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STATE OF NEVADA
EXECUTIVE CHAMBER

Carson City, Nevada 89710

BOB MILLER
Acting Governor

TELEPHONE
(702) 683-6670

11/21...To EDO for Appropriate Action...Cpys to: RF, EDO, LSS, GPA
89-1246

November 14, 1989

The Honorable James D. Watkins
Secretary of Energy
1000 Independence Avenue
Washington, D.C. 20585

Dear Secretary Watkins:

In view of your announced current effort to restructure the U. S. Department of Energy Nuclear Waste Policy Act program, I believe it is important that I provide you with some of our information and thoughts on the Yucca Mountain Project that may bear on your upcoming decisions.

You will find attached to this letter a brief description of three elements regarding the geotechnical suitability of Yucca Mountain for a geologic repository which the State of Nevada believes should cause the site to be disqualified from further consideration. These are in the areas of (1) the potential for future human intrusion, (2) tectonics, including faulting and vulcanism, and (3) groundwater travel time. Each of these topics has been discussed in past State of Nevada comments on the Draft Environmental Assessment for Yucca Mountain, the Consultation Draft Site Characterization Plan, and most recently, the Site Characterization Plan. However, because of the importance of these issues, I believe they should be brought directly to your attention during your current program evaluation and restructuring.

As you will see from the attached discussion, there is no question that Yucca Mountain is located within a rich mining district that will remain attractive for exploration and development for many years in the future. Because of this location, it is essentially assured that Yucca Mountain and its nearby surroundings, at some time in the future, will be intruded in search of valuable mineral resources, regardless of what any current natural resources evaluation at the site might conservatively conclude. Such a potential for future human intrusion simply cannot be eliminated or even mitigated through either engineering means or passive controls over the long period

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of time required for waste isolation. This attribute of Yucca Mountain, alone, is sufficient reason for you to find, now, that the Yucca Mountain Site is disqualified pursuant to the intent of Section 112(a) of the Nuclear Waste Policy Act, and the DOE siting guidelines (10 CFR Part 960) which were promulgated to implement that section of the Act.

The existing information regarding the number and ages of geologic faults intersecting and associated with the Yucca Mountain Site, coupled with the extremely complex tectonic and hydrologic setting of the site, should certainly serve as a warning that there is significant risk of disruption of repository performance during the waste isolation period. It is also highly questionable whether geophysical technology exists, or can become available by the time needed, to test the site parameters necessary for characterization of the tectonic setting and site performance assessment. If the standards of conservative technical judgment and the use of reasonably available technology called for in the DOE siting guidelines are applied, as they must be, once again, there exists now, sufficient reason for disqualification of the site pursuant to the guidelines.

In the area of hydrology, as related to groundwater travel time evaluations, the DOE appears to have abandoned any pretext of conservative scientific assumptions, and has embraced with enthusiasm an unwarranted optimism.

While a thick unsaturated zone surrounding a geologic repository may appear beneficial to waste isolation in a generic sense, characterizing that zone at Yucca Mountain sufficiently to assure an understanding of present groundwater movement is beyond available hydrologic modelling and testing capabilities. Furthermore, the ability to validate such models, as is required for use in long-term performance assessment relative to the site hydrology, does not exist at present, and likely cannot be achieved within the time period available for site characterization. The scientific community acknowledges that the science of unsaturated zone hydrology necessary for characterization and modelling of future performance is in its infancy. It further recognizes that it will take considerable basic research and time, first in settings less complex than Yucca Mountain, to bring this discipline to a level of maturity and validation sufficient for acceptable application to the Yucca Mountain project.

Aside from the problem of hydrologic modelling of the unsaturated zone, Nevada's previous reviews and comments have pointed out that conservative calculations using DOE's Yucca Mountain data can show that the NRC's groundwater travel time standard for licensing would be violated, even if DOE's optimistically postulated slow matrix flow condition prevails. Evaluation of existing data shows that the faster, fracture flow condition exists, and suggests that it likely prevails. Therefore,

the DOE guidelines requiring use of both reasonably available technology and the application of conservative technical judgment cannot be met, again providing sufficient reason now for you to determine, pursuant to the guidelines, that the Yucca Mountain site is disqualified.

In addition to the evidence attached and summarized above which should result in your immediate disqualification of the Yucca Mountain site, there are further factors which I would like to bring to your attention prior to your announcement of decisions regarding restructuring of the Nuclear Waste Policy Act program.

As I am sure you are aware, it has been my belief that the Nevada Legislature's adoption, and my signature of Assembly Joint Resolutions Number 4 and 6, in early 1989, constituted a Notice of Disapproval of the Yucca Mountain site, pursuant to the Nuclear Waste Policy Act. The Notice became effective once these resolutions opposing, and refusing State consent for, a repository were transmitted to the Congress as required by law. In order to reassure myself on this matter, I requested an opinion from the Nevada Attorney General regarding the validity of the resolutions as a Notice of Disapproval. For your information, I have attached a copy of the Attorney General's Opinion, which finds that the Notice is valid and that the Congress failed to respond in the manner required by the Nuclear Waste Policy Act. Therefore, it is Nevada's position that the Yucca Mountain site has been lawfully vetoed, and that the DOE's authority from Congress to pursue the Yucca Mountain site as a nuclear waste repository has terminated.

As you are also aware, there are numerous obstacles that have already, or likely will continue to halt or impede progress on the Yucca Mountain Project, only some of which are within your ability to control and resolve within the Department of Energy. The following are a few examples of obstacles in addition to those discussed in the attachments to this letter: there are at least two unrelated endangered species issues which must be reconciled with the federal agency of jurisdiction; acquisition of protested, although needed water rights from the State of Nevada for the Yucca Mountain project must be accomplished; numerous lawsuits regarding both the DOE's programmatic implementation of the Nuclear Waste Policy Act and the Yucca Mountain Project are pending, any one of which could invalidate key past actions of the DOE and cause significant further delays and reversals; and, there are significant unresolved issues regarding the compatibility of the missions of the Nevada Test Site and the Nellis Air Force Range with acceptable nuclear waste management and isolation at Yucca Mountain.

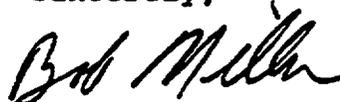
I must also remind you that it is of more than passing interest that the people of the State, joined by the Legislature, are firmly resolved to oppose the imposition on Nevada of a disposal site for the nation's commercial nuclear waste. The

singling out a state for imposition of such an unwanted federal intrusion is without precedent in our nation's history, and rightfully so. I, as Governor, cannot permit Nevada's rights as a state to be so abridged without exhausting every available challenge.

In light of your responsibilities as the federal official charged by law with implementation of the Nuclear Waste Policy Act and prudent administration of the ratepayer-funded Nuclear Waste Fund, I believe you are compelled now to exercise your duty under the Nuclear Waste Policy Act and inform the Congress, and the Governor and legislature of Nevada, that you have removed the Yucca Mountain site from further consideration as a high-level nuclear waste repository.

It is my hope that you will consider seriously the matters I have presented in this letter before proceeding with any decisions to restructure the Nuclear Waste Policy Act program and the Yucca Mountain Project.

Sincerely,



Bob Miller
Governor

Attachments (2)

**SUMMARY STATEMENT OF GEOLOGIC AND HYDROLOGIC DEFICIENCIES
SUPPORTING DISQUALIFICATION OF THE YUCCA MOUNTAIN
POTENTIAL NUCLEAR WASTE REPOSITORY SITE**

INTRODUCTION

Section 113(c)(3) of the Nuclear Waste Policy Act, as amended by the NWPA of 1987, provides, in part, as follows:

"If the Secretary at any time determines the Yucca Mountain site to be unsuitable for development as a repository, the Secretary shall -

(A) terminate all site characterization activities at such site;

(B) notify the Congress, the Governor and the legislature of Nevada of such termination and the reasons for such termination;

(C)

(D) take reasonable and necessary steps to reclaim the site and to mitigate any significant adverse environmental impacts caused by site characterization activities at such site;

(E)

(F) report to Congress not later than 6 months after such determination the Secretary's recommendations for further action to assure the safe, permanent disposal of spent nuclear fuel and high-level radioactive waste, including the need for new legislative authority."

Sufficient information exists to compel the conclusion that Yucca Mountain is unsuitable for development as a repository and thus to invoke the provisions of §113(c)(3). This information has been developed by the Department of Energy (DOE) itself, or its contractors, and thus is found in the agency's records, or has been developed or brought to DOE's attention by the State of Nevada, the Nuclear Regulatory Commission (NRC), or others, and is thus reasonably available to the Secretary. This Statement will set forth that information, and demonstrate how it requires that the site be found unsuitable.

Before proceeding a disclaimer is necessary, however. Nevada's primary message in this Statement is that under the Secretary's final guidelines for siting nuclear waste repositories, adopted as required by the NWPA, disqualifying factors clearly exist. Further efforts to demonstrate the site's suitability would prove fruitless, and thus characterization should not proceed and work at and in support of the Yucca Mountain site should be terminated under the provisions of §113(c)(3) of the NWPA, as amended. The State believes that those guidelines are invalid under the NWPA, and has challenged them under §119 of the Act in the Ninth Circuit Court of Appeals. See Nevada v. Watkins, No.

85-7308 (managed under EPI v. Watkins, No. 84-7854).¹ In showing unsuitability under those guidelines in this Statement, Nevada, in no way intends to concede their validity or operative effect as to the State, or to retreat from any of the positions stated in its Petition for Review which is pending before the Ninth Circuit. Even though they may not be applied to the disadvantage of the State of Nevada, until those guidelines are declared invalid by the courts, they bind the Secretary in his conduct of the repository siting and development program. Even under those guidelines, invalid as they may be, sufficient information exists in the current record, or is reasonably available to the Secretary, to conclude that Yucca Mountain is disqualified under his own siting guidelines, and thus to compel his abandonment of any further efforts to characterize the site.

Recent events make crystal clear that the Department's repository siting program has arrived at the point where prudence dictates that no further expenditure of federal, or state, time and effort, or rate-payers' money, is warranted on attempting to qualify the Yucca Mountain site under the Secretary's own siting

¹ In that challenge, Nevada, as well as the other petitioners, assert that the Secretary's final guidelines do not go far enough; that they do not contain enough disqualifying factors, that certain potentially adverse conditions should in reality constitute disqualifying factors, and that certain other considerations required under §112 of the NWPA, which would themselves mandate disqualification of the Yucca Mountain site, are missing from the guidelines entirely. We thus take the position, in that litigation, that had the Secretary in 1984 adopted guidelines strictly in compliance with the requirements of the NWPA the Yucca mountain site would not have gotten as far as it has in this process.

guidelines. The camel will simply not pass through the eye of the regulatory needle. The State hopes that this document will show, to the informed and objective reader, that in three specific areas at least, the site is, and will remain disqualified.

THE ROLE OF THE GUIDELINES

Section 112(a) of the NWPA, 42 USC 10132, requires the Secretary to adopt guidelines which:

"shall specify detailed geologic considerations that shall be primary criteria for the selection of sites in various geologic media. Such guidelines shall specify factors that qualify or disqualify any site from development as a repository, including factors pertaining to the location of valuable natural resources, hydrology, geophysics, seismic activity, and atomic energy defense activities, proximity to water supplies, . . . ". (Emphasis supplied

The Secretary did adopt such guidelines, roughly a year and a half later than the statute required. 10 CFR Part 960. The guidelines contain various qualifying, disqualifying, favorable and potentially adverse conditions. This Statement will focus primarily on three disqualifying conditions, in the areas of

mineral resources (human intrusion), tectonics, and hydrology (ground water travel time).

The guidelines contain, as good science and prudence would require, a significant constraint on the Secretary's handling of the scientific information developed in the course of the siting process. That is, conservative assumptions must be throughout. Section 960.3-1-4-2, which is part of §960.3-1-4, Evidence For Siting Decisions, provides, in part, as follows:

"In developing the above-mentioned bases for evaluation, as may be necessary, assumptions that approximate the characteristics or conditions considered to exist at a site, or expected to exist or occur in the future, may be used. These assumptions will be realistic but conservative enough to under-estimate the potential for a site to meet the qualifying condition of a guideline; that is, the use of such assumptions should not lead to an exaggeration of the ability of the site to meet the qualifying condition." (Emphasis supplied)

That provision is explained in the supplementary information to the guidelines themselves, at 49 FR 47728, (12/06/84) as follows:

"Included in the provision for evidence is a discussion about the use of assumptions. Before site characterization is completed, preliminary assessments of the potential of the site to meet the qualifying conditions

must necessarily employ judicious assumptions where definitive data are missing. Many commentators were concerned that consistent optimism in such assumptions would create benefits out of deficiencies in the scope of field testing and research undertaken by the DOE. Accordingly, §960.3-1-4 only allows the use of assumptions that would tend to underestimate the ability of a site to meet the qualifying conditions. Such assumptions are commonly termed 'conservative' because they are chosen to minimize the possibility that later findings will prove the assumptions to be wrong. This is a commonly used approach in engineering and in scientific predictions. Where some data exists, a statistical range of uncertainty may constrain the latitude of such assumptions. Even where no direct data exist, it is often possible to establish a sufficient conservative range of values by examining comparable situations in nature and by inference from related phenomena." (Emphasis supplied)

Unfortunately, as many commentators (including Nevada) suggested even in 1983 and 1984, consistent optimism in DOE's assumptions continues to pervade the Department's entire technical program. In the simplest terms, Nevada's argument can be summarized as follows: The Secretary is required, not only by good science and the prudence required of him as fiduciary, but his own guidelines, to apply conservative assumptions where uncertainty exists in the data available to him at any stage in the siting process. The application of such conservative assumptions, at least in the areas of natural resources (human intrusion), tectonics and hydrology, require him to conclude, at this stage, that not only will the qualifying conditions of the guidelines not be met at the conclusion of site characterization, but that the disqualifying conditions applicable in each of those cases currently exist.

NATURAL RESOURCES (HUMAN INTRUSION)

Two guidelines sections are directly applicable, and require a determination, based on the current record, that the Yucca Mountain site is unsuitable for development as a repository.

Section 960.4-2-8, Human Interference, reads as follows:

"The site shall be located such that activities by future generations at or near the site will not be likely to affect waste containment and isolation. In assessing the likelihood of such activities, the DOE will consider the estimated effectiveness of the permanent markers and records required by 10 CFR Part 60, taking into account site specific factors, as stated in §§960.4-2-8-1 and 960.4-2-8-2, that could compromise their continued effectiveness."

The natural resource postclosure disqualifying condition, §960.4-2-8-1(d), reads in part as follows:

"The site shall be disqualified if -
(1) . . .
(2) Ongoing or likely future activities to recover presently valuable natural mineral resources outside the controlled areas would be expected to lead to an inadvertent loss of waste isolation."

This section provides that a site must be located in a place where "activities by future generations at or near the site will not be likely to affect waste containment and isolation." The record currently indicates, as will be demonstrated, that the Department must assume that some exploration activities by future generations will take place, if not at, then certainly near the site. The Department must also assume that those activities may affect waste containment and isolation. Likewise, the Department must assume that the estimated effectiveness of the permanent markers and records required by 10 CFR Part 60 will be less than 100 percent - that they will be unable to prevent all human intrusion. Again, with respect to the disqualifying condition, the Department must assume, based on the present information available to it, that future exploration will take place to recover valuable natural resources outside of the controlled area, and that those activities should be expected to lead to some inadvertent loss of the waste isolation capability of the site.

Numerous Nevada ore deposits demonstrate common geologic features, many of which exist within the Yucca Mountain area. These features include certain types of rock alteration, and a distinct geochemical signature (gold, silver, arsenic, mercury, antimony, molybdenum, zinc, barium, and fluorine). Also these ore

deposits are commonly found along and within faults and breccia zones, and are often associated with felsic or granitic dikes, plugs, sills, and stocks. Late stage barite (with or without fluorite) veins is common. All of these features exist within the immediate Yucca Mountain area.

Economically important mineralization within hydrothermal mineral deposits is obvious in several locations in the Yucca Mountain region. This is true in the Bullfrog Hills and at Bare Mountain, and probably at Wahmonie as well. In Bullfrog Hills, ore grade gold/silver mineralization is largely hosted by rocks of the Timber Mountain-Oasis Valley caldera complex and has been in the past, is currently, and will certainly in the future be exploited.

The Yucca Mountain area presents a favorable geologic environment in which to find hydrothermal mineral deposits. Hydrothermal activity has taken place as a result of repeated magmatic and volcanic activity. The area has abundant faults, and a complex structural history. Gold Bar, Sterling, Daisy and Bond Bullfrog are producing mines in the vicinity of Yucca Mountain. Other mines in the vicinity, such as Gexa's Mother Lode, are currently in the development stage. Other areas, such as the Cordex claims (Bare Mountain), Transvaal and Thompson Mine northwest of Yucca Mountain, and the Calico Hills, Wahmonie, and

Mine Mountain areas within the Nevada Test Site are areas with geochemistry and geologic conditions favorable to mineral exploration.

Typical host rocks of mineral deposits in the Yucca Mountain area include dacitic to rhyolitic volcanic rocks and Paleozoic sedimentary rocks. Silicification, adularia, and argillic alteration are present and the mines and prospective mines show similar chemical signatures, such as elevated concentrations of one or more of the following: gold, silver, barium, arsenic, antimony, lead, copper, zinc, molybdenum, mercury, and fluorine. Favorable structures exist, such as faults, breccias and contacts, and dikes, plugs, and stocks are present in the area.

Yucca Mountain contains features that are suggestive of mineral potential. Hydrothermal alteration of the type associated with epithermal mineralization is clearly evident in the very limited published data from the subsurface of Yucca Mountain. In the subsurface hydrothermal mineral assemblages include quartz, illite, albite, K-feldspar, chlorite, calcite, pyrite, fluorite, and barite. The data available show elevated concentrations of fluorine, barium, zinc and gold in the subsurface. Elevated concentrations of arsenic, antimony, mercury, zinc, molybdenum, lead, and gold are present in altered rocks in Trench 14, less than

1 mile from the repository site. Elevated arsenic, mercury and gold concentrations are also present at the surface of Yucca Mountain in the Prow Pass and Claim Canyon areas. The elevated concentrations of one or more of these elements at various locations demonstrate that the hydrothermal system or systems were metal bearing. Radiometric dating and stratigraphic relations show that hydrothermal activity at Yucca Mountain is the same age as hydrothermal activity and mineralization in the Bullfrog Hills, northern Bare Mountain, Transvaal, Calico Hills, and Mine Mountain areas. The same volcanic rock units of which Yucca Mountain is composed host gold/silver ore at Gold Bar, Bond Bullfrog, the Cordex prospect, and at Mother Lode deposit. Finally, Yucca Mountain contains numerous faults and breccias, and high permeability channels that could have been favorable conduits for hydrothermal fluid circulation and mineral deposition.

The recent discoveries of mineral deposits in areas near, and even adjacent to, Yucca Mountain reflect increased and successful mineral exploration in the region. Such discoveries and successful exploration efforts make hydrothermally altered areas of the southern part of the southwestern Nevada volcanic field much more attractive to explorationists than was the case in the past.

In summary, the Yucca Mountain site is within an area of

widespread base and precious metal mineralization. Currently there is intense mineral exploration and development in all areas surrounding Yucca Mountain that are open to entry. Because, historically, where known or perceived mineralization exists, exploration and the resulting human intrusion has always taken place, it must be assumed that will be the case here, and that human intrusion, affecting the Yucca Mountain site, will also take place in the future, certainly during the 10,000 to 100,000 years within which the emplaced spent fuel and high-level waste must be isolated.

All of the information discussed above suggests that valuable mineral resources in the immediate area surrounding Yucca Mountain must be recognized, along with the potential for resulting human interference and intrusion at the site. Yucca Mountain is surrounded by nearby mineral districts that host at least one world class gold deposit (Bullfrog).

The presence of extensive subsurface rock alteration, a feature characteristic of hydrothermal mineral deposits, and being within an area already containing valuable working mines, means that the Yucca Mountain area will unquestionably attract exploration in the future. Explorationists, as history has proven time and time again, are much more likely to test even those areas

with the least promising surface characteristics when they find themselves in such a prolific area. In fact, in any particular area exploration is rarely a one shot effort. Repeated testing, often separated by years or decades, by successive companies, is the norm rather than the exception. This is particularly true during times of favorable metal prices, a factor which is and will remain, totally outside of the control of DOE.

The Department should recognize the evidence it has at hand and disqualify the Yucca Mountain site on the basis of the human interference guideline.

TECTONICS

The tectonics disqualifying condition, §960.4-2-7(d) reads as follows:

"A site shall be disqualified if, based on the geologic record during the Quaternary period, the nature and rates of fault movement or other ground motion are expected to be such that a loss of waste isolation is likely to occur."

In Chapter 1 of its SCP DOE acknowledges that there are 32 active (Quaternary) faults that either transect or immediately surround the Yucca Mountain site. Such faults are found within the repository block itself. Additionally, late Pleistocene/Holocene volcanic activity exists in the near vicinity of the site. It is not acceptable to assume, under the guidelines, that any of the active faults, particularly those transecting the repository block itself, can be described in sufficient detail to ever resolve with reasonable assurance whether the nature of the present system is such that waste can be safely isolated. Most significantly, future movement on the active faults transecting and bounding the repository block (and some must be conservatively assumed) presents an unacceptable condition for predicting, with reasonable assurance that there will be no loss of waste isolation. Movement on faults will alter the repository geometry in an unpredictable manner. This, for example, could result in open pathways for water movement into and through the repository, thus destroying the integrity of the natural barrier and creating significant pathways to the accessible environment, along with extremely short ground water travel times.

Any movement on these active faults, whether from seismic creep, significant earthquakes on other nearby fault systems, or induced stress from DOE's underground nuclear explosions at the adjacent Nevada Test Site, has the distinct potential for causing

or continuing a condition where waste isolation will be adversely affected, or lost entirely. The nature of the changes brought about by these kinds of conditions is entirely unpredictable, and it is impossible to demonstrate that they will not occur.

NRC regulations (10 CFR 60, 10 CFR 100, Appendix A), and the methodologies and principles employed therein, also provide a de facto disqualifier in this area. Under 10 CFR 60.122(c)(4) and (11) the presence of active (Quaternary) faulting is a potentially adverse condition. Such a condition may compromise the ability of the repository to meet the performance objectives relating to waste isolation. Unless such faulting can be thoroughly investigated (10 CFR 60.122(a)(2)(i)), adequately evaluated using conservative assumptions (10 CFR 60.122(a)(2)(ii)), and shown not to affect significantly the waste isolation capability of the site, it should be considered, as a practical matter, taking into account historical NRC treatment of active faulting near nuclear facilities, unlicensable, and thus disqualified.

The preclosure guidelines also contain a disqualifying tectonic condition, §960.5-2-11(d), which reads as follows:

"The site shall be disqualified if, based on the expected nature and rates of fault movement and other ground

motion, it is likely that engineering measures that are beyond reasonably available technology will be required for exploratory-shaft construction or for repository construction, operation, or closure."

The presence of active faults transecting and bounding the proposed repository block presents a formidable engineering problem. Furthermore, the Department has not demonstrated that there is "reasonably available technology" to deal with those problems now, nor is it likely to be available in the near future. Of particular concern are the hazards associated with possible fault rupture during repository construction and operation.

Several other major problems exist. For example, the sealing problem may be one that cannot be demonstrated to have been resolved. Once the nature of the disturbed zone surrounding all repository openings including faults has been sufficiently characterized (assuming this is possible) between the repository horizon and the saturated ground water system there is the much more difficult problem of developing and demonstrating the adequacy of seals for the faults, as well as for the extensive number of bore holes that will be required to describe them. In developing the sealing program it must be conservatively assumed that movement will occur on one or more of these faults within the next 10,000 to 100,000 years ((§960.4-2-1(b)(2) and §960.4-2-1(d)). Further problems exist with respect to the faults and the disturbed zone

surrounding them relative to canister placement, performance allocation and performance assessment. Because the physical configuration of each emplacement hole and the spacing between holes must be assumed, conservatively, to change unpredictably with time, and because it must be assumed that any such changes will affect waste isolation, realistic performance allocation and assessment will be impossible.

HYDROLOGY (GROUND WATER TRAVEL TIME)

The disqualifying condition for ground water travel time, §960.4-2-1(d), reads as follows:

"The Site shall be disqualified if the pre-waste emplacement ground-water travel time from the disturbed zone to the accessible environment is expected to be less than 1,000 years along any pathway of likely and significant radionuclide travel." (Emphasis supplied)

The available evidence not only supports, but literally demands, a finding that this disqualifying condition exists at the Yucca Mountain site.

The Department's conceptual model of the Yucca Mountain hydrogeologic system is simplistic and not conservative in nature. It assumes that rock matrix flow (water flow within the interconnected pore spaces of the rock itself) will not only dominate, but fracture flow (water flow along ruptures or breaks in the rock) will be absent. It assumes uniformly distributed infiltration from the surface, an absence of existing water, such as perched water or locally saturated zones within the vadose (unsaturated) zone, and it assumes that there will be essentially no net recharge available (less than 1 mm/yr). Based on these optimistic assumptions, extremely long predicted ground-water travel times are calculated by the Department.

The Department was shown, as long ago as March of 1985, when the State submitted its comments on the Draft Yucca Mountain Environment Assessment, that travel times may be much shorter, on the order of 970 years, even while using the Department's preferred matrix flux conceptual model (see Nevada's comments on DOE's Draft EA, Volume II, Specific Comments of the Water Resources Center, Desert Research Institute, The University of Nevada System, at pages 36-39). Even if the Department's rather simple conceptual model of the hydrologic system is applied, conservative calculations would lead to ground-water travel times less than those required in the disqualifying condition.

The Department should recognize the evidence that indicates fracture flow, and assume that it predominates, if not throughout the repository block, then certainly in some portions of the vadose zone. It should further assume that some of these fractures or fracture networks are interconnected from the surface to the repository horizon and from there to the ground-water table.

Water has been encountered within the vadose zone (which is typically more than 60 percent saturated) in the form of perched water or zones of saturation. This leads to the conclusion that fracture flow likely will produce pre-waste emplacement ground-water travel times along a pathway (and no more than one is required under the guideline), of less than 1,000 years. And, it is probably impossible to demonstrate that this is not the case.

The Department currently has ample evidence for the existence of fracture flow in the vadose zone. Fracture flow has been demonstrated to exist in similar tuffs at Rainier Mesa, where an extensive database exists. (Russell, C. E. 1987, "Hydrogeologic Investigations of Flow In Fractured Tuffs, Rainier Mesa, NTS," MS Thesis, University of Nevada, Las Vegas; and Thordarson, W., 1965, "Perched Groundwater In Zeolitized-Bedded Tuff In Rainier Mesa and

Vicinity, NTS", NV.; U.S. Geological Survey Preliminary Report TEI862).

Recent Chlorine-36 data from Yucca Mountain indicate fracture flow from the surface to a depth of approximately 500 feet over relatively short periods of time in borehole UZ1 (North, A. E., 1989, "The Use of Chlorine Isotope Measurements To Trace Water Movements At Yucca Mt.," LA-UR-89-2573, in press-proceedings of American Nuclear Society Topical Meeting-Focus 89, September, 1989).

The Department has demonstrated water within the vadose zone capable of being transported through the repository to the water table, and from there to the accessible environment. DOE drilling has encountered saturation within the vadose zone, in drillhole UZ4, UZ1, and H1. Free water was directly observed in core from UZ4 in September of 1984 by Nevada scientists. Reports for UZ1 and H1 show the presence of saturation as well. The presence of liquid water is direct evidence of fracture flow.

The Department should conservatively assume a reasonable net recharge to the hydrologic system. USGS studies prior to the repository program estimate a net recharge for the area of about

4.5 mm/yr. The Department has acknowledged that if vertical flux is greater than about 1 mm/yr, fracture flow will likely occur, if not predominate. The 4.5 mm/yr rate itself is a reasonable, but not overly conservative estimate. A conservative assumption would hold the 4.5 mm/yr estimate to be a modern climate value only, and that future infiltration and corresponding flux rates will, at least at times, be greater during climatically wetter periods, similar to those well documented during the Quaternary in the region. This, coupled with the 1 mm/yr fracture flow threshold, should disqualify the site.

Authigenic mineralization in the fracture system at Yucca Mountain also indicates that fracture flow exists. The minerals would not have formed without the presence of fracture flow. The presence of minerals such as zeolites located just below the repository horizon indicates massive water interaction with the volcanic glass. Therefore, mineralogical evidence suggests that vadose zone water is being transported in fractures in the stratigraphic zone between the surface of Yucca Mountain and the Calico Hills formation below the repository horizon. The Calico Hills formation has been shown to be highly fractured, and therefore must be assumed to have the capability to transport these vadose zone waters to the saturated zone in a short period of time.

The Department recognizes that fracture flow will be fatal to the project. As recently as December 13, 1988, in an address to the 20th Annual Meeting of the NRC's Atomic Safety and Licensing Board Panel, Dr. Maxwell Blanchard of the Yucca Mountain Project staff said:

"Also, the current evidence indicates that water flow is mostly confined to rock matrix. And I want to talk a little bit about that later, because, that is a fundamental characteristic of waste isolation in the unsaturated zone. If that is not true, we probably do not have a viable site." (Emphasis supplied)

The Department should recognize the existence of fracture flow and acknowledge, for that reason along, that Yucca Mountain is not a "viable site".

The existing data base also suggests that there is active soil gas circulation in the vadose zone at the Yucca Mountain site. If that is the case, then clearly such active upward gas circulation will represent the fastest path to the accessible environment at the ground surface immediately above the repository. Such soil gas circulation will surely provide a means for rapid radionuclide migration (C 14, I 129, Tritium) from failed canisters to the accessible environment well faster than the required minimum

1,000 year travel time. Any site with such a known or suspected condition does not merit further consideration as a repository.

CONCLUSION

The technical deficiencies which are pointed out here can only become more acute with further study of the Yucca Mountain site. The active faults transecting and bounding the repository will remain, and their age will not change. The fact that some movement on those faults might occur is almost inescapable, and must therefore be anticipated. The extensive fracturing in the vadose zone at Yucca Mountain will continue to exist, and the affect of those fractures cannot be compensated for in performance assessment. The mineralization in the immediate area of Yucca Mountain will not disappear, and basic human drives for resource exploration will likewise remain. There is no question that as the nation's mineral resources become scarcer and the need for them grows, areas even less promising than the Yucca Mountain vicinity will become targets for mineral exploration.

Section 960.3-1-5 provides that:

"A site shall be disqualified at any time during the siting process if the evidence supports the finding by the DOE that a disqualifying condition exists or the qualifying condition of any system or technical guideline

cannot be met." (Emphasis supplied)

The evidence supports such a finding for each of the disqualifying conditions discussed in this statement. The time has come to disqualify this site, and to initiate the action required by §113(c)(3) of the NWPA, as amended.