RICHARD H. BRYAN
Governor

STATE OF NEVADA

ROBERT R. LOUX
Director

Blue Sac

DOE LII

NUCLEAR WASTE PROJECT OFFICE

OFFICE OF THE GOVERNOR
Capitol Complex
Carson City, Nevada 89710
(702) 885-3744

WM Record File 102.3

WM Project 11
Docket No.
PDR ✓
LPDR ✓

August 21, 1985-01

Distribution:
KEB JOB DRM Linehan
MJB RDM CFR Stablein
(Return to WM, 623-SS) WKerr Sac
DKunihiro
(add. to CRowell)

Donald Vieth
Director
Waste Management Project Office
Department of Energy
P.O. Box 14100
Las Vegas, Nevada 89114-4100

Dear Dr. Vieth:

This letter is a response to your letter of June 19, 1985, confirming a State/DOE meeting on June 21, 1985, and transmitting a series of clarification questions relative to the State's draft EA response comments. Additional clarification questions were presented by your staff at the June 21 meeting. The clarification questions were discussed with members of your staff during the meeting. The attached responses are formal documentation of those clarification discussions.

Please do not hesitate to call if there are any questions or additional clarifications.

Sincerely,

Robert R. Loux
Director

RL/kf

WM DOCKET CONTROL
WM DOCKET CONTROL CENTER
'85 SEP -4 P12:04

8509300089 850821
PDR WASTE
WM-11 PDR

#1023845

763

STATE OF NEVADA

RESPONSE TO QUESTIONS

TO CLARIFY STATE COMMENTS ON THE YUCCA MOUNTAIN DRAFT EA

II - 115

Second line at top: What is the basis for claiming that J-13 water does not appear chemically similar to other ground water at Yucca Mountain?

The following table is a summary of hydrogeochemical data developed from DOE references on Yucca Mountain (references either cited in the draft EA or contained in the NNWSI project library).

	AVERAGE	RANGE	
	YUCCA MOUNTAIN	YUCCA MOUNTAIN	J-13
Mono-valent charge balance	0.43	0.39 - 0.47	0.35
SiO_2/Na	0.29	0.14 - 0.37	0.67
Di-valent charge balance	0.13	0.03 - 0.60	0.73
Na/K	37.0	22.0 - 83.0	9.0

	AVERAGE	RANGE	
	YUCCA MOUNTAIN	YUCCA MOUNTAIN	J-13
Na + Ca/Mg + K	39.0	24.0 - 83.0	8.0
K mg/l	2.3	1.5 - 3.3	5.3
Na/Ca	39.8	6.0 - 155.0	4.0
Na/Ca + Mg*	39.5	6.0 - 154.0	3.0
Mg/K	0.04	.007 - .07	0.3

* Resolved to K = 1 (comparable to Zeolite ratios where K is resolved to unity).

Analysis of this table supports our position that there is evidence to support the statement that J-13 water does not appear chemically similar to other ground water at Yucca Mountain. Further analysis of hydrogeochemical data from individual wells suggests that J-13 is more related to J-12 and UE-29 a # 2 (based on ion ratios) than to wells on Yucca Mountain. If various ion ratios were plotted on a map of the proposed repository, we suspect that this map would also support the contention that J-13 water is not necessarily related to Yucca Mountain water.

II-124

Please provide references on recurrence rates from microseismicity data in the Basin and Range.

Wallace, R.E.., 1978, "Patterns of Faulting and Seismic Gaps in the Great Basin Province" in proceedings of Workshop VI- Methodology for Identifying Seismic Gaps and Soon-To-Break Gaps, USGS open-file report 78-943, p. 857-868.

Ryall, A.S. and U.R. Vetter, 1982, "Seismicity related to geothermal development in Dixie Valley, Nevada", final report of University of Nevada, Reno seismological laboratory on USDOE contract DE-AC08-79NV10054, p.1-102.

Wallace, R.E. and R.A. Whitney, 1984, "Late Quaternary History of the Stillwater Seismic Gap, Nevada", Bull. Seismological Society of America, Vol. 74, p. 301-314.

Greensfelder, R.W., F.C. Kintzer, and M.R. Somerville, 1980, "The Seismotectonic Regionalization of the Great Basin, and the Comparison of Moment Rates Computed from Seismic Strain and Historic Seismicity", Bull. Geological Society America, Vol 81, pp 518-523.

Algermissen, S.T. and others, 1983, "Seismic Energy/Release and Hazard Estimation in the Basin and Range Province", USGS Open-file Report 83-358.

II-122

2nd para: Please provide references in regard to Yucca Mountain being located with (sic) an east-west seismic belt in southern Nevada.

The inclusion of Yucca Mountain within the East-West Seismic Belt is based on the following evidence:

1. Figure 3-9 of the draft EA is incorrectly drawn. The outline of the East-West Seismic Belt does not agree with either Rogers and others (1983), Carr(1984), or the U.S. Geological Survey (1984) who all show this seismic belt merging with the Central Nevada Seismic Belt. In addition, Carr(1984) shows the southern boundary lying much farther south than the boundary on Figure 3-9 (which appears to be arbitrarily drawn since it excludes a large cluster of epicenters on the Nevada Test Site).

2. Yucca Mountain is incorrectly located on Figure 3-9 of the draft EA. Any standard topographic map will show that Yucca Mountain extends north to almost 37°N latitude. Even though the southern boundary of the East-West Seismic Belt is incorrectly drawn on Figure 3-9, the location of Yucca Mountain near the 37th

parallel would still place it on or within the boundary of the seismic belt.

Plotting Yucca Mountain on other maps of the Seismic Zone (Rogers and others, 1983; U.S. Geological Survey, 1984) also shows that at least the northern part of Yucca Mountain lies within the boundary of the belt.

3. DOE's position the Yucca Mountain lies outside of the East-West Seismic Belt appears to be based on the low level of monitored seismicity at the site. The lack of instrumental seismicity at the site, however, is not sufficient evidence to exclude Yucca Mountain from inclusion in, or association with, the active seismic zone. The instrumental record at Yucca Mountain is too short (a few years long) to allow conclusions to be drawn from it. As noted by the U.S. Geological Survey (1984, p. 78), the site itself has been relatively seismically quiet during the last few years, but it is surrounded by several belts of relatively high rates of seismic activity, and the region as a whole must be regarded as seismically active. In addition the DOE states (draft EA, p. 6-288): "Present knowledge about seismic cycles and the relation between seismicity and the age of faulting does not permit confident judgement about the meaning of relative quiescence of faults at Yucca Mountain...".

U.S. Geological Survey, 1984, A Summary of Geologic Studies Through January 1, 1983, of a Potential High-Level Radioactive Waste Repository Site at Yucca Mountain, Southern Nye County, Nevada", USGS open-file report 84-788.

Rogers, A.M., Harmsen, S.C., Carr, W.J. and Spence, W., 1983, "Southern Great Basin Seismological Data Report for 1981 and Preliminary Data Analysis", USGS open-file report 84-854.

II DCNR

What does the State expect to be defined in a memorandum of understanding or a memorandum of agreement with the State Historic Preservation Officer?

State and federal laws govern procedures that must be employed to preserve historic sites and resources in the state. The Department of Conservation and Natural Resources (see DCNR comments in Volume II of the State comments) points out that, under law, DOE must consult with the state (DCNR) in this regard.

DOE should contact Alice Becker, Archeologist at the DCNR, Office of Historic Preservation and Archeology for further guidance in this matter.

We believe that the DCNR comments contained in the State document are self-explanatory and require no clarification. Those comments merely point out that the draft EA failed to consider certain legal aspects relative to historic preservation activities and indicate how DOE can go about complying with applicable requirements.

I-31

Where are the studies at the University of Arizona described, and what is Ross (1984)? It is not listed in the reference list. The University of Arizona has a research contract with the Nuclear Regulatory Commission to look at two aspects of the high-level nuclear waste program:

1) Review of drilling effects and plug performance in crystalline rocks, and

2) Unsaturated flow and transport modeling infractured crystalline rocks.

Numerous reports have been prepared as part of this research. Much of this research is applicable to Yucca Mountain and should be reviewed. NRC contract officer for this work is Thomas J. Nicholson (301) 427-4039.

Ross, Benjamin, 1984, "A Conceptual Model of Deep Unsaturated Zones with Negligible Recharge", Water Resources Research, Vol. 20, No. 11, pages 1627-1629, November.

I-17

The State contends that "by using only average values in addressing potential transportation impacts, DOE effectively underestimates potential risks associate with waste shipments." The DOE believe that conservation was applied to the average values such that the resulting costs and risks are overestimated. Can the State provide specific evidence for transportation risks being underestimated?

We believe- as do many EA reviewers from other states- that the risk analyses performed by DOE in the draft was anything but conservative. Our specific comments concerning transportation (see pages II-32 thru II-35; II-51 thru II-52; II-64 thru II-71; and II-156 thru II-161) explain why we feel that the entire approach used by DOE is faulty. There is in fact, a special section of our comments devoted to risk analysis relative to the transportation appendix (see pages II-156 thru II-159 of our comments).

It would appear to be incumbent upon DOE to demonstrate, as part of the final EA, that it's transportation risk assessment is, in fact, conservative. Our comments are designed to show that DOE has not done that adequately in the draft.

I-17

The State contends that data used in the transportation analysis is not adequate to assess the regional and local effects of the transport of HLW to a repository at Y.M. The DOE needs State designated routes for transport of HLW in order to do a realistic regional analysis. Can the State supply these routes?

As we clearly point out in our comments (see pages I-16;II-33; II-34; II-35; and II-64 thru II-71), the number of available transportation routes into Nevada and within Nevada to Yucca Mountain are extremely limited. We believe that DOE, as part of its transportation analysis, should have examined the most likely routes (both rail and highway) within the state. Even a cursory look at a Nevada road map clearly reveals which routes will most likely be used for waste transportation.

We contend that DOE does not need "designated" routes prior to performing an adequate analysis. The information on potentially preferred routes is readily available, and requires little in the way of speculation to uncover.

Our comments in this regard point out that we found it extremely difficult to see how DOE could claim to have conducted "local" and "regional" transportation analyses without considering routes or without clearly defining what is meant by "local" and "regional".

I-19, II-29, II-30

The State notes that the DOE makes no attempt to project long-range land/water needs (i.e. 100, 500, or 1000 years or more). Is the State aware of any studies that project land/water needs 100 or more years into the future?

Our comments in this regard are intended to point out what we believe to be a significant failing of the draft EA. Not only does the document not attempt to address long-range land/water needs and issues, but it concludes that the repository would be benign with regard to land and water use in Nevada. We contend that, in order to arrive at such a conclusion, DOE must evaluate future land/water use patterns and requirements. County and city planning departments have conducted numerous studies on long term water needs and sources in southern Nevada.

Our comments on these issues are designed show that the draft EA cannot support the conclusions it draws relative to land and water effects of a repository. What the draft EA says is that, because there are no studies (a questionable assumption in itself) relative to long-range land/water use projection, it is appropriate for DOE to conclude that repository effects in their regard will be benign. Our comments point out that it is not possible to make a positive finding (or any finding for that

matter) in the absence of data. We believe that this issue is important enough that it should be addressed, and that the EA is the appropriate place to address it.

II-43

Comments on rural social organization and structure state that Native Americans tend not to be evenly distributed throughout the area. Rather, they reside in somewhat segregated subcommunities. What data are available to substantiate this observations?

Our comments on rural social organization and structure were intended to demonstrate that the treatment of the subject in the draft EA was seriously inadequate and did not provide sufficient foundation for drawing any conclusions relative to possible repository effects. The fact that the draft EA failed to consider the impact of population subgroups on the overall analysis is only a small aspect of the inadequacy we describe.

Even the most inexperienced of social researchers with knowledge of native American settlement patterns and western experience in this regard should have been able to point out the relative seperation of Indian communities from the wider

population - especially in rural, western locales. Information relative to this issue should be readily available from county planning departments, school system, and a variety of other services. It appears that DOE simply did not consider the matter in the draft. We are suggesting that it does so in the final EA.

II-43

State comments suggest that Native Americans living on reservations should be discussed. Does the State have evidence to suggest that Native Americans living on the Moapa or Duckwater reservations may be affected by a repository at Yucca Mountain?

Throughout our comments on the transportation and socioeconomic sections of the draft EA, we point out that Indian issues and impacts are consistently ignored in the analysis contained in the document. The Moapa Reservation encompasses both the primary rail line and primary highway route through southern Nevada. One need only glance at a Nevada highway map to draw the conclusion that Moapa will be affected by high-level waste shipments in the same manner that Clark County communities bordering I-15 or the Union Pacific rail line will be. Our comments on this issue were intended to point out that the draft EA omitted consideration of Moapa tribal impacts just as it omitted consideration of Lincoln County and City of Caliente

impacts. There is sufficient information available from census data, tribal officials, state highway statistics, the Union Pacific Railroad, and other sources for DOE to be able to assess potential impacts of waste shipments through the Moapa reservation.

Duckwater and other Indian reservations may not be impacted as directly as Moapa - depending, of course, on which routes are used for HLW shipments. However, as pointed by the Nevada Indian Commission (see Volume II of the State Comments), the draft EA avoids discussion of key Native American issues that are definitely relevant to determining the potential impacts of a repository an the State and other people who reside in the state (including Native Americans).

II-63

The State indicates plans for the establishment of bighorn sheep in the Spotted Range. Please provide references indicating such plans.

This comment was excerpted from the submission of the Nevada Department of Wildlife which indicated that plans are being made jointly by the state (Dept of Wildlife) and the U.S. Fish and Wildlife Service to locate bighorn sheep in the spotted Range . (See Department of Wildlife comments in Volume II of the State Comments.)

We believe that their comment, like many of the other DOE has questioned, is really self-explanatory and requires no clarification. It is not the role of the state in the EA process to provide DOE with references material. We have, appropriately, pointed our instances where DOE has apparently missed important data, and we have identified where DOE should go to obtain that data. In this case, DOE should contact the State Department of Wildlife for the specifics of any plans under consideration for bighorn sheep in the Spotted Range.

II-51

The State indicates that efforts at NTS to prohibit unauthorized excavation or collection of archeological sites have not been successful. Can evidence of this be provided?

Comments relative to DOE's past performance in prohibiting excavation or collection of archeological sites were derived from the information provided by the State Department of Conservation and Natural Resources, (See Volume II if the State's Comment: pages 10-11 of the DCNR section). For further elaboration relative to the State's concerns, DOE should contact Alice Becker, Archeologist for the Division of Historic Preservation and Archeology, 201 S. Fall St., Carson City, NV 89710 (Phone: 885-5138)

GENERAL:

Could we get complete citations for the following references?

Jacobson, 1982 cited on p.I-24

Ross, 1984 cited on p. I-31

Slemmons, 1984 cited on p. II-130

Ross, Benjamin, 1984, "A Conceptual Model of Deep Unsaturated Zones with Negligible Recharge", Water Resources Research, Vol. 20, no.11, pages 1627-1629, November.

Jacobson, R.L., 1982 "Hydrologic Short Circuits in the Unsaturated Zone-Nevada Test Site" -Abstract, EOS, Vol. 63, No. 18, May 4.

Slemmons, D.B., 1984, "Evaluation of Seismic Hazards in Earthquake-Resistant Design: Identification and Characterization of Active Faults" in Evaluation of Seismic Hazards in Earthquake-Resistant Design, C.B. Crouse and G.R. Martin, eds, EERI pub. 84-06.

DOE should also consider Slemmons (1982) as it forms the basis for Slemmons (1984).

Slemmons, D.B., 1982, "Determination of Design Earthquake Magnitudes for Microzonation," 3rd International Earthquake Microzonation Conf. Proceedings, p. 119-130.

II-122

How would a large earthquake beneath Yucca Mt. influence flux in the unsaturated zone as suggested in this paragraph?

The draft EA stated on page 6-225: "because of the limited water flux that is expected in the unsaturated zone and the long travel times, the impact of earthquakes on containment or isolation is judged to be insignificant." That statement is very conclusive given the extremely limited knowledge of flux in the unsaturated zone. Depending on actual flux in unsaturated zone, a large earthquake could significantly increase fracture permeability, and thus possibly increase flux. Additionally high ground motion from a large earthquake could totally alter the hydrologic regime changing ground-water levels, altering in-situ pressures, and modifying gradients.

Also on p. 6-234 of the draft EA the text states that faulting between the site and ground-water discharge points could affect the ground-water flow system in such a way that the paths of the travel times to the accessible environment could be changed locally. This statement obviously contradicts the previous statement on p. 6-225 and supports our argument that large earthquakes could influence water movement at the site.

II-122

Can you offer published references on the Mammoth Lakes earthquake swarms that might be useful to interpretation at Yucca Mt?

Hill, D.P., R.A. Bailey, A.S.Ryall eds, 1984, "Proceedings of Workshop XIX - Active Tectonic and Magmatic Processes Beneath Long Valley Caldera, Eastern California", USGS open-file report 84-939, January 24-27.

Ryall, F. and A. Ryall, 1982, "Propagation of Effects and Seismicity associated with Magma in the Long Valley - Caldera, Eastern California," Earthquakes Notes, Vol. 53, No. 1, p. 46-47.

Hartzell, S., 1982, "Simulation of Ground Accelerations for the May 1980 Mammoth Lakes, California, Earthquakes", Bull. Seismological Society of America, Vol. 72, p. 2381-2387.

Given, J.W., T.C. Wallace, and H. Kanamori, 1982, "Teleseismic analysis of the 1980 Mammoth Lakes Earthquake Sequence", Bull. Seismological Society of America, Vol. 72, p. 1093-1109.

Cramer, C.H. and T.R. Toppozada, 1980, "A seismological study of the May 1980 and Earlier Earthquake activity near Mammoth Lakes, California", Cal. Division of Mines and Geology Special report 150, p. 91-130.

Julian, B.R., 1983, "Evidence for Dyke Intrusion Earthquake Mechanisms near Long Valley, California", Nature, Vol. 303, p. 323-325.

Ryall, A. and F. Ryall, 1981, "Spatial - Temporal Variations in Seismicity Preceding the May 1980 Mammoth Lakes Earthquakes, California", Bull. Seismological Society of America, Vol. 71, p. 747-760.

Savage, J.C. and M.M. Clark, 1982, "Magmatic Resurgence in Long Valley Caldera, California: Possible Cause of the 1980 Mammoth Lakes Earthquakes", Science, Vol. 217, p. 531-533.

Van Wormer, J.D. and A.S. Ryall, 1980, "Sierra Nevada - Great Basin Boundary Zone: Earthquake Hazards Related to Structure, Active Tectonic Processes, and Anomalous Patterns of Earthquakes Occurrence", Bull. Seismological Society of America, Vol. 70, p. 1557-1572.

Vetter, U.R. and A.S. Ryall, 1983, "Systematic Change of Focal Mechanisms with Depth in the Western Great Basin", Journal Geophysical Research, Vol. 88, p. 8237-8250.

II-130

On what basis do you suggest that an acceleration of 1.0g at the surface facility site could result from an earthquake on the Solitario Canyon fault?

Peak deterministic ground accelerations approaching or exceeding 1.0g at the repository site can be realistically postulated based on the following lines of evidence.

The Solitario Canyon fault is only one of several north-south-trending faults at or near Yucca Mountain which should be considered active; other faults include the Paintbrush Canyon, Bow Ridge, and other numerous unnamed strands comprising an extensive north-south zone of faulting within and bounding both flanks of Yucca Mountain. (The evidence for considering north-south Yucca Mountain faults to be active is listed in our draft EA comments.) The area of potentially active faulting is therefore not necessarily confined to any one specific "named" fault but rather consists of a large zone which encompasses Yucca Mountain, including the respository site.

Historic surface faulting in central, north-central, and western Nevada indicates that faulting associated with moderate-to large -magnitude earthquakes is not restricted to singular fault traces. Faulting associated with the 1954 Fairview Peak earthquake (M 7.1), for example, occurred not only on numerous discontinuous segments but also on opposite sides of the valley (the east flank of Fairview Peak and the west flank of the Clan Alpine Mountains). Consequently, there is substantial evidence that if faulting were to occur in association with a large-magnitude earthquake at Yucca Mountain, movement would not be limited to single fault strands such as the Solitario Canyon fault.

Even in light of the above faulting relationships, large peak ground accelerations can still be predicted solely on the basis of individual fault strands. The length of the Solitario Canyon fault is 24 km; this is measured from Yucca Wash on the north to the southern end of Crater Flat. This length is based on Figure 3 of the U.S. Geological Survey (1984) which shows the Solitario Canyon fault to be part of a north-south-trending fault zone bounding the east side of the caldera underlying Crater Flat. Using the curves of fault length vs. magnitude (Bonilla and others, 1984), magnitudes of 6.5 to 7.0 can be interpolated. Using their regression relationship of $M_s = 6.04 + 0.708 \log L$, a magnitude of 7.0 is calculated for a 24 km length.

Numerous published references indicate peak ground accelerations approaching or exceeding 1.0 g can occur near the epicenter during an earthquake of magnitude $\geq$ 6.5. Maximum near-field ground accelerations of 0.8-0.9 g are widely accepted for $M \geq 6.5$ at distances of 1 to 2 km from the energy source. (See, for example, Seed and Idriss, 1982). These are average values and actual maximum values can be (and have been) greater depending on location and rock conditions. Peak ground accelerations associated with the 1971 San Fernando earthquake (M 6.6) exceeded 1.0 g; a maximum acceleration of 1.24 g was recorded at Pacoima Dam. The proposed repository is less than 1 km from the Solitario Canyon fault, thus placing the repository in a near-field exposure for earthquakes of $M \geq 6.5$ on the fault.

U.S. Geological Survey, 1984, "A Summary of Geologic Studies through January 1, 1983, of a Potential High-Level Radioactive Waste Repository Site at Yucca Mountain, Southern Nye County, Nevada" USGS -open file report 84-792.

Bonilla, M.G., Mark, R.K., and Lienkaemper, J.J., 1984, "Statistical Relations Among Earthquake Magnitude, Surface Rupture Length, and Surface Fault Displacement", Bulletin-Seismological Society of America, Vol. 74, No. 6, p. 2379-2411.

Seed, H.B. and Idriss, I.M., 1982, "Ground Motions and Soil Liquefaction During Earthquakes", Earthquake Engineering Research Institute, Monograph EP-50MNB-5, 134p.

II-130

Given the NRC's implicit approach to appropriate recurrence intervals for seismic design criteria for reactors (1000 to 10,000 years), what recurrence interval would the state reviewers consider acceptable for repositories?

Our comments were directed toward the conclusive statement made in the draft EA that current seismic design criteria and return periods are overly conservative for geologic repositories. It is presently unknown what NRC's position will be relative to seismic-design criteria and return periods for repositories. Reiter and Jackson (1983) acknowledge that return

periods on the order of 1,000 or 10,000 years for seismic design spectra have been implicitly accepted by the NRC in recent licensing hearings for reactors, however the applicability of these return periods to geologic repositories is conjectural at this time. Reither and Jackson further state that while the 100 year spectra is currently accepted, it is not possible to define with any certainty that the true return period is 1000 years. They further acknowledge that at the present time there is no way of establishing rigourously defined confidence limits to return periods.

II-132 and IV-153

What evidence do you have that "there seems to be wide fluctuations in chemical composition with time for single wells" at Yucca Mt.?

The following references provide information on the topic of concern:

1. Bryant, E.A. and D.T. Vaniman, 1984, "Research and Development Related to the Nevada Nuclear Waste Storage Investigations: July 1- September 31, 1983", Los Alamos National Lab. Report LA-10006-PR.

2. Benson, L.V., J.H. Robison, R.K. Blankennagel, and A.E. Ogard, 1983, "Chemical Composition of Ground Water and the Locations of Permeable Zones in the Yucca Mountain Area, Nevada", U.S.G.S. Open-file Report 83-854.

3. Ogard, A.E. and J.F. Kerrisk, 1984, "Ground Water Chemistry Along Flow Paths Between as Proposed Repository Site and the Accessible Environment", Los Alamos National Lab. Report LA-VR-10188-MS.

4. Young, R.A., 1972, "Water Supply for the Nuclear Rocket Development Station at the U.S. Atomic Energy Commission's Nevada Test Site", USGS Water Supply Paper 1938.

These references provide hydrochemical data for seven well sites located on Yucca Mountain or juxtaposed to Yucca Mountain. The well sites are: J-12, J-13, UE 25 b#1, UE 29 a#2, H-1, H-5, USW VH-1. While the data was collected during different time periods time, six of the wells show significant variations in chemistry with time (site VH-1 showed little variance during three sample periods in 1981). The most significant variations occur in Carbon-14, del Deuterium, Fluoride, Bicarbonate, Chloride, and in some cases Calcium, Potassium, Magnesium, and Strontium.

The term "wide fluctuations" used in our draft EA comments might be better stated as "significant fluctuations". The variations observed in the chemical data may not necessarily affect water quality, but most certainly could be responsible for variations in hydrogeochemical reactions.

Schilling letter to Loux

Point (2) What is the basis for concern about felsitic eruptions in the area when there has been no silicic activity in southern Basin and Range for the past 5-6 my?

The Great Basin is a geologically active area. Just because there has been no silicic volcanic activity for the past 5-6 my does not dismiss the possibility of future activity. Mono Craters is an example of recent volcanic activity in the Great Basin. Statements made in the draft EA are too conclusive about future volcanic activity given the limited studies performed to date.

What "deep circulating springs" close to Yucca Mountain do you think should be examined, and how would you suggest examination be done?

Garside and Schilling (1979) and Trexler, Flynn and Koenig (1979) both identify thermal springs in the vicinity of Yucca Mountain.

We think these springs should be sampled and analysed for both temperature and chemistry. The objective would be to determine if these thermal springs have a volcanic origin. Analysis of thermal springs is another tool to help determine whether there is a potential volcanic hazard at the site.

Bell's comments--App. A 10 CFR 100

What is your rationale for thinking that App. A should be applied to a nuclear waste repository, especially considering that the unofficial NRC position is that new criteria will be developed for repositories?

The rationale for applying Appendix A of 10 CFR 100 (seismic and geologic siting criteria for nuclear power plants) is that DOE has already acknowledged and use these criteria. The Appendix A criteria, furthermore, are the only established standards for nuclear facilities. Therefore, we find this question somewhat puzzling and not founded on a thorough knowledge of what DOE has already adapted for use in the draft EA.

The Preclosure Favorable Tectonics Condition (Section 6.3.3.4.3) states: "The nature and rates of faulting, if any, within the geologic setting are such that the magnitude and intensity of the associated seismicity are significantly less than those generally allowable for the construction and operation of nuclear facilities." (emphasis added.) DOE evaluates this favorable

condition using Appendix A criteria. The Draft EA (p. 6-286) indicates that there is an apparent lack of significantly faulting during the last 40,000 years ("no unequivocal evidence") or during the last 500,000 years ("...not had large (more that 1m) surface displacements..."). These "threshold" ages used by DOE (40,000 and 500,000 years) are essentially the same as those established by Appendix A for capable (35,000 years) and recurrent (500,000 years) fault movement.

DOE further evaluates this favorable condition (draft EA, p. 6-287) by indicating that "...nuclear reactors in tectonically active areas... be designed and constructed for peak observed surface accelerations of 0.4 g or more." DOE analyzes the maximum anticipated ground acceleration and concludes that "the peak surface acceleration predicted for Yucca Mountain is not significantly smaller than that generally allowable for nuclear facilities." DOE clearly uses nuclear power plant siting criteria to establish that this favorable condition is <u>not</u> present (draft EA, p. 6-287).

<u>Bell's Comments - p.19</u>

How did you arrive at your recommended scenario of "an earthquake with 3-m displacement could occur at the repository in the next 10,000 years"?

This question and the question on the isolation period for tectonic processes are related to our concern with DOE's statement in the draft EA (p. 6-234) that "No mechanisms have been identified whereby future tectonic processes or events could lead to unacceptable radionuclide releases."

Based on existing evidence (previously discussed in our draft EA comments) there is a significant potential for at least one large-magnitude earthquake at or near the repository during the next 10,000 years. Using DOE's guidelines for conservative assumptions (draft EA, p. 6-4) we estimated a maximum anticipated surface rupture of 3 meters. This is based on an earthquake of M 7 and on the statistical relationships developed by Bonilla and others (1984) for fault displacement and magnitude.

The proposed 3-m displacement is also based on observed surface ruptures associated with both the 1954 Fairview Peak (M 7.1) and Dixie Valley (M 6.9) earthquakes in west-central Nevada. It is also based on the fact that a 3-m displacement is commonly used as a paleoseismic indicator of $M \geq 7$ earthquakes (Wallace, 1978; Bell, 1984b).

We would like to point our that the use of a 3-m displacement for potential surface faulting is not inconsistent with previous draft EA comments which show that small displacements ($<$1m) may have been associated with large-magnitude earthquakes at Yucca

Mountain. Displacements of both orders of magnitude have been observed in areas of historic-faulting in central and western Nevada. Small (<1m) displacements were associated with the 1932 Cedar Mountain (M 7.3), the 1934 Excelsior Mountains (M 6.3), the July, 1954 Rainbow Mountain (M 6.6), and the August, 1954 Rainbow Mountain (M 6.8) earthquakes. On the other hand, large (up to 5 m) displacements occurred during the 1915 Pleasant Valley (M 7.2), 1954 Fairview Peak (M 7.1) and Dixie Valley (M 6.9) earthquakes. Based on DOE's guidelines for conservative interpretations, it seems clear from the historical record that both large and small displacements should be evaluated for repository siting.

Bonilla, M.G. Mark, R.K. and Lienkaemper, J.J., 1984, "Statistical Relations Among Earthquake Magnitude, Surface Rupture Length, and Surface Fault Displacement", Bulletin-Seismological Society of America, Vol. 74, No. 6, p. 2379-2411.

Bell, J.W., 1984, "Holocene Faulting in Western Nevada and Recurrence of Large Magnitude Earthquakes," Western Geological Excursions, Guidebook for 1984 Annual Meeting, Geological Society of America, v. 4, p. 388-401.

Wallace, R.E., 1978, "Patterns of Faulting and Seismic Gaps in the Great Basin Province", USGS Open-file report 78-943.

Bell's Comments - p.19

Given that the Implementation Guidelines explain how the Technical Guidelines are to be used, on what basis do you justify your position that the isolation period for tectonic processes should be extended to 100,000 years, particularly considering that the EPA criteria for releases to the accessible environment apply thru 10,000 years ?

The evaluation of this conservative assumption is justified by DOE's guidelines (draft EA, P. 6-4) and by DOE's Postclosure Favorable Hydrologic Condition (Section 6.3.1.1.3) which states (draft EA, p. 6-121): "The nature and rates of hydrologic processes operating within the geologic setting during the Quaternary Period would, if continued into the future, not affect or would favorably affect the ability of the geologic repository to isolate the waste during the next 100,000 years".

Tectonic activity, in particular surface faulting, must be included as part of the "nature and rates of hydrologic processes" in order to identify mechanisms which could lead to unacceptable radionuclide releases. This is implicit in DOE's evaluation of the Postclosure Tectonics Qualifying Condition in

which they state (draft EA, p. 6-234) that "...faulting between the site and ground-water discharge points could affect the ground-water flow system in such a way that the paths or the travel times to the accessible environment could be changed locally."

Tectonic processes, including faulting, fracturing, and regional warping, will clearly influence the nature of hydrologic processes expected during the next 100,000 years. This linkage needs to be evaluated either in the postclosure tectonics section (Section 6.3.1.7.6) or in the hydrologic conditions section (6.3.1.1.3).