seismicity maps, it seems ~~more likely that the Yucca Mountain site can be interpreted to be lying within the SNEWSB~~. At least one publication (Carr and Rogers, 1982, page 9) delineates the extent of the "East-West Zone" to include the Yucca Mountain site. Another reference, Carr (1984), suggests the southern boundary of the SNEWSB be located further south of the that which is presented in the Draft EA. Algermissen, et al. (1982) and Bucknam and Thenhaus (1979) estimate a maximum expected Richter magnitude earthquake in this region coincident with the SNEWSB on the order of 7.0 to 7.5. A higher degree of tectonic and seismic activity is implied if the site is included within the SNEWSB.

BJR 2/1/85

SOUTHERN BOUNDARY OF THE SNEWSB ENCOMPASSES THE YUCCA MOUNTAIN SITE.

The NRC suggests the DOE identify how the southern boundary of the SNEWSB was determined and, if the site is indeed within the SNEWSB, how this will affect the estimated maximum ground acceleration at the site. (Rice 3/9/85)

3-12

Section 3.2.3, Seismicity, Page 3-21, Paragraph 2

This paragraph states that "under the assumption that Yucca Mountain faults are not active", the peak deterministic ground acceleration computed for the site is 0.4g, resulting from an earthquake of magnitude 6.8 (this information is detailed in Chapter 6, see, for example, Section 6.3.1.7.5). According to the definition of active fault presented in the Glossary of the draft EA (page G-1) it cannot be assumed that the Yucca Mountain faults are not active. The Solitario Canyon fault, located within a kilometer of the western margin of the Yucca Mountain site, is approximately the same length as the Bare Mountain fault. The maximum magnitude computed for the Bare Mountain fault is 6.8. Should such an earthquake occur on the Solitario Canyon fault, the deterministic peak acceleration may exceed ~~1.0g and would exceed 0.4~~g. The Ghost Dance fault, which intersects the Yucca Mountain site, might also be considered active according to the Glossary definition. An earthquake on the Ghost Dance fault would most likely cause accelerations within the repository in excess of the 0.4g stated in the EA.

The NRC suggests the DOE assume the faults are active at Yucca Mountain and assess the seismic hazard accordingly.
(Rice 2/1/85)

3-13

Section 3.3.2.1, Groundwater Movement, Page 3-28, Paragraph 3

This section of the draft EA discusses potential recharge to the groundwater system at Yucca Mountain. According to the EA, "most of the annual precipitation, 150 to 200 mm, is returned to the atmosphere by evaporation and plant transpiration. A small part of the precipitation that falls on Yucca Mountain, probably less than 1 mm/yr (personal communication from P. Montazer referred to in previous section), percolates through the matrix of the unsaturated zone." The data base is inadequate to support the estimated percolation rate of 1 mm/yr suggested by Montazer and Wilson (1984). Therefore, the validity of the 1 mm/yr percolation rate used in the travel time calculations throughout the draft EA is questionable. In a subsequent section of the draft EA the method used to estimate the 1 mm/year flux rate is presented but other values could be defended. This statement is explained further under comments on Section 6.3.1.1. Data in support of the 1mm/yr flux through the unsaturated zone are critical to all travel time estimates.
(Jeffrey Pohle 1/23/85)

3-14

Section 3.3.2, Groundwater, Table 3-3, Page 3-29

This table is from a report which has only recently been published: Montazer, P. and Wilson, W., Conceptual Models for Flow Through the Unsaturated Zone at Yucca Mountain, Nevada. In Table 3-3, The stratigraphic order of the Pah

CHAPTER 4

4-1

4-2

4-3

Section 4.1.1.1, Exploratory Drilling, Page 4-3, Paragraphs 2 and 3

Descriptions of exploratory drilling activities state that drill site location preparation requires the disruption of the regolith for drill pads and that the access road would be 5 miles in length and 50 feet in width. A maximum of 30.3 acres would be disturbed for drilling pad locations. These estimates could be too low if borrow areas to build appropriately graded access roads are needed. If 20 new borehole locations are developed, over 600 acres of regolith could be disturbed. The potential for increased infiltration to the unsaturated zone should be evaluated.
(Jeffrey Pohle 1/23/85)

4-4

Section 4.1.1.2, Geophysical Surveys, Pages 4-4 through 4-6

The geophysical surveys and techniques described indicate the use of off-road vehicles for site characterization activities; some shallow drillholes may also be required for seismic energy generation by use of explosives set off in drilled shotholes. Transportation and data acquisition efforts in a relatively arid area such as the Yucca Mountain site and vicinity will disturb the desert type vegetation. For example, wheel tracks will be susceptible to gullying during periods of heavy rainfall, and may therefore be considered as an effect on the environment. The DOE should consider discussing not only the plans for geophysical surveys, but also the impacts on the environment due to these surveys.
(Rice 2/1/85)

BJR

4-5

Section 4.1.2, Exploratory-Shaft Facility, Pages 4-7 through 4-20

The draft EA does not adequately address the possible effects of the lateral extent of the main underground testing facility on the DOE's evaluation of some of the siting guidelines (e.g. guidelines related to environmental quality 960.5-2-5, socioeconomic impacts 960.5-2-6, transportation 960.5-2-7, and system guidelines 960.5-1).

Section 4.2 of the draft EA includes a description of the exploratory shaft facility that is planned for site characterization. However, no information is given on the lateral extent of the main underground testing facility. The size

spent-fuel at the repository, and its effect on the evaluation of siting guidelines related to environmental quality (960.5-2-5), socioeconomic impacts (960.5-2-6), transportation (960.5-2-7), and system guidelines (960.5-1).

(e) Backfilling of access and emplacement drifts vs. open rooms

From the discussion provided in paragraph 3, page 5-11 of the draft EA, it appears that the decision to backfill access and emplacement drifts or to maintain open rooms prior to closure and decommissioning has not been finalized. The environmental impact of each alternative is likely to be different, especially with regard to retrievability. Retrieval of backfilled rooms would possibly involve handling extremely hot muck, leading to potentially hazardous environmental conditions. Evaluation of the siting guidelines (e.g., 10 CFR 960.5-2-9(4)) could also be influenced by the decision to backfill the access and emplacement drifts. Therefore, the final EA should present the environmental impact resulting from both alternatives.

(f) Accident Analysis

In paragraph 3, page 6-15 and paragraph 3, page 6-35 of the draft EA, it is stated that the information used for assessments of accidental radiological releases is not the same as that contained in Jackson (1984), or in Section 3.4.7 and Section 5.2.9. The DOE should update the information given in Sections 3.4.7 and Section 5.2.9 to accurately reflect the assumptions made in assessing the environmental impact.

Much of the information on accidental radiological release used in assessing the environmental impact in Chapter 5 appears to have been taken from Jackson, 1984 (page 5-59, last paragraph). Since this analysis has been revised, the DOE should use the results of the revised analysis to discuss radiological effects in the final EA.

The final EA should evaluate and discuss the impacts of the above mentioned assumptions and other alternate design assumptions so that effects of these can be evaluated.
(Dinesh Gupta 2/1/85)

5-5

5-6

Section 5.2.1, Geologic Impacts, Page 5-34, Paragraph 2

~~The concern in~~ This section addresses ~~is~~ the potential for induced seismicity due to the stress releases imposed by repository construction at Yucca Mountain. The statement, "excavation of the repository represents an insignificant disturbance to the overall competence of the rock units at Yucca Mountain."

85/03/12

TOO OPTIMISTIC
may be ~~inaccurate~~ in light of the available data on the Yucca Mountain structural and tectonic environment. The following list of interpretations presented in the draft EA ~~lead to potentially adverse impacts on the geologic system:~~ SUGGEST THAT FAULTS MAY BE NEAR FAILURE AND COULD SLIP IN RESPONSE TO HUMAN-INDUCED STRESS CHANGES:

1) "At present, a preliminary conclusion could be made that the north-trending faults at Yucca Mountain should be considered active even though the absence of fault scarps and the near absence of seismic activity suggests that they are not active." (6-226, Last Paragraph).

2) "...Interpretations of stress measurements at Yucca Mountain could indicate that certain faults may be near failure..." (6-227, First Paragraph).

3) "...The accompanying aftershocks indicate that these faults (at Pahute Mesa) may have been tectonically stressed near the failure point, and slip was triggered by stress changes produced by the explosions (Underground Testing)." (6-227, First Paragraph).

BJR

FIELD CHANGES
The significance of this concern is that stress ~~crops~~ imposed by the construction of an underground facility at Yucca Mountain may initiate slip on faults that may be at or near the failure point. Stress changes near the Solitario Canyon Fault, and perhaps the Ghost Dance Fault are of particular concern. Major displacement on either of these faults has the potential to generate significant seismicity, which ~~would~~ have impacts on the integrity of the underground and surface facilities as well as the safety of repository personnel.

COULD

To resolve this concern, it is suggested that the in situ stress regime at Yucca Mountain and potential changes to that regime due to repository construction, including impacts on fault displacement and resulting seismicity for faults in and around the repository location be critically evaluated. (Rice 2/1/85)

5-7

Section 5.2.2 Hydrologic Impacts, Pages 5-35 and 5-36

This section identifies potential hydrologic impacts on the physical environment as a result of locating a repository at Yucca Mountain. Relative to groundwater, the following potential impacts have been identified in this section. They include: 1. The exclusion of any future exploitation of ground water in the area immediately surrounding the repository; 2. Regional draw-down effects from groundwater withdrawals at Yucca Mountain; and 3. Release of radionuclides into the groundwater. Comments relative to the these potential groundwater impacts follow below.

1. The exclusion of any future exploitation of groundwater in the area immediately surrounding the repository.

6-18

Section 6.2.1.8.3, Favorable Condition (9), Conclusion, Page 6-98, Paragraph 2

The DOE has not evaluated the transportation route potential disruption outside of Nevada and the routes from the bulk of reactor sites in the U.S., i.e., the midwest and northeast would have to be through the severe winter weather belt (Wyoming, Nebraska, Colorado, etc.), where there could be significant routine winter disruption of transportation through these regions. Only the severe weather conditions in the general region of Yucca Mountain were evaluated by the DOE. It is suggested that the DOE evaluate the potential transportation disruption outside the Nevada area and between the reactor sites and the Yucca Mountain site.
(Irwin Spickler 1/31/85)

6-19

6-20

Section 6.2.2.2.3, Evaluation of the Yucca Mountain Site, Page 6-109, Paragraph 6

In the discussion of the construction of an access road from Interstate 95, there is reference to "Nevada State Route 17A". It is assumed by the NRC that Nevada State Route 160 is the former Nevada State Route 29, intersecting Interstate Route 95 at Amargosa Valley (formerly Lathrop Wells). Since the highway routes of Nevada have been recently renamed, it is suggested that a map be provided showing the renamed highways (and perhaps town settlements) where appropriate throughout the EA.
(Rice 2/1/85)

LOCATION MAPS ARE UNIMPORTANT DELETE BJR

6-21

Section 6.3.1.1.2, Data Relevant to the Evaluation, Page 6-113, Paragraph 3

Emphasis provided in discussions in this paragraph concerning faults is on vertical displacement. However, strike-slip displacement has been observed on a number of historical faults at Yucca Mountain (Stewart, 1980, p. 117; Maldonado and Koether, 1983, p. 45). Without considering horizontal displacement faults, the structural setting of Yucca Mountain cannot be adequately described. The DOE should consider including a discussion of strike-slip (or oblique slip) faults at Yucca Mountain in this section.
(Rice 2/1/85)

BJR

6-22

Section 6.3.1.1.2, Data Relevant to the Evaluation, Page 6-113, Paragraph 3

The statement "the attitudes of faults and fractures at depth in drill holes are similar to those on the surface (Maldonado and Koether, 1983; Scott et al., 1983, 1984)." is made in this section. In reviewing the cross sections developed by Scott and Bonk (1984) based on surface mapping and borehole data, it appears that many of these faults are interpreted to change attitude with depth. Granted that it is often very difficult to be certain that a projected surface fault correlates with a borehole fault, the attitudes are different as evidenced by the curved nature of major faults on Scott and Bonk's (1984) cross-sections of Yucca Mountain. This change in attitude may play an important role in predicting radionuclide transportation via ground water, as well as the constructability and flexibility of the underground facility. It is suggested that the DOE consider indicating the degree of potential dissimilarity between the surface and subsurface fault and fracture attitudes at Yucca Mountain.
(Rice 2/1/85)

BJR

IN ITS LOCATION.

6-23

Section 6.3.1.1.2, Data Relevant to the Evaluation, Table 6-15. Summary of Analyses for Section 6.3.1.1, Geohydrology (10 CFR 960.4-2-1), Page 6-115, Condition (i), second column

Table 6-15 (Page 6-114 through 6-118) presents a summary of analyses for Section 6.3.1.1. This table presents a DOE finding that the hydraulic conductivity is less that 1 mm/yr in the host rock and surrounding geohydrologic units. This finding is overgeneralized and should be revised. For example, according to Table 3-3 on page 3-29 of the draft EA, the saturated matrix hydraulic conductivity of the Paintbrush nonwelded unit above the Topopah Spring Member is given as 3,300 mm/yr. The saturated matrix hydraulic conductivity of the tuffaceous beds of Calico Hills below the Topopah Spring Member ranges from 3 mm/yr for the zeolitic portion to 1,460 mm/yr for the vitric portion of this unit. Therefore, Table 3-3 indicates that the surrounding geohydrologic units have significantly higher saturated matrix hydraulic conductivites than the host rock (Topopah Spring Member).
(Jeffrey Pohle 1/23/85)

6-24

Section 6.3.1.1.2, Data relevant to the evaluation, Table 6-15. Summary of analyses for Section 6.3.1.1, Geohydrology (10 CFR 960.4-2-1), Page 6-115, Condition (ii), second column

The statement "Hydraulic conductivity is downward..." should probably read "Hydraulic gradient is downward...".
(Jeffrey Pohle 1/23/85)

6-25

1. The draft EA states (page 6-178, first sentence) that the primary host rock area (area 1) consists of approximately 890 ha (2,200 acres), and that 15% of this area may not be suitable for the repository location because of the presence of minor faults and breccia. However, it should be noted that the excluded area is not likely to be concentrated at one location; rather, it may be distributed in segments throughout the host rock. The random location of these areas may deter complete utilization of the remainder of the area 1 host rock, and thus could further reduce the potentially available usable area. The EA should consider this possibility in terms of its effects on the availability of sufficient lateral extent of area 1 host rock for waste emplacement.

2. The draft EA states (page 6-176, paragraph 3) that emplacement in the Topopah Spring Member is proposed in the relatively lithophysae-free zone (containing less than 15 to 20 percent lithophysae). It is further stated that at low percentages, the lithophysae have little effect on mineability and ground support requirements; at high percentages (probably near 30 percent) it could affect mineability and ground stability. However, adequate basis to substantiate these conclusions is not provided in the draft EA or in the reference document (viz., Mansure and Ortiz, 1984). In addition, no data are provided to support the contention that the so-called "lithophysae-free" zones have sufficient lateral continuity for the placement of the underground facility. If lithophysae-free zones are found to be intermingled with zones having a relatively high percentage of lithophysae, the isolation capability and thermomechanical properties of the repository host rock would have to be further evaluated. The final EA should recognize this possibility and describe the measures to be taken in case a suitable lithophysae-free zone of sufficient lateral extent is not found within Area 1.

3. The draft EA concludes that sufficient host rock thickness is available to provide vertical flexibility in the placement of the repository (page 6-178, last paragraph). However, the basis for this conclusion is not clearly stated. The final EA should discuss the extent of possible restrictions on vertical flexibility due to lithophysae content. Data should be presented in the final EA to support the conclusion that a sufficiently thick lithophysae-free zone is available for repository placement and that this zone meets other requirements (e.g. sufficient rock strength, desirable thermal properties, limited fracture density, etc.) for locating the underground facility.

(Dinesh Gupta 2/1/85)

6-110

Section 6.3.1.3.3, Favorable Conditions, Pages 6-177 and 6-179, Figures 6-5 and 6-6

Figures 6.5 and 6.6 identify the map locations of Area 1 "Primary area" for the underground facility and approximate area of the underground facility showing

the overburden contours, respectively. Both diagrams show key features in evaluating the site against the siting guidelines, one for adequate area for waste emplacement and the other for the 200 meter overburden requirement. It is suggested that the DOE use one standard design area and scale for all such figures throughout the text. This should eliminate the potential for misinterpretation of design requirements imposed by the existing geologic setting.
(Rice 2/1/85)

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6-111 93

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Section 6.3.1.3.3, Favorable Conditions, Page 6-178, Last Paragraph

Based on the stratigraphic features of the Topopah Spring Member (the repository host rock), the statement "the potential host rock at Yucca Mountain is sufficiently thick to provide significant vertical flexibility in the placement of the repository to ensure isolation." The highly variable nature of the lithophysal cavities and vitrophyre of the lower units limits the downward flexibility. Furthermore, the 200 meter overburden disqualifying condition limits the upward flexibility. Considering the unpredictable nature of the host tuff unit petrology and structure, there is limited construction flexibility available for repository openings in the host rock. INHOMOGENEITIES THUS, the repository envelope (45 meters in diameter) can move only slightly up or down based on the previously mentioned restrictions. It is then suggested that within this section of the EA, the DOE indicate that there is "marginally adequate vertical flexibility" rather than "significant vertical flexibility". RECONSIDER THEIR ASSESSMENT OF THE AMOUNT OF VERTICAL FLEXIBILITY AVAILABLE.
(Rice 2/1/85)

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6-112 96

Section: 6.3.1.3.3(2), Favorable Conditions, Pages 6-181 through 6-182,

The draft EA conclusion (page 6-182, paragraph 2) that the repository host rock will accommodate the thermal and mechanical stresses developed during the period of peak temperatures with no adverse effect on waste containment and isolation is almost solely based on the near and far-field finite element thermal analyses conducted by Johnstone et al. (1984). The Johnstone et al. (1984) study was apparently done for the prime objective of ranking the tuff horizons. A definite conclusion based on this study alone may not be appropriate due to the preliminary nature and many inherent limitations of the study. Some of the limitations are identified below:

- Little is known about joint frequencies, orientations, joint infillings, and joint strengths (page 6-175, paragraph 2 of the draft EA).

(Linda Kovach 1/22/85)

6-118

Section 6.3.1.3.4, Potentially adverse condition(3) Page 6-187, Paragraph 1 and 3

The analyses by Braithwaite and Nimick (1984) are extremely dependent on the magnitude of groundwater flux; a greater flux results in a greater increase in porosity. In addition, this analysis is for a single component and does not take into consideration the complexities of multi component rock-water interactions. The experimental results of Moore et al. (1984) are also questioned. In these experiments, the permeability increased from 3 to 10 microdarcies, upon heating and then leveled for a period of two weeks. The silica concentration of the groundwater increased in a similar fashion. It is not clear whether the dissolution of the rock was buffered by the silica activity, and why the rock behaved thusly. The results should be based on a more conservative fluid flux.
(Linda Kovach 1/22/85)

6-119

6-120

Section 6.3.1.3.4, Potentially adverse conditions (3), Page 6-188, Paragraph 2

Vapor phase transport is a viable means of radionuclide transport for Cl, Cs, I, and any other element that may occur in a gaseous phase. These radionuclides could be released and transported during the drying cycle immediately following closure if canisters are breached. There is also the possibility of aerosol formation and transport during the wet-dry cycling (Evans, 1983). The DOE should include an analysis of the possibilities of vapor-phase or aerosol transport.
(Linda Kovach 1/22/85)

6-121

Section 6.3.1.3.4, Potentially Adverse Conditions (3), Page 6-188, Paragraph 4

The statement "permeability changes due to host rock dissolution and precipitation process should not be significant,..." is based on a laboratory test that was conducted on a heated sample core of Topopah Spring Member Tuff using J13 well water. The results may not represent in situ conditions around the proposed repository for the following reasons: ~~First,~~ 1) since the host rock is highly fractured, a sample core without fractures may not have the same response, ~~Secondly,~~ 2) the use of J13 water may be inappropriate since its chemistry may be different from that of the Topopah Spring Member in the unsaturated zone, ~~Finally,~~ and 3) the laboratory test was conducted for two weeks and

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the results were extrapolated over the length of time for repository performance without an assessment of the reliability of the extrapolation.

The DOE should consider reevaluating or qualifying the conclusions for this potentially adverse condition in light of the above considerations. (Rice 2/1/85)

6-122

Section 6.3.1.4.3, Favorable Conditions (2) Page 6-198, Paragraph 2

This section evaluates favorable condition 2 of the guideline on climatic changes (10 CFR 960.4-2-4). While the DOE's conclusion that this favorable condition is not present at Yucca Mountain is appropriate, there are statements in this section which when evaluated against previous statements and hypotheses presented in the draft EA are either inconsistent or appear to ignore the transient nature of the system.

This section discusses the potential increase in the groundwater recharge rates during pluvial periods. According to the draft EA, "the increased flux probably was not sufficient to affect the potential for developing perched water conditions in the unsaturated zone or to modify the hydrologic system in the underlying saturated zone. Hydrologic tests and measurements of core samples from unsaturated rock units overlying saturated rock units underlying Yucca Mountain indicate that fracture and matrix permeability generally is high enough to transmit water not only at the low moderate fluxes (probably less than 1 mm/yr) but also at the postulated much higher fluxes of pluvial times (Section 6.3.1.1). Thus, the increase in recharge that is postulated for pluvial climates probably did not significantly affect the potential for developing perched water conditions." These statements are considered relative to the following statements presented elsewhere in the draft EA:

1. It is stated on page 6-121 that "preliminary modeling efforts using the regional hydrology model developed by Waddell (1982) depict that the water table elevations at and near Yucca Mountain may have been as much as 130 m above the current position of the water table". This is restated in paragraph 3 on page 6-199. In addition, the conclusion section for this favorable condition (page 6-200) indicates that "the water table may have been as much as 25 percent shallower and flow paths to discharge areas may have been modified." This is the very basis for concluding that this favorable condition is not present at Yucca Mountain. Therefore, the statement in paragraph 2 on page 6-198 that "the increased flux probably not sufficient to ... modify the hydrologic system in the underlying saturated zone" is inconsistent with other discussions and conclusions in the rest of the draft EA.

2. It is stated on page 6-126 that "the combined effect of the capillary and permeability barriers is to limit the downward flux through the host rock to a maximum of 1 mm/yr under unsaturated conditions". If the statement

difficult to evaluate and support the conclusion, "The large volume of water produced from this well... suggest the the aquifers underlying Yucca Mountain can yield large quantities of ground water for long periods of time without lowering the regional ground-water table." If long-term discharge data for well J-13 are available they should be provided. Presumably, such information would be included in source/sink terms when evaluating the groundwater system.
(Jeffrey Pohle 1/23/85)

6-15

Section 6.2.1.8, Transportation (10 CFR 960.5-2-7), Page 6-86

Since the radiological risks of waste transportation are small, they would appear to be a poor site discriminator, were they used for the selection of qualified sites. If these risks have a role in the site selection process, it may be in the minimization of overall risk for sites found to be qualified on other, more important, factors, i.e., postclosure guidelines. In the evaluation of qualified sites, it might be appropriate to consider the transportation risks on an ALARA basis (i.e., keep the acceptably small transportation risk as low as is reasonably achievable, taking into account cost andtechnological feasibility). However, it appears that other factors could dominate the small transportation contribution in an overall consideration of site risks.
(Cook 2/10/85)

6-16

Section 6.2.1.8.2, Data Relevant to the Evaluation, Page 6-91, Paragraph 1 and Section 6.2.1.8.3, Favorable Conditions, Page 6-93, Paragraph 1

The potential for flooding in the Yucca Mountain region is ~~of concern~~ SIGNIFICANT because of the climatic conditions and topography there favor sudden cloud bursts and the concentration of runoff in arroyos. Because of the flood potential of Fortymile Wash to the east of Yucca Mountain and because of the proposed construction of either a railroad or auto bridge is planned to cross the wash, it is a conern that design specifications for this bridge be evaluated with appropriate flood hazard analyses. ~~Section 6.2.1.8.2 provides no indication of the design criteria for the bridge.~~ BJR

In addition, information presented in Section 6.2.1.8.3 does not consider the potential for damage resulting from flash floods crossing the alluvial fan at the base of Sheep Range and disturbing rail lines. This potential hazard is also not considered in Chapter 5, page 5-71 and 5-72.

The DOE should consider evaluating flood potential (Squires and Young, 1984) and its effects on ~~all~~ engineered structures including proposed railways and bridges in the geologic setting of Yucca Mountain related to the waste repository.
(Rice 2/1/85)

(Jeffrey Pohle, 2/22/85)

6-
Section 6.3.1.5 Erosion, Page 6-204

The DOE has not completely considered the available data and alternative interpretations of Quaternary geologic processes and features (such as erosion rates) at Yucca Mountain in its evaluation of the erosion guidelines. Erosion rates at Yucca Mountain are important because the proposed repository is within 30 meters of the 200 meter overburden disqualifying condition for erosion (960.4-2-5(d)).

A comprehensive analysis of Quaternary geologic processes operating in the Yucca Mountain geologic setting is required for the DOE to evaluate the following postclosure guidelines on erosion: 960.4-2-5(a), 960.4-2-5(b)(2) and (3), and 960.4-2-5(c)(1) and (2). The draft EA provides data and interpretations from only two sources from which, only three measured rates of stream incision are used in the assessment of postclosure erosion rates at Yucca Mountain. Many more data and interpretations are available for the rates of geologic processes applicable to the Yucca Mountain geologic setting that have been utilized by the DOE.

Erosion rates are of significance in the Yucca Mountain geologic setting for three reasons: 1) the repository is sufficiently shallow as to be subject to concern for exhumation; 2) rates of erosion are highly variable in arid climates (annual precipitation is low, but often comes in pulses and results in flash flooding; and erosion is most effective on steep slopes and in washes, both of which are present at the site) and 3) the host rock for the repository (Topopah Spring Member) is exposed on both the east and west sides of Yucca Mountain, where it outcrops in Abandoned Wash above the eastern margin of the proposed repository and, therefore, is currently subject to erosion. The presentation of erosion rates at Yucca Mountain provided in the draft EA does not consider these processes which are present at Yucca Mountain (the data used was not collected from Yucca Mountain itself). Additional data from Yucca Mountain and other areas in the Southern Great Basin would provide for the evaluation of uncertainties and alternative interpretations as they are addressed under the guideline conclusions.

The DOE should consider additional and alternative interpretations of Quaternary geologic processes and features in the Yucca Mountain geologic setting and then re-evaluate the appropriate guidelines on erosion rates in light of these findings.
(B. Rice, 2/15/85)

6-124

Section 6.3.1.5.2, Data Relevant to the Evaluation, Page 6-204, Paragraph 3

The overall analysis of Quaternary features and processes, including the stratigraphic units, climatic fluctuations and erosional history, is based on the views of the authors of two references (predominated by personal communications). ~~Typically, in reporting highly interpretive geologic histories, numerous authors are cited and their various hypotheses presented. Such~~ A comprehensive literature search will support the interpretations being suggested and will also acknowledge potential alternative hypotheses. As presented in the draft EA, the analysis is incomplete and does not aequately support the preliminary conclusions. CanD

8. ____, 1983, Full-glacial southwestern United States: Mild and wet or cold and dry?: Quaternary Research, v. 19, p. 236-248.
9. King, T.J., Jr., 1976, Late Pleistocene-early Holocene history of coniferous woodlands in the Lucerne Valley region, Mohave Desert, California: Great Basin Naturalist, v. 36, p. 227-238.
10. Lajoie, K.R. and Robinson, S.W., 1982, Late Quaternary glacio-lacustrine chronology Mono Basin, California: Geological Society of America Abstracts with Programs, v. 14, p. 179.
11. Mayer, L. and Bull, W.B., 1981, Impact of Pleistocene-Holocene climatic change on particle sizse distribution of fan deposits in southwestern Arizona: Geological Society of America Abstracts with Programs, v. 13, p. 95.
12. McFadden, L.D., 1982, The impacts of temporal and spatial climatic changes on alluvial soils genesis in southern California (Ph.D. dissertation): Tucson, University of Arizona, 430 p.
13. McFadden, L.D. and Bull, W.B., 1981, Impact of Pleistocene-Holocene climatic change on soils genesis in the eastern Mojave Desert, California: Geological Society of America Abstracts with Programs, v. 13, p. 95.
14. Melton, M.A., 1965, The geomorphic and paleoclimatic significance of alluvial deposits in southern Arizona: Journal of Geology, v. 73, p. 1-38.
15. Smith, L.N. and Anderson, R.Y., 1982, Pleistocene-Holocene climate of the Estancia Basin, central New Mexico: New Mexico Geological Society Guidebook 33, p. 347-350.
17. ____, 1977, Holocene woodlands in the southwestern deserts: Science, v. 198, p. 189-192.
18. Van Devender, T.R. and Spaulding, W.G., 1979, The development of vegetation and climate in the southwestern United States: Science, v. 204, p. 701-710.
19. Wells, S.G., 1977, Geomorphic controls of alluvial fan deposition in the Sonoran Desert, southwestern Arizona: in Doering, B.O., ed., Geomorphology in arid regions: State University of New York at Binghamton, Publications in Geomorphology, p. 27-50.
20. ____, 1978a, Geomorphic framework of an open drainage basin in the Basin and Range province of southwestern Arizona: Geological Society of America Abstracts with Programs, v. 10, p.153.
21. ____, 1978b, Processes and patterns of wash sedimentation and Quaternary fan building on piedmonts of the Sonoran Desert: Abstracts, Tenth International Congress on Sedimentology, v. II, p. 734.

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22. Wells, S.G., Ford, R.L., Grimm, J.P., Martinez, G.F., Pickle, J.D., Sars, S.W., and Weadock, G.L., 1982, Development of debris mantled hillslopes: (Rice 2/1/85)

6-125

Section 6.3.1.5, Erosion, Page 6-210, Paragraph 3

Incision rates presented in this section are based on only three reported measurements. If more data are available they need to be presented and used in the evaluation. An erosion rate based on three measurements can, at best, be considered ~~very~~ speculative, and not adequate ~~to~~ base decisions concerning the integrity of the proposed site. ARE AN IS FOR BJR

The DOE should consider incorporating other available data in their analysis of erosion rates at Yucca Mountain and qualifying their conclusions based on the data used.
(Rice 2/1/85)

6-126

6-127

Section 6.3.1.7.3, Favorable Condition, Page 6-222

The DOE has indicated its concern for potential hydrothermal activity and its effects on the movement of groundwater. ~~This is indicated by DOE's~~ IN ITS elimination of the Wahmonie site because, among other reasons, "...local surface deposits from recent warm springs indicate upward seepage of groundwater, possibly from great depths," (p.2-14). The DOE has also indicated that the highest probability of basalt volcanic activity is 4.7×10^{-4} per 10,000 years (page 6-222). This exceeds the requirements for potential repository disruption. There is evidence of elevated water temperatures in boreholes surrounding Yucca Mountain within the geologic setting (p. 3-22) as well as evidence of earlier hydrothermal systems below the host rock at Yucca Mountain (6-216). Trench work adjacent to Yucca Mountain also show evidence of travertine and opal (potential hot spring deposits) in faults cutting alluvial sediments (NRC ~~memo~~ TRIP REPORT from ~~Ken~~ Rice to ~~Wahl~~ Coplan, 12/28/84) suggesting that Yucca Mountain may have been more recently subjected to hydrothermal activity. BJR

In higher temperature water, waste container integrity may decrease. The solubility of some radionuclides (as well as sorbing zeolites) increases within this temperature environment. This would indicate that the upward movement of hydrothermal solutions, induced by magmatic activity, may have adverse impacts on radionuclide isolation at Yucca Mountain.

It is suggested that the potential for development of hydrothermal systems be evaluated ~~with existing data~~ and ~~included under the analysis of the site against this favorable condition.~~ APPLIED TO THIS FAVORABLE CONDITION GUIDELINE.

(Rice 2/1/85)

6-128

Section 6.3.1.7.3, Favorable Conditions, Page 6-222, Paragraph 3

No source for the "mean" probability for basalt volcanic disruption of the repository is given. Crowe (1982) data and results indicate a wide range of probabilities, yet many of which appear to exceed the "1 chance in 10,000 (10^{-4}) during the first 10,000 years after closure". The DOE should consider indicating how the "mean" value was derived and what the actual value is and why the mean value would be appropriate. (Rice 2/1/85)

6-129

Section 6.3.1.7.3, Page 6-223, Paragraph 3

Insufficient information is presented in this section regarding repository construction. The Draft EA states that "care will be taken to minimize contact with preexisting fault zones". The EA ~~fails to clarify~~ which fault zones may be contacted. ~~Since~~ a limited amount of flexibility is available for construction of the proposed repository in Yucca Mountain, it is necessary for the DOE to accurately ~~estimate the~~ location ~~of potential~~ fault zones. To maximize the ~~amount of~~ area within the repository while avoiding faults, the location, configuration, and width of faults and fault zones must be ~~known~~.

The NRC suggests the DOE consider presenting a discussion of the faults ~~to be avoided and to include a discussion of the fault parameters identified above.~~ (Rice 3/9/85)

6-130

Section 6.3.1.7, Potentially adverse conditions, Page 6-224, Continuing Paragraph

The draft EA states that the lack of fault scarps on or near Yucca Mountain ~~has~~ that are demonstrably younger than 40,000 years indicates that there ~~has~~ been no repeated normal movements on faults in the vicinity. As stated in the SAIC technical report (1984), fault plane solutions for the central and western portions of the Basin and Range Province show varied distributions of pure normal, oblique normal, and strike-slip solutions. The SAIC report also states that the nature of the motion on the fault will influence the likelihood that a large scarp is generated by a large earthquake.

It is suggested that the DOE ~~should~~ consider evidence of all fault displacements (in addition to normal displacements) when addressing the fault activity in the last 40,000 years on or near Yucca Mountain. (Rice 2/1/85)

6-132

Section 6.3.1.7.4, Tectonics, Potentially Adverse Conditions, Page 6-226 Paragraph 2

See Comment 3-XX. (Rice 2/1/85) (SNESW 13

6-133

Section 6.3.1.7.4, Potentially Adverse Conditions, Page 6-226, Paragraph 3 M&B

This paragraph states that a preliminary conclusion could be made that the north-trending faults at Yucca Mountain should be considered potentially active. This conclusion is in contrast to assumptions made elsewhere in the Draft EA when addressing seismic impacts on the site.

The evidence that suggests faults at Yucca Mountain are active is based on the following: Healy, et al. (1982) report a least principal horizontal stress direction of N70W ± 10 degrees based on hydraulic fracturing techniques, "...stress measurements suggest that the rocks may be extentionally stressed to near the point of failure along certain faults."; various authors have concluded that faults in the Yucca Mountain area, which have north to northeast trend, are potentially active based on the current stress regime, orientation of the faults, and type of faults ~~(normal)~~ (Rogers, et al., 1982 and Healy, et al., 1982); and "Although none of these data or arguments are conclusive, a combination of the stress data, the historical seismicity of the region, and the indication from current seismicity that fault activity depends more on fault orientation than on fault age suggests that there is a potential for significant seismicity on faults at or near Yucca Mountain (Rogers, et al., 1983), despite geologic evidence of general long-term tectonic stability in the last 10 million years (personal communication from W. Carr, USGS, 1984)." (page 6-227, paragraph 1). BJR

The DOE makes the assumption that the faults at Yucca Mountain are not active when addressing the calculation of maximum peak expected ground acceleration at the site. The consequences of doing this results in lower estimates than if the faults were assumed to be active. The DOE states that this maximum peak acceleration is 0.4g assuming a magnitude 6.8 earthquake were to take place on the Bare Mountain fault (located 14km west of the proposed site). The Solitario Canyon fault is located within a kilometer of the site and is approximately the same length and orientation as the Bare Mountain fault. If the faults at Yucca Mountain are assumed to be active, then the Solitario Canyon fault would be potentially active. Assuming a magnitude 6.8 earthquake were to occur on the Solitario Canyon fault, ~~using the same technique the DOE~~ 85/03/12

OF ACCELERATION

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~~used for the Bare Mountain fault~~, the peak deterministic ground acceleration at the site could exceed ~~1.0g and would exceed~~ 0.4g. In addition, the Ghost Dance fault, which intersects the proposed repository, would also be considered active. An earthquake on the Ghost Dance fault would most likely produce accelerations in excess of 0.4g at the repository level.

The DOE should consider re-evaluating the nature of activity of the Yucca Mountain faults when addressing the guidelines that require estimates of ground acceleration at the site. The DOE should also ~~consider maintaining~~ BE consistent throughout the EA when discussing the nature of fault activity in the geologic setting of Yucca Mountain.
(Rice 2/1/85)

6-134

Section 6.3.1.7.4, Tectonics, potentially adverse conditions, Page 6-229, Table 6-33

The nature of uplift and subsidence in the Yucca Mountain region must be accurately assessed in order to determine its impacts on rates of erosion. Erosion is a potentially adverse geomorphic process affecting the isolation of waste at Yucca Mountain.

Table 6-33 shows vertical tectonic uplift rates for various locations in the Great Basin. One location is the "Sierra Nevada Owens Valley - White -Inyo Mountains", with a 0.4m/1000 yr vertical rate. ~~is ascribed to this location.~~ The reference listed for this vertical rate is an "average of 9 estimates from the literature". This is difficult to evaluate because it is not clear why the Sierra Nevada and the White Mountains are grouped together, and the data for the estimate ARE not presented. The Sierra Nevada and the White Mountains are separate blocks, and should be considered as separate entities in the tectonic analysis. Although 0.4m/1000 yr may be a good approximation for the Sierra Nevada, Huber (1981) estimates an uplift rate of 0.3m/1000 yr for the Sierra Nevada at 38 degree north latitude, while the White Mountains have been estimated to have an uplift rate of 0.8m/1000 yr (Wallace, 1978) at the northern end.

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The NRC suggests that the DOE ~~consider~~ present~~ing~~ the Sierra Nevada and White Mountains vertical tectonic rates separately and ~~provide the documentation of~~ CONSIDER how this may effect erosion rate estimates at Yucca Mountain.
(Rice 2/1/85)

6-135

6-136

Section 6.3.1.8.2, Data Relevant to the Evaluation, Page 6-236, Paragraph 2

Natural resource exploration has been banned within the Nevada Test Site for the last 30 years. Because of this, the analysis of past and present mines and surface workings in the region may not be a good indicator of economic potential. This is particularly true since "Geophysical, geological, and geochemical data, as well as historical background, make Wahmonie (on the NTS) a prime exploration target for precious metals." (NBMG, 1933). The NRC suggests that the discussion in this section ~~include a qualification of the~~ PLACE THE data used in the survey by Bell and Larson (1982) ~~and~~ how it impacts the conclusions for each applicable guideline in this section. IN THE PROPER CONTEXT AND EXPLAIN
(Rice 2/1/85)

6-137

Section 6.3.2, Postclosure System Guideline (10 CFR 960.4-1), Pages 6-246 to 6-252

It is stated in the draft EA (page 6-246, paragraph 3) that the waste-disposal system consists of a natural-barrier subsystem (the geologic setting at the site) and an engineered-barrier subsystem (the waste package and the mined repository). However, the definition of the engineered-barrier system as stated in 10 CFR 60.2 includes the waste packages and the underground facility (underground facility does not include shafts, boreholes and seals). The DOE should use the 10 CFR 60 definition of the engineered-barrier system in the final EA and base the evaluations of the environmental impacts on that definition.
(Dinesh Gupta 2/1/85)

6-139

Section 6.3.2, Postclosure System Guidelines (10CFR960.41), Pages 6-246 through 6-252

The preliminary analysis of the postclosure system guideline presented in this section states that the results may be bounding estimates because of the conservative assumptions made on pages 6-246 through 6-252. The conclusion that Yucca Mountain will meet the requirements of the proposed EPA 40CFR191 and NRC 10CFR60, is based solely on these proposed conservative assumptions. The analysis and in turn the conclusion does not reflect the treatment of uncertainties affecting most of the subsystem parameters. Since the analysis is based on the main assertion that the groundwater travel time within the unsaturated rocks of Yucca Mountain is sufficiently large that a almost NONE of the radionuclides will be released to the accessible environment within the first 93,000 years after closure (see tables 6.44 and 6.45), an explanation and justification should consider the uncertainties of the flow of water through the unsaturated rocks and the impact on the calculations of groundwater travel time under postclosure conditions.
(Atef Elzeftawy 1/22/85)

6-139

adequate allowances for their potential effect on repository operation and waste retrieval should be made.

It is recommended that the draft EA discuss some of the anticipated problems during waste retrieval operations and the mitigation alternatives. Some of the likely scenarios (USNRC, 1984) worthy of consideration include:

1. The procedure for retrieving waste canisters out of long horizontal holes.

2. Retrieval operations for breached canisters .

3. Retrieval operations, if the preclosure backfilling option is exercised.

4. Retrieval operations in the event of hole liner failure (due to faulty liner installations, corrosion, or borehole decrepitation), especially for long horizontal emplacement holes.

5. Retrieval operations near cave ins, roof falls, or floor heave.

(Dinesh Gupta 2/1/85)

6-151

Section 6.3.3.4.3, Favorable Condition, Page 6-286, Paragraph 2

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See comment 6-XX. (Rice 2/1/85)

SYLVIE HELP

6-152

6-153

Section 6.3.3.4.4, Potentially Adverse Conditions, Pages 6-287, Paragraph 3 and 6-288, Continuing Paragraph

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See comment 6-X.
(Rice 2/1/85)

6-154

Section 6.3.3.4.4, Potentially Adverse Conditions, Page 6-289, Paragraph 1

BJR

The NRC is in the process of preparing a generic technical position on seismotectonic evaluation methods. This paper will cover the types of seismotectonic investigation and evaluation methods which will need to be conducted for a repository. In addition, the NRC will need to separately review the types of structures to be constructed, their functions and the consequences of potential accidents before the actual design requirements can

be determined. At the present time, it is premature to state that the design requirements for nuclear power plants are the same as those required for a waste repository. The DOE should consider stating at this time that the design requirements of structures important to safety will comply with 10 CFR 60 and appropriate EPA regulations.
(Rice 2/1/85)

6-155

Section 6.3.3.4.5, Disqualifying Condition, Page 6-291, Paragraph 2 and Page 6-292, Paragraph 1

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SYLVIE HELP

See comment 6-XX.
(Rice 2/1/85)

6-156

Section 6.4.1, Preclosure Radiological Safety Assessments for Yucca Mountain, Page 6-300

The source term presented for routine operational releases (spent fuel pin leaks that begin while being transported to the repository site) is only one of the source terms expected from the various operations indicated in the facility description, Section 6.4.1.2.2. There will be other source terms associated with cleaning and decontamination of shipping casks, with fuel disassembly and pin consolidation, with the handling of DHLW containers and TRU packages, with the processing of radioactive liquid wastes and with the management of the low-level wastes generated on site. Spent fuel when removed from the reactor has a layer of radioactive matter on its outer surfaces that provides a source term for fuel handling operations even if no leaky fuel pins are present. Leaky fuel pins are present in most spent fuel pools and must be disposed of also. In the contamination found in spent fuel pool water the predominant radionuclides are usually Cesium-134, Cesium-137, Cobalt-58, Cobalt-60, and Ruthenium-106, depending upon the history of the spent fuel and the pool water. It is suggested that the final EA present a Preclosure Radiological Assessment that addresses the source terms originating in the various cleaning, handling, packaging, and processing operations that might be conducted in the Waste Handling and Packaging Facility, the expected emissions after cleanup in the HVAC and any other gaseous waste handling systems, and the resulting radiological impacts in the environment (US NRC,1980).
(T. Mo 1/16/85)

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Results of preliminary performance analyses for the Yucca Mountain site apparently have been used to support guideline findings, although the DOE