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RICHARD H. BRYAN
Governor

STATE OF NEVADA

ROBERT R. LOUX
Director

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Enclosed please find a copy of the comments prepared by the State of Nevada on the U.S. Department of Energy's draft Environmental Assessment concerning a proposed nuclear waste repository site at Yucca Mountain.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Robert R. Loux
Director

RRL/gjb

Enclosure

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RICHARD H. BRYAN
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SUMMARY OF STATE OF NEVADA COMMENTS ON THE U.S. DEPARTMENT OF ENERGY DRAFT ENVIRONMENTAL ASSESSMENT FOR THE PROPOSED HIGH-LEVEL NUCLEAR WASTE SITE AT YUCCA MOUNTAIN

To The Reader:

In an effort to provide a brief, concise overview of the major areas of concern identified in the State's comments on the U.S. Department of Energy's (DOE) draft Environmental Assessment (EA) for the proposed high-level nuclear waste repository at Yucca Mountain, the Nevada Nuclear Waste Project Office has prepared the following summary of key issues.

THE NUCLEAR WASTE POLICY ACT OF 1982

The Nuclear Waste Policy Act of 1982 established a framework by which the U.S. Department of Energy is to screen and select sites for nuclear waste repositories. Prior to choosing sites for detailed evaluation and testing (called site characterization), the Act requires DOE to prepare Environmental Assessments to determine which three of the nine potentially acceptable sites should be investigated further.

The Act specifies that each EA directly address the following:

(1) an evaluation as to whether the site is suitable for characterization under the siting guidelines (which were developed by DOE pursuant to the Act);

(2) an evaluation as to whether the site is suitable for development as a repository under each such guideline that does not require site characterization to apply the guideline;

(3) an evaluation of the effects of site characterization

activities on public health and safety and on the environment;

(4) a reasonable comparative evaluation of each candidate site with other sites and locations that have been considered;

(5) a description of the decision process by which the site was recommended; and

(6) an assessment of the regional and local impacts of locating a repository at the proposed site.

On December 20, 1984, the U.S. Department of Energy issued a draft Environmental Assessment for Yucca Mountain in southern Nevada as one of nine sites being considered for a high-level nuclear waste repository. Draft EAs were also issued for the other eight sites, which are located in the states of Texas, Mississippi, Washington, Utah, and Louisiana.

In order to assure development of a comprehensive and coordinated State response to the Nevada draft EA, the State Nuclear Waste Project Office performed an extensive review of the draft document and its supporting references. Comments were also solicited from other State agencies and from local governments in southern Nevada.

PREJUDGEMENT OF THE YUCCA MOUNTAIN SITE

The information contained in the draft EA strongly supports the argument that the selection of the Yucca Mountain site for characterization has been predetermined for some time.

(1) The Pre-Act Siting Process

The rationale used by DOE in the draft EA for examining sites in Nevada is contained in a 1979 report by the Comptroller General of the United States. That report urged DOE to look for potential repository sites on federal reservations at Hanford, Washington; Idaho Falls, Idaho; Savannah River, South Carolina; and the Nevada Test Site (NTS), Nevada. The Comptroller General cited four reasons (or criteria) for examining such reservations for possible repository siting:

- The lands are already contaminated;
- These reservations already contain significant quantities of high-level waste needing disposal;
- There is a high degree of public and political acceptance for using such reservations for nuclear purposes; and

- DOE already owns or controls the land.

Yucca Mountain does not qualify under any of these conditions. In fact, the site is not even located on NTS. In addition, there is no discussion as to why the Idaho Falls and Savannah River reservations were never screened for potential repository sites.

The information presented in the draft EA does not demonstrate that Yucca Mountain was selected on the basis of an objective screening process in accord with the direction provided by the 1979 Comptroller General's report. More disturbing, the draft EA fails to show that Yucca Mountain is the best site available within the Nevada Test Site or in the immediately adjacent area.

(2) Subjectivity of the Site Selection Process

Nevada and other states have contended, since the original publication of the DOE Siting Guidelines, that those Guidelines were illegally subjective. The draft Environmental Assessment amounts to the subjective application of these subjective guidelines. Throughout Chapter 7 of the draft EA, DOE makes general, subjective conclusions that certain physical conditions either do or do not exist, assigns subjective values to each of those conditions, and subjectively determines which of the sites is better than the others with regard to each condition in the collective mind of the Department of Energy.

(3) Weighting of Postclosure Versus Preclosure Guidelines

The draft EA assumes that considerations relative to the long-term (10,000 year) performance and safety of the repository (i.e., postclosure considerations) are considered to be roughly equal to considerations relating to the construction and initial operation of the repository during the preclosure phase. Congress clearly intended, by establishing geology as the "primary" criterion for siting, that guidelines relative to the ability of potential sites (and host materials) to isolate waste for a period of 10,000 years or more be preeminently weighted in the development and application of siting criteria.

Had DOE adhered to the directives of the Nuclear Waste Policy Act and weighted its postclosure guidelines so as to truly represent the "primary criteria" for site selection, it is very likely that the comparative analysis in Chapter 7 would rank neither Yucca Mountain nor Hanford among the top three sites.

(4) Unwarranted Weight of Geohydrologic Setting

Instead of employing a straightforward comparison of all nine sites, DOE has chosen to group sites according to five geohydrologic settings or provinces. **The use of this device guarantees that the two federal sites in Nevada and Washington will automatically be selected as two of the five to be considered for characterization simply because each federal site is the only one located in its respective geohydrologic setting.** Because DOE has arbitrarily decided that only one site from each geohydrologic setting can be considered for further evaluation, technically superior sites may be overlooked in favor of less appropriate ones.

(5) Inadequate Comparison of Yucca Mountain with Other Sites

Chapter 7 of the draft Environmental Assessment purports to comparatively evaluate five sites. Yet the Act requires that each Environmental Assessment include "a reasonable comparative evaluation by the Secretary [of Energy] of such site with other sites and locations that have been considered" (emphasis supplied). **The draft EA is deficient because it does not compare the Yucca Mountain site with the Lavender Canyon (Utah), Swisher (Texas), Vacherie Dome (Louisiana), or Cypress Creek Dome (Mississippi) sites, all of which were earlier determined by the Department of Energy to be potentially acceptable sites for a first repository.** Nor does the draft EA comparatively evaluate the Yucca Mountain site with any other site or location that the Department of Energy considered in arriving at the list of nine potentially acceptable sites.

(6) Questionable Ranking Methodologies

The methodologies used by DOE in the draft EA to rank sites appear designed to assure that Hanford and Yucca Mountain would be included in the top three sites for characterization. The most objective of the three methods involves averaging scores assigned to each guideline for each site being considered. This method places Yucca Mountain fourth out of the five sites compared. **Of the three methodologies, the utility estimation method is the most blatantly subjective. It is also the only method by which Yucca Mountain ranks first.**

MAJOR DEFICIENCIES IN THE DRAFT EA

The draft Environmental Assessment for Yucca Mountain contains several omissions and other deficiencies of content that cast considerable doubt on the validity of the analyses contained and the conclusions reached in the document.

(1) Exclusion of Lincoln County and City of Caliente

In examining the socioeconomic and transportation impacts of a repository at Yucca Mountain, **Lincoln County and the City of**

Caliente are omitted from all of the analyses contained in the draft EA, despite the fact that the main rail route by which high-level waste would enter the State traverses the entire length of Lincoln County and bisects the City of Caliente.

(2) No Consideration of Indian Communities and Issues

The draft EA also fails to consider repository impacts on Native American communities. The Moapa River Paiute Reservation and the Las Vegas Paiute Tribe will be directly and significantly impacted by the transportation of waste--both by rail and by road.

(3) Inadequate Treatment of Defense Wastes

The draft EA evaluates defense high-level wastes only in terms of the transportation costs and risks associated with shipping such waste from the DOE Savannah River facility in South Carolina. **There is no discussion of the defense wastes that are currently stored at Hanford, Washington and Idaho Falls, Idaho, which will have to be moved to a repository at some point.** DOE estimates that 10,000 metric tons of defense waste will ultimately be colocated in the first commercial repository.

(4) Failure to Consider MRS Implications

The Nuclear Waste Policy Act contains provisions whereby DOE may determine that short-term, temporary storage for utilities--or Monitored Retrievable Storage (MRS)--are needed as part of its waste management system. Long before the draft EA was completed, DOE officials indicated that the Department intended to pursue the MRS option as a means of facilitating waste transportation, packaging and handling.

The use of an MRS facility as part of the overall waste management system will cause considerable changes in waste package design; in waste handling facilities and practices at the repository; in assumptions about transportation; and in other key areas of the repository program.

(5) Inadequate Treatment of Transportation

The treatment of transportation in the draft EA is seriously inadequate. Despite numerous and repeated requests from states, tribes, local governments, and the general public for a truly comprehensive approach to the subject, **the Department of Energy has steadfastly refused to perform anything more than an overly general evaluation of national transportation impacts based on generic, averaged, and aggregated data.**

The draft EA makes no attempt to evaluate route-specific conditions and variables that are crucial for any meaningful analysis of risk or for an adequate comparative evaluation of the various repository locations vis-a-vis transportation impacts, costs, and risks.

In assessing local and regional transportation impacts, the draft EA uses a definition of "site" that is overly restrictive and fails to encompass localities and areas that will be most directly affected by repository-related transportation. **It also fails to address the risks that will be associated with peak-volume shipments and contains major inconsistencies in comparing transportation costs among sites.**

(6) Two-Phased Repository

The draft EA indicates that the proposed Yucca Mountain repository would be constructed and operated using a two-phased approach whereby one portion of the repository would be completed and waste emplacement begun while the remaining parts of the facility were still being built. **As presented in the draft EA, the two-phased repository seems intended more for meeting DOE's 1998 waste acceptance deadline than for any legitimate design purpose. Such a proposal poses numerous health and safety issues that are not addressed in the draft EA.**

LAND AND WATER ISSUES

For the most part, the draft EA deals only with current (i.e., present-day) conditions when describing land and water use in the area of the proposed site. **There is no attempt to project long-range land/water needs (i.e., 100, 500, 1,000 years or more) and to examine the impacts of the repository program on area communities.** Likewise, there is no rationale provided for DOE's proposal to withdraw 50,000 acres of BLM land from the public domain for the repository--nor is there any indication of exactly what land is being considered for such withdrawal or what such a scheme will do to present and future land-use patterns in the area.

Apart from the environmental and socioeconomic effects of the proposed repository stemming from land and water issues, **there are also potential impacts to established institutional processes that are generally ignored in the draft EA. Preeminent among such institutional impacts is the implied displacement by DOE of the State's traditional jurisdiction over land and water.**

SOCIOECONOMIC ISSUES

The draft EA for the Yucca Mountain site is flawed in a number of important respects with regard to its treatment of socioeconomic issues and impacts. The document presents a "best-case" scenario that minimizes potential impacts to the social and fiscal systems of southern Nevada. **It ignores risk,**

assumes unchanging demographics, and proceeds from the premise that all markets function with perfect information. It uses a model of questionable validity and ignores relevant differences between Clark and Nye Counties (and ignores the rest of the State entirely).

The methodologies employed in the draft EA (and in supporting documents) to estimate crucial elements of the socio-economic-impact-analysis formula such as direct and indirect labor-force numbers, settlement patterns of inmigrating workers, and even the number or percentage of inmigrants expected are either lacking altogether or are seriously deficient. **Direct employment figures are almost 200 percent higher for Yucca Mountain than for any other site. Likewise, indirect employment is apparently inflated by the use of a multiplier that is 2 1/2 to 5 times greater than multipliers employed for other sites.**

The draft EA is also seriously deficient in its analysis of potential repository-related impacts on the primary sector of Nevada's economy--tourism. **The tourism analyses contained in the EA and in supporting materials are superficial and largely irrelevant.**

TECHNICAL CONCERNS

(1) Disqualifying Conditions

The DOE Siting Guidelines for nuclear waste repositories identifies 17 disqualifying conditions, any one of which if clearly present at a site, would disqualify the site from further consideration. The draft EA states there are no disqualifying conditions present at Yucca Mountain which would disqualify the site. **We find that while there is no "hard evidence" that would disqualify the site, there is some evidence which suggests that four disqualifying conditions may be present.** These four disqualifying conditions are:

A. Tectonics

The Siting Guidelines indicate that a site should be disqualified if fault movement and other ground motion would result in loss of waste isolation. The draft EA acknowledges that Yucca Mountain is in a tectonically-active area and the faults on Yucca Mountain may be "potentially active," but indicates these present no problems for siting a repository at Yucca Mountain. **However, we find that a reasonable interpretation of the available information suggests that a large earthquake with accompanying surface faulting could probably occur during the lifetime of the facility, with the possibility of loss of repository integrity.**

B. Geohydrology

The Siting Guidelines indicate that a site should be disqualified if the ground water travel time from the repository to the assessible environment is less than 1,000 years. The draft EA admits that necessary hydrologic parameters for the unsaturated zone are poorly known and much uncertainty exists in the model calculations, but results indicate ground water travel times ranging from 20,000 to 55,000 years for the site. **However, our calculations, using conservative approximations to bound numerical uncertainty, find that ground water travel time could range from 900 to 34,000 years. The minimum number for ground water travel time does not meet the geohydrologic requirement.**

C. Offsite Installations

The Siting Guidelines indicate that a site should be disqualified if atomic energy defense activities conflict irreconcilably with repository activities. The draft EA states that there will be no conflicts, because of engineering design which will accommodate weapons testing effects and coordination of repository schedules with testing schedules will minimize safety concerns. **We find, however, that a repository at Yucca Mountain may conflict with future weapons testing and the established mission of the Nevada Test Site.** We acknowledge that the long-term future of atomic testing is uncertain, but if testing does continue in the future, areas in close proximity to Yucca Mountain are likely locations for such testing. We believe this guideline cannot be satisfied without documentation from the Department of Defense that future atomic testing will not conflict with a waste repository at Yucca Mountain.

D. Water Quantity and Quality

The Siting Guidelines indicate that a site should be disqualified if repository activities would degrade water quality or reduce water quantities for human consumption or crop irrigation. The draft EA finds that repository water use will not lower the regional ground-water table or reduce water quality. **We find there is insufficient information provided in the draft EA to judge the impacts of repository water use on water quantity or quality.** Amargosa Valley, down-gradient from Yucca Mountain, could be affected in the long term by degradation of the ground water by repository activity.

<u>(2) Other Technical Areas of Concern</u>

There are a number of other technical areas in the draft EA where "positive findings" about the site are not supported by the available evidence presented in the draft EA. The technical areas of major concern are:

A. Mineral Resources

The draft EA indicates that based upon a "literature review" study, there is no natural resource potential at Yucca Mountain. On the other hand, we find that there is insufficient evidence available to form a conclusion about natural resource potential. The presence of gold and silver mineralization in drill core from Yucca Mountain and the location of Yucca Mountain along the rim of a buried caldera containing known mineralization support the potential of natural resources at the site.

B. Volcanic Activity

The draft EA concludes that even though the site is located adjacent to a major volcanic field in southern Nevada, there is little chance of a volcanic eruption. However, EA-support documents suggest that a risk of volcanic eruption exists at Yucca Mountain.

C. Climate Change

The draft EA indicates that any future climatic changes in southern Nevada will have no effect on the waste isolation capability of the site. However, the draft EA presents little evidence to support this conclusion. A review of climatic changes in southern Nevada over the last 10,000 years suggests that under future "wet" cycles (possibly glacial periods), water infiltration may increase and cause a rise in the ground water table to possibly the repository level (thus potentially impacting the isolation capability of the site).

D. Geochemistry

The draft EA indicates that zeolites, an accessory mineral in tuffs, will retard movement of radionuclides and thus their presence will help ensure the isolation capability of the site. However, proposed repository conditions described in the draft EA and supporting geochemistry literature do not support this conclusion. Zeolites are unstable at expected repository temperatures and thus may not effectively retard radionuclide movement, and may in fact promote instability of underground repository openings.

E. Exploratory Shaft Surface Facilities

In the draft EA, DOE proposes that the exploratory shaft surface facilities will be located in Coyote Wash, adjacent to the proposed exploratory shaft site. We have two concerns with DOE's planned facilities:

- **Sewage and waste disposal facilities as designed are unacceptable to State Department of Environmental Protection**

- **Flash flood protection measures are inadequate to handle a "probable maximum precipitation" event**

F. Repository Design

The draft EA briefly describes the conceptual repository design should Yucca Mountain be selected for repository development. We have major concern with two areas of repository design:

- **The surface facilities are located in an area subject to surface flooding during high precipitation events.**

- **It is questionable whether there is sufficient acceptable host rock available for waste emplacement at Yucca Mountain, given the decision to commingle defense waste with commercial waste.**

CONCLUSION

The overriding objective of the Nuclear Waste Policy Act of 1982 is to isolate the nation's high-level radioactive waste from the accessible environment for thousands of years. The actual test that will ultimately determine if DOE has accomplished this mission will be reflected in the thousands of years of post-closure experience with the decommissioned repository. Because it is impossible to judge actual performance over such a lengthy span of time from a vantage point in the present, DOE must rely on institutional analyses, before the fact, to guide it in choosing sites and otherwise making plans that will afford the highest probabilities for successful containment of these materials.

The institutional analyses that the Nuclear Waste Policy Act requires involve: (1) pre-established radioactivity-release limits around which any site-selection methodology must be designed; (2) objective guidelines for determining overall site suitability; (3) conservative and objective application of those guidelines against objectively gathered data of sufficient volume and reliability to guarantee credibility of conclusions; (4) comparative analyses of <u>all</u> available siting options; and (5) proof that sites ultimately selected will be safe from a public health and environmental standpoint and will meet the standards of licensing imposed by the Nuclear Regulatory Commission. In reviewing the draft Environmental Assessment for Yucca Mountain, it is readily apparent that the entire approach to institutional analysis DOE has employed to date must be corrected if the process is ever to lead to the selection of a licensable site--one that can be shown to be capable of isolating high-level radioactive waste for thousands of years while adequately protecting the environment and guaranteeing the health and safety of the public.

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THE STATE OF NEVADA
EXECUTIVE CHAMBER
Carson City, Nevada 89710

RICHARD H. BRYAN
Governor

TELEPHONE
(702) 885-5670

April 24, 1985

John S. Harrington, Secretary
U.S. Department of Energy
Forrestal Building
1000 Independence Avenue, S.W.
Washington, D. C. 20585

Dear Secretary Harrington:

The State of Nevada has completed its review of the draft Environmental Assessment (EA) issued by the Office of Civilian Radioactive Waste Management on December 20, 1984. The document containing our comments is enclosed for your review and response.

As you know, the official comment period established by your Department expired on March 20, 1985. Due to the complexity of the draft EA, the need to review numerous reference documents, and the large number of state agencies and local governments involved in the review process, it was impossible to complete our work within the unrealistic time frame established by the Department of Energy (DOE).

Prior to March 20, 1985, the State Nuclear Waste Project Office had received requests from many local governments asking that the comment period be extended for another 60 to 90 days. On February 12, 1985, Mr. Robert Loux, of this Office, wrote to Ben Rusche, Director of your Office of Civilian Radioactive Waste Management, formally requesting that an extension be granted. In his February 25, 1985 response to that request, Mr. Rusche declined to postpone closing the official comment period, noting that DOE will, "consider late comments to the extent practicable consistent with our intent to recommend sites for characterization by early fall."

Given the obvious inadequacy of a 90-day period for reviewing 9 documents of over 1,000 pages each, plus related reference materials, we trust that our comments will be afforded <u>full</u> consideration by your Department.

As we point out repeatedly in the enclosed comments, there are numerous areas in the draft EA for Yucca Mountain that must be reexamined and significantly revised before that document can be viewed as a credible basis for evaluating the suitability of the Nevada site for characterization.

There are, I believe, significant deficiencies with regard to the Siting Guidelines, which form the basis for determining such suitability in the draft EAs. These Guidelines are overly vague, promote subjectivity in their application, and are biased toward the selection of sites in Washington and Nevada.

More disturbing even than the inadequacies of the Guidelines, however, is the fact that the information and analyses contained in the draft EA itself fails, in most instances, to support the conclusions drawn and findings made by DOE in evaluating the site against the Guidelines. Time and again, conclusions are made that simply cannot be supported by information in the draft or in referenced materials that were compiled by DOE's own contractors. On numerous occasions, conclusions and findings made in one section of the document can be seen to contradict information presented elsewhere. The problem is compounded when these unsubstantiated conclusions and findings are used as the basis for comparing and ranking sites later in Chapter 7 of the draft.

Nevada has long contended that the Department of Energy is engaged in a site selection process more driven by a desire to find an expedient location for a repository than by a commitment to identifying the most suitable and technically superior site available. The data, analyses and conclusions contained in the draft EA reinforce our concerns in this regard.

In its zeal to identify sites on existing federal reservations (such as the Nevada Test Site and Hanford, Washington), DOE seems to have relegated considerations of technical suitability to a secondary role in site selection. This becomes very apparent with regard to Yucca Mountain, when one considers that the site is located in what the U.S. Geological Survey has designated as a, "major seismic risk area." It is difficult to believe that this site would even have been considered were it not located adjacent to the Nevada Test Site.

Even if DOE's logic relative to locating sites on federal lands that are already contaminated was sound, and the concern about seismicity did not exist, the selection of Yucca Mountain would still be questionable, because the site is not located on the Test Site. In fact, the draft EA indicates that DOE will have to withdraw 50,000 acres of additional land from the public domain to make the site viable.

An objective, scientifically-minded observer reviewing the draft EA for Yucca Mountain can come to but one conclusion, based on the information contained in the document; namely, that there simply is not enough data available to allow any conclusion to be reached relative to the suitability of the site for characterization, and that given this inadequacy of data, it is impossible to compare Yucca Mountain against any of the other sites in any reasonable or objective fashion.

The enclosed comments demonstrate convincingly that serious problems exist with regard to almost every aspect of the draft EA (and the entire DOE siting process). To proceed with the selection of sites for characterization, based on such an obviously flawed and inadequate document, will further damage -- perhaps irrevocably -- the credibility of the entire program.

I urge you to reconsider the potentially self-destructive course that DOE has embarked upon with regard to these Environmental Assessments. The Nuclear Waste Policy Act provides that the Secretary of Energy may determine that available information is insufficient to justify the selection of sites for characterization, and may direct that additional data be collected prior to making this important decision. The intent of the Act, as well as the interests of DOE, the states, and the nuclear industry, would be served by reevaluating the entire site selection process, so that adequate and comparable data can be collected and utilized in making critical site characterization decisions.

I trust that our comments will be taken in the constructive manner in which they are presented. My staff stands ready to meet with representatives of your Department to discuss our findings, or to assist you in reexamining the draft EAs, or any other aspect of the repository site selection program.

Thank you for your consideration of our comments. I look forward to receiving your response.

Sincerely,

RICHARD H. BRYAN
Governor

RHB/sc
Encl.

STATE OF NEVADA COMMENTS

ON THE

U. S. Department of Energy Draft Environmental Assessment for the Proposed High-Level Nuclear Waste Site at Yucca Mountain

Richard H. Bryan
Governor

COMPILED BY

THE NUCLEAR WASTE PROJECT OFFICE
OFFICE OF THE GOVERNOR

MARCH, 1985

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STATE OF NEVADA COMMENTS

ON THE

U.S. DEPARTMENT OF ENERGY DRAFT ENVIRONMENTAL ASSESSMENT

FOR THE PROPOSED HIGH-LEVEL NUCLEAR WASTE SITE

AT YUCCA MOUNTAIN

PREPARED BY

THE NUCLEAR WASTE PROJECT OFFICE

OFFICE OF THE GOVERNOR

MARCH 1985

VOLUME I

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INTRODUCTION

On December 20, 1984, the U.S. Department of Energy issued a draft Environmental Assessment for Yucca Mountain in southern Nevada as one of nine sites being considered for a high-level nuclear waste repository. Draft EAs were also issued for the other eight sites, which are located in the states of Texas, Mississippi, Washington, Utah, and Louisiana.

These draft documents are intended to assess the suitability of each site for more detailed testing and evaluation (known as site characterization) and for possible development as a repository. The draft EA also attempts to compare sites to determine which three should be nominated for characterization.

In order to assure development of a comprehensive and coordinated State response to the Nevada draft EA, the State Nuclear Waste Project Office (NWPO) performed an extensive review of the draft document and its supporting references. Comments were also solicited from other State agencies and from local governments in southern Nevada.

The results of this overall State effort are contained in subsequent sections of this document. Because the draft EA and the decision process of which it is a part are of major importance to the state as a whole as well as to individual local communities (especially those in southern Nevada), we have attempted to organize the State response in such a way as to clearly reflect areas of commonality without abridging the need for a clear delineation of issues of specific concern to local governments and individual State agencies.

Part I of our response document focuses on those issues and topics that are considered to be of major concern. These comments are relatively general in nature and are organized according to subject area--not according to chapter or location in the draft EA. As such, this section represents something of an overview of our response to the document.

Part II contains specific comments relative to each chapter and section of the draft. These comments respond to specifics of the document and do so in relation to the organizational schemata employed in the draft EA. Because of the way it is organized, the draft EA encouraged--even required--a certain degree of redundancy in our response. We have attempted to reduce such redundancy wherever possible, but not to the extent that the meaning, impact, or potential utility of our comments will be affected.

Part III of this response document contains verbatim comments received from affected local governments in southern Nevada. We consider these comments to be a crucial element of our overall response to the draft EA. As such, each set of comments in this section should be treated as separate and important of itself. Although many of the points raised by local governments have been mentioned--to varying degrees--in Part I and Part II, each local government has a unique and important perspective that is reflected in the totality of its comments.

Comments received from State agencies are contained in Part IV. While many of these comments have been incorporated into the information in Part I and Part II, the individual agency comments contained in this section not only serve to expand upon various issues that have been addressed elsewhere, but also contain additional points and information not found in Parts I and II. As such, these comments should be viewed as important in their own right--not as appendices to the response document.

Taken together, these comments represent as comprehensive and thorough a review as possible (given the time constraints involved) of all the major elements contained in the draft EA for Yucca Mountain. What criticism they contain is intended to be constructive. Our aim throughout is to assist DOE in preparing a clear, concise, and factual final document--one that will not only meet the statutory requirements of the Nuclear Waste Policy Act but also will justify and promote the high degree of public confidence and acceptance that must exist if the search for a high-level nuclear waste repository site is to be successful.

PART I

COMMENTS ON MAJOR AREAS OF CONCERN

PART I

COMMENTS ON MAJOR AREAS OF CONCERN

PREJUDGMENT OF THE YUCCA MOUNTAIN SITE

We believe that the selection of the Yucca Mountain site for site characterization has been predetermined within the Department of Energy for some time. The subjective nature of the guidelines certainly allows the continuance of this predetermination, and the subjective application of the guidelines in Chapter 7 clearly seems intended to ratify the predetermined selection of Yucca Mountain. Other evidence of this predetermination exists outside of the draft Environmental Assessment. We believe that the Department of Energy should not have made up its mind about where it wants to develop a high-level waste repository until all the facts are in. It is not objective to start out a study knowing the result you want before it is completed.

(1) The Pre-Act Siting Process

Prior to 1977, national site screening for a nuclear waste repository focused on finding suitable geologic host materials, principally salt, crystalline rock, and shale. This became known as the "host rock approach." According to the draft EA, "Screening of sites in basalt and tuff was initiated when the DOE began to search for suitable repository sites on some Federal lands where radioactive materials were already present. The approach was recommended by the Comptroller General of the United States (1979)." The Comptroller General's report recommended screening of the federal reservations at Hanford, Washington; the Nevada Test Site (NTS), Nevada; Idaho Falls, Idaho; and Savannah River, South Carolina; to determine if geologically suitable sites could be found on those reservations. The report pointed out that not only were those reservations already contaminated but several of them also contained quantities of high-level waste requiring disposal. Moving this waste to another location for permanent disposal was considered to be "questionable from a safety standpoint." In the final analysis, the Comptroller General recommended that DOE examine such reservations for four reasons:

1. The lands are already highly contaminated;

2. These sites contain significant quantities of high-level waste needing disposal;

3. There is a high degree of public and political acceptance for using such reservations for nuclear purposes; and

4. DOE already owns or controls the land.

Yucca Mountain does not appear to qualify under any of these conditions. It is not located on the Nevada Test Site, and (even according to DOE) it is not contaminated. The Nevada Test Site does not contain--nor has it ever contained--any quantities of high-level waste requiring disposal (although portions of the site are contaminated as a result of other nuclear activities). There is not a high degree of public or political acceptance for the proposal to store nuclear waste at NTS. Finally, DOE does not own or control the land on which Yucca Mountain is situated (in fact, it will take an act of Congress to withdraw the required land from the public domain). Moreover, DOE has completely failed to consider the extent to which location of a repository at Yucca Mountain, or elsewhere at the Nevada Test Site, might have a negative impact on the future weapons-testing program at NTS. The fact that the search for the prospective repository site was geographically limited to the southwestern portion of the NTS away from the testing-program areas suggests the incompatibility of these two programs. The importance of the weapons-testing program to the national security and the economic well-being of Nevada should not be jeopardized by the prejudgment of the Department of Energy in selecting a site for a nuclear waste repository.

DOE's implementation of the recommendations contained in the Controller General's report--and the subsequent identification of Yucca Mountain and Hanford as the only potentially acceptable sites--raises several important questions that bear directly on the validity of the entire screening process.

There is no discussion, in the draft EA or elsewhere, as to why the Idaho Falls and Savannah River reservations were not screened for potential repository locations. Both areas clearly fall within the parameters established by the Controller General. If existing land use was a primary consideration in the selection of sites in Washington and Nevada, it should have been an equally compelling reason to closely examine Idaho and South Carolina.

Another question that continues to obscure DOE's logic in following the Comptroller General's recommendations involves the rationale for looking at Yucca Mountain in the first place. Given the limitations in the report, why did DOE move off the Nevada Test Site in its search for possible repository locations?

The Comptroller General, in the same 1979 report, implies that DOE may have been under considerable pressure to identify potentially acceptable sites on at least one federal nuclear reservation:

> If DOE were to find that the geology at these reservations was unacceptable for a permanent repository, it would face very disturbing questions about permanent solutions regarding what to do with the wastes at these sites that cannot be moved to another location. Looking at the problem from another angle, if the DOE reservations are not acceptable for storing wastes that would be shipped there from other locations, then they should not be acceptable for the long-term storage of wastes already there. Clearly, these contaminated sites present a set of very perplexing problems to DOE.

The motivation to find a site at or adjacent to NTS is obviously very strong.

There is no doubt that DOE had made a determination prior to January 7, 1983, that a site at the Nevada Test Site would be selected for characterization. On August 22, 1982, Jan W. Mares, Acting Under Secretary of the Department, wrote to Senator Slade Gorton in response to his request about the Department's preference for the Hanford site, as follows:

> The "candidate site" mentioned by Dr. [Thomas A.] Dillon [in DOE testimony before the Subcommittee on Energy and Environment of the Committee on Interior and Insular Affairs on June 17, 1982] refers to the area within the Hanford Reservation that appears promising for further site characterization. It is not, a priori, the site for the nuclear waste repository. In 1983, two other candidate sites for detailed characterization and exploratory shaft development will be selected in tuff at the Nevada Test Site and at one of the salt formations being considered.

As late as May 14, 1984, the Department still openly declared that a site in basalt, tuff, and salt would be characterized, as though the 112(a) guidelines and the 112(b) environmental assessments meant nothing other than ratification of DOE's pre-Act decisions. In its Draft Preamble to the Siting Guidelines, DOE stated, at p. 30:

> The group of preferred sites, along with the sites that are the only sites in their settings, <u>will be the sites proposed</u> for nomination. (Emphasis supplied.)

Concern about the objectivity of the siting process has been exacerbated by statements of various DOE officials that site-characterization work has actually been going on for several years at Yucca Mountain and that most of the necessary materials and equipment needed for such activities have been procured.

The DOE apparently believes that those site-screening activities that preceded the passage of the NWPA were ratified by the Act and that the site-selection process required by §112 of the Act did not require that all pre-Act siting decisions be rejustified under the new statutory process.

Although we do not always agree with positions stated by the Environmental Policy Institute, a portion of EPI's comments on the Yucca Mountain draft Environmental Assessment are very much in point regarding DOE's prejudgment of site selection. We agree specifically with those comments and restate them here:

> There is, we believe, a fundamental question concerning the validity of those screening decisions which predate the NWPA especially the validity of the basic screening decision based on Federal land use and other methods used at other sites. Once an area had been selected on the basis of Federal land use, DOE was forced to try to find suitable sites or media within that area rather than starting with an area already deemed to be suitable for geologic reasons. The description in Chapter 1 of the selection of the Yucca Mountain and Hanford locations makes explicitly clear that DOE has attempted to locate geologically suitable sites <u>in a geologically unsuitable area</u>.

As described in Chapter 1, and Chapter 2 of the Yucca Mountain Draft EA, for example, DOE literally retreated to one corner of the Nevada Test Site before it could even begin to try to find a geologically suitable site because of nuclear weapons testing activities and ultimately had to select a principal location outside the boundary of the site thereby defeating the principal siting criteria.

The consequence of these pre-NWPA screening decisions and DOE's view that they are not "reviewable" is not expressed in Chapters 1 and 2. Perhaps, as noted above, this omission is due to the fact that the final Guidelines were not published or effective during preparation of the draft EA's and the policy of "non-reviewability" was not as clearly articulated. Being less charitable, however, DOE may have deliberately down-played its view that pre-NWPA decisions are not reviewable, and were not, in fact, reviewed after the passage of the Act in light of the new requirements of the Act.

It is our opinion that the Congress intended, in enacting the NWPA, review of pre-NWPA site screening decisions. Congress did not prejudge the suitability of any sites already known to be under investigation. Congress also did not presume to either know of all the sites, hence the notification requirement in Section 116 of states of potentially acceptable sites, nor to assume that such sites were suitable, hence the detailed requirements in Section 112 for Guidelines, nomination, and environmental review.

Not only has DOE committed a substantive error in ratifying its pre-Act decisions with subjective evaluation since the Act's passage, it has done so without the proper consultation with the State of Nevada. Most disturbing (given the fact that DOE was unable to find a suitable site on the Nevada Test Site and proceeded to screen sites outside of the NTS boundaries), is a 1979 memo from the DOE Nevada Operations Office to the DOE Headquarters (M. Gates to S. Meyers, April 16, 1979). In this memo, the Manager of the Nevada Operations Office pledged that he would seek State agreement before examining potential repository locations off the Test Site. Although DOE has been evaluating Yucca Mountain since late 1979, the Department has never consulted with the State before proceeding off-site--in violation of DOE's own pledge to seek basic agreement with the State.

Similarly, DOE's 1981-1982 area-to-location screening may be seen as a mere ratification of the Nevada Nuclear Waste Storage Investigation's (NNWSI) 1979 intuitive choice of Topopah Springs tuff beneath Yucca Mountain as a candidate site. Though technically sound, the studies done by DOE (as referenced in Sec. 2.2.4, p. 2-15) after that intuitive choice was made <u>do not</u> support the decision that Yucca Mountain is the best site available within the Nevada Test Site or in the immediately adjacent area. The fact that the reference studies in Section 2.2.4 confirm the 1979 DOE decision is not surprising. Given that many of those involved in the 1979 choice of Yucca Mountain also participated in the 1981-1982 studies, we would be more surprised if the results had not agreed. DOE must develop a rationale under its own guidelines (10 CFR 960) and appropriate supporting data to reasonably demonstrate that Yucca Mountain is better than any other site actually on the Nevada Test Site from all standpoints.

(2) Subjectivity

Nevada has contended since the original publication of §112(a) siting guidelines that they were illegally subjective. In Nevada's brief in the NRC Guidelines Concurrence Proceeding, we stated:

> Congress intended that objective standards could be applied with certainty in site recommendation after site characterization was complete: the decision of "suitability." Site suitability for development is determined under the statute as a pre-condition of site recommendation. It is a determination that a site meets the DOE guidelines. Note that 42 USC 10132(a) speaks of "guidelines for the recommendation of sites." The Department of Energy, because of a desire to create rules which could be used at earlier stages of decisionmaking, i.e., site nomination, elected to use a subjective approach when an objective one was required. Congress contemplated that the same objective standards could be applied less certainly in preliminary determinations of potential suitability. See statement of Representative Ottinger, 128 Cong. Rec. H8796, discussing "preliminary determination of suitability" during the site characterization phase.

We also stated:

> The distinction between a subjective and objective approach to repository site selection is significant to host states. If an objective approach is used the Department of Energy must compare the known or unknown physical condition of the site with a known measurable standard. Though site analysis before characterization would necessarily require some relatively uncertain conclusions, or assumptions, the comparison at the time of site recommendation after characterization is an objective one. On the other hand, if the Department of Energy may use a subjective approach, it is only required to compare the same known or unknown physical condition with issue areas or policy statements. The conclusion derived therefrom, that one site is better or worse than another, is entirely subjective, and the host state, in deciding whether to approve or disapprove of the recommendation, is thus likewise forced to make, and defend, a subjective, unscientific decision.
>
> It is obvious that the objective approach also better favors the purpose of the guidelines "to protect the public health and safety and the environment. . . ." See colloquy of Reps. John Seiberling and Morris Udall, 128 Cong. Rec. H8778.

Notwithstanding Nevada's and other states' continued objection that the guidelines were too subjective, DOE proceeded, allowing itself to continue with pre-Act conclusions that required no reexamination.

Now, what the states feared, that §112(b) environmental assessments would amount to subjective application of subjective guidelines, has occurred. The manner in which the Department of Energy has used the guidelines, in Chapter 7 of the draft EA, is clear evidence that they are not capable of being objectively applied. Some examples of the text illustrate this subjectivity.

The draft EA compares five sites against the guideline on geohydrology (960.4-2-1) at pp. 7-5 through 7-15. Table 7-1 and the text at p. 7-11 conclude that Yucca Mountain is the only site of the five where favorable condition 2 is not present. Table 7-1 and the text at p. 7-13 also conclude that Yucca Mountain is the only site of the five in which a particular potentially adverse condition is present. (The favorable and potentially adverse conditions at issue involve the nature and rates of hydrologic process operating within the geologic setting which affect the ability of the repository to isolate waste, and the presence of ground-water sources suitable for crop irrigation and human consumption without treatment along ground-water flow paths from the host rock to the accessible environment, respectively.) There is no discussion in Chapter 7, however, revealing that the absence of the favorable condition or the presence of the potentially adverse condition affected in any way the comparative evaluation of the five sites for purposes of ranking.

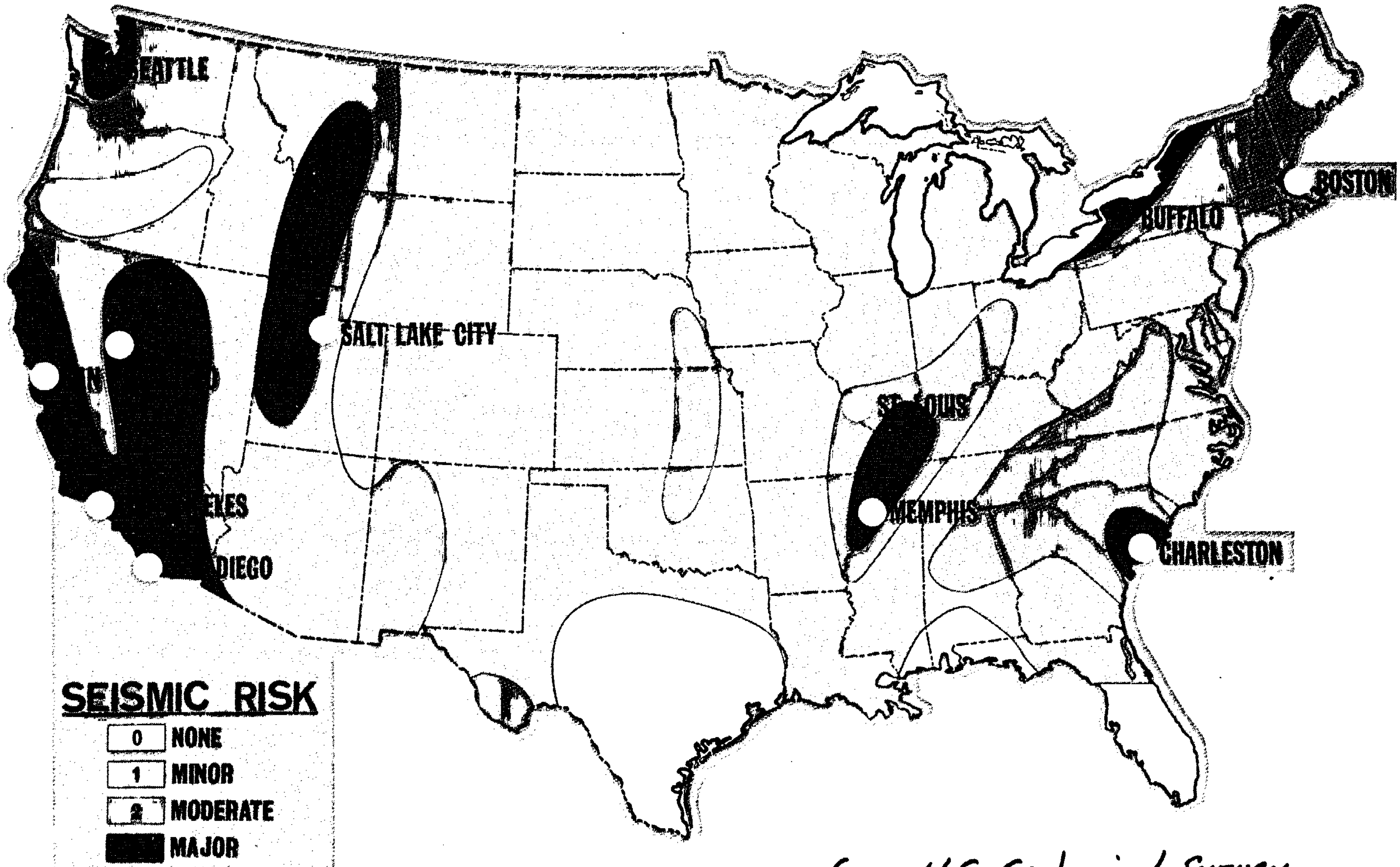
Similarly, five sites are comparatively evaluated against the guideline on geochemistry (960.4-2-2) at pp. 7-15 through 7-22. Though Table 7-2 and the text at p. 7-21 conclude that a particular potentially adverse condition (chemically oxidizing pre-waste-emplacement ground-water conditions) is present only at Yucca Mountain, the comparative evaluation does not even discuss that potentially adverse condition in ranking sites under the guideline. The presence of the potentially adverse condition seems to have no bearing upon the ranking.

Throughout Chapter 7, the DOE makes general subjective conclusions that certain physical conditions either do or do not exist, assigns subjective values to each of those conclusions, and subjectively determines which of the sites is better than the others in the collective mind of the Department of Energy. This analysis seems a far cry from the Congressionally intended measurement of possible repository sites against siting guidelines.

Adding insult to injury, the Department of Energy, in Chapter 7, takes the various subjectively determined data (rankings under each guideline) and performs statistical aggregation procedures upon them to arrive at a conclusion regarding the best of the five compared sites. With the amount of subjective determination used in applying the guidelines and with conclusions regarding ranking having been drawn from their application, any aggregation of those rankings would compound the subjectivity of the ranking notwithstanding the computational method of aggregation used.

Probably the most telling development regarding the subjectivity of the DOE siting guidelines, their subjective application in the draft environmental assessment, and the DOE's attempt to ratify its pre-Act selection of Yucca Mountain is the failure of DOE's entire analysis to identify or evaluate the fact that a United States Geological Survey map of seismic risk (see p. I-7) places Yucca Mountain in a region of major seismic risk. None of the other potentially acceptable sites are located in such areas according to

Seismic Risk Map of the Conterminous United States



from U.S. Geological Survey

this map. A process that would or could not identify this striking fact can hardly be said to be an objective comparison of sites against each other.

(3) Statutory Adequacy of the Environmental Assessment Under §112(a)

The draft Environmental Assessments are inadequate under §112(a) of the Act in three important respects other than their subjectivity. The Environmental Assessments do not give sufficient weight to postclosure considerations (i.e., geologic considerations), give unwarranted weight to geohydrologic settings, and do not adequately treat the transportation issue.

(a) Postclosure Guidelines Versus Preclosure Guidelines

The Act clearly requires that geologic considerations be the primary criteria for the selection of repository sites in various geologic media. In the draft EA, the postclosure guidelines (which deal with the geologic and hydrologic conditions relative to the long-term storage of high-level radioactive materials) have been arbitrarily weighted at 51 percent of the total weight of all of the guidelines. The preclosure guidelines (those that deal primarily with the construction and operational phases of the repository and do not pertain to long-term isolation capabilities) have been weighted at 49 percent of the total.

Such assignment of relative values hardly meets the statutory directive that geologic considerations be primary. Congress clearly intended, by establishing geology as the "primary" criterion for siting, that guidelines relative to the ability of potential sites (and host materials) to isolate waste for a period of 10,000 years or more be preeminently weighted in the development and application of siting criteria. The wording of the Act in this regard was specifically designed by Congress to guarantee the selection of technically superior sites in an apolitical process.

The establishment by DOE of the 51 percent to 49 percent relative values for postclosure and preclosure guidelines affords relatively equal importance to each set of factors, something Congress clearly never intended and something we regard as a violation of the Act.

DOE seems to have done exactly what Congress tried to proscribe. It has developed and applied guidelines that allow DOE to ratify its earlier selected sites with consideration of non-geologic and non-technical factors (such as current land use and perceived ease of siting).

Had DOE adhered to the directives of the Nuclear Waste Policy Act and weighted its postclosure guidelines so as to truly represent the "primary criteria" for site selection, it is very likely that the comparative analysis in Chapter 7 would have yielded very different results. If, for example, the relative values applied to postclosure and preclosure guidelines were 70 percent to 30 percent or 80 percent to 20 percent, respectively, neither Yucca Mountain nor Hanford would have ranked among the three (or even five) highest-scoring sites (even using the overly optimistic and generally unsubstantiated data and analyses contained in the draft EA). Unless the postclosure guidelines are applied in such a manner as to clearly reflect their prime importance in the screening and selection of sites, the entire process is deficient. It is also possible that the repository location that is ultimately selected will not effectively isolate the waste for the time period necessary. The implications of such an "error" in siting judgment are obvious and potentially catastrophic.

(b) Unwarranted Weight of Geohydrologic Setting

Instead of employing a straightforward comparison of all nine sites, DOE has chosen to group these sites according to five geohydrologic settings or provinces. Apart from the fact that such grouping is not relevant to this stage of the selection process, the use of this device guarantees that the two federal sites in Nevada and Washington will automatically be selected as two of the five to be considered for characterization simply because each federal site in the only one located in its respective geohydrologic setting. (See discussion of prejudgment above.) Because DOE has arbitrarily decided that only one site from each geohydrologic setting can be considered for further evaluation, it has dictated that technically superior sites may be overlooked in favor of less appropriate ones. This could hardly have been the intent of Congress.

DOE rationalizes its reliance on such geohydrologic settings by citing from the Act that the Secretary ". . . to the extent practicable . . . recommend sites in different geologic media" (Section 112(a)). In so rationalizing, DOE has confused the desire for geologic diversity with a requirement for characterization of different geohydrologic settings and has ignored completely the qualifying phrase "to the extent practicable." The draft Environmental Assessment is, therefore, inadequate under §112(a) of the Act.

When Congress included the requirement that the DOE consider sites in different geologic media, it was concerned that, if all sites being considered were in a single type of host rock, a major flaw in that host material--should it come to light very late in the process--could seriously impair the entire repository program. However, Congress did not intend that the requirement for diversity preclude identification of superior sites. The Act clearly requires that geologic suitability is to be the primary criterion in site selection. By modifying the requirement that DOE recommend sites in different geologic media with the phrase "to the extent practicable," Congress clearly sought to keep the Act consistent with its intention that geologic conditions must be the primary basis for siting.

The DOE process produces a set of five sites irrespective of the actual merits of the nine or more sites under consideration. There is no assurance that the process used will discover five final sites that are technically superior (more suitable) than the others that have been considered.

(c) Inadequate Treatment of Transportation Issues

Section 112(a) of the Act requires that the guidelines "consider the cost and impact of transporting to the repository site the solidified high-level radioactive waste and spent fuel to be disposed of in the repository and the advantages of regional distribution in the siting of repositories." The guidelines are statutorily defective to the extent they do not address this important subject. While DOE guidelines do address (albeit inadequately) the proximity of specific repository sites to the national interstate highway and railroad routing system, there is no comparative analysis in the environmental assessments of the transportation-related risks that may arise from the selection of specific repository sites. This analysis must consider the specific transportation routes and distances that the selection of each of the considered repository sites would dictate and the impact on the public and environment that the selection of each would cause. Since this is a factor of repository siting that is statutorily required by §112(a) and since this is a factor the analysis of which does not require site characterization (see §112(b)(1)(E)(ii)), the Environmental Assessment is inadequate under the Act.

Also, of course, the "transportation corridor states" have a legitimate interest in this same analysis whether or not it is statutorily required. The DOE's failure to address this important topic is but another example of DOE's effort to ratify its pre-Act determination of the preference of federal sites.

(4) Statutory Adequacy of the Environmental Assessment Under §112(b)

(a) Comparative Evaluation of a Nominated Site With Other Sites and Locations That Have Been Considered (Sec. 112(b)(1)(E)(iv))

Chapter 7 of the draft Environmental Assessment purports to comparatively evaluate five sites. Yet §112(b)(1)(E)(iv) of the Act requires that each nomination of a site under that section be accompanied by an Environmental Assessment that includes "(iv) a reasonable comparative evaluation by the Secretary of such site with other sites and locations that have been considered" (emphasis supplied). Chapter 7 of the draft EA is obviously legally deficient because it does not compare the Yucca Mountain site with the Lavender Canyon, Swisher, Vacherie Dome, or Cypress Creek Dome sites, all of which were earlier determined by the Department of Energy to be potentially acceptable sites for a first repository. Nor does Chapter 7 comparatively evaluate the Yucca Mountain site with any other site or location that the Department of Energy considered in arriving at the list of potentially acceptable sites. Without this broader comparison, the Congressional plan, that DOE be guided to a suitable site by the guidelines and by comparison with all other sites and locations that have been considered, is replaced by a Department of Energy plan that its pre-Act site preference be ratified by subjective guidelines and limited comparisons.

Section 112(b)(1)(E)(iv) does not specifically state that the "other sites and locations that have been considered" is limited to "potentially acceptable sites" as that term is used in §116(a). It certainly does not limit the comparison to only the five nominated sites. It is logical that the concept "other sites and locations that have been considered" is much broader than "potentially acceptable sites," possibly including every site that the Department of Energy may have investigated both before and after the passage of the Act. The concept must, of course, be bounded by some limits of reasonableness. The Nevada site is, nevertheless, entitled at least to a comparison with the Swisher County site, which the EA says is only "marginally" less suitable than the one in Deaf Smith County.

(b) Ranking Methodology

Nevada and other states have repeatedly communicated to the Department of Energy their desire to comment upon the decision methodology that was to be utilized by the Department of Energy in determining which of the three nominated sites it would recommend for characterization. The Department's position, stated in correspondence from Mr. Rusche to Mr. Loux, was that that methodology was not going to be disclosed to the states prior to its exercise. Now, in fact, the Department has used that methodology, subjective ranking, in comparing five sites with each other in Chapter 7 of the draft EAs for all nine of the potentially acceptable sites. The State had no opportunity to evaluate or comment upon this methodology prior to this time.

Ranking the sites on the basis of postclosure guidelines above (see Table 7-23), the averaging method places Yucca Mountain fourth and the pair-wise-comparison places it tied for fifth. If the ranking stopped there, and if postclosure guidelines were given the kind of weight that the states, and probably the NRC, were led to believe, then Yucca Mountain would not even be characterized. But the Department goes further, and applies two entirely subjective methods to reach down and pull Yucca Mountain up to the top ranking.

The first, of course, is the utility estimation method. That method is entirely subjective. All one need do is determine the number of 10s that must be assigned to Yucca Mountain, as well as the number of 6s and 7s to the predetermined less favorable sites, and anyone can produce a number 1 ranking for Yucca Mountain, or any other predetermined site. For postclosure guidelines, then, Yucca Mountain qualifies for characterization and ranks first only under the most subjective aggregation method, the one that not only allows but encourages unfettered manipulation of the data.

A striking example of such manipulation is shown in Table B-2 on p. B-9. Yucca Mountain and Davis Canyon are earlier ranked fourth and fifth under the site ownership and control guideline because both require Congressional action to withdraw the land necessary to develop the repository, at best not absolutely guaranteed. Yet in applying the utility estimation method, the Department assigns a score of 10 to all five sites. That is not only subjective manipulation of the data, it is completely ridiculous and indeed dishonest. Any honest assignment of scores under that guideline would give Hanford a 10 because it is already owned by the Department, Deaf Smith and Richton lower scores because both sites can be acquired by either purchase or condemnation but will entail additional expense, and Davis Canyon and Yucca Mountain even lower scores, perhaps a 5 or 6, because of the inherent uncertainties surrounding any Congressional action.

A thorough-going critique of the ranking methodologies used in the draft Environmental Assessment is contained in the final "Analysis of the Methods Used to Rank Potential Sites for Nuclear Waste Repositories, As Reported in the USDOE Draft Environmental Assessment, December, 1984." That critique was prepared by ECO Northwest for the Joint Legislative Committee on Science and Technology of the Washington State Legislature. We concur with the criticisms contained in that analysis and raise them as objections to the draft Environmental Assessment for the Yucca Mountain site. In particular we join in the conclusion:

Because of inappropriate methods and poor execution, the sites the DEA selects for characterization cannot be proved to be the best three sites of all sites evaluated for a repository.

MAJOR DEFICIENCIES IN THE DRAFT ENVIRONMENTAL ASSESSMENT

The draft Environmental Assessment contains several omissions and other content deficiencies that seriously impede the overall analysis of key subject areas and cast considerable doubt as to the validity of the conclusions that are reached.

(1) Exclusion of Lincoln County and City of Caliente

In examining the socioeconomic and transportation impacts of a repository at Yucca Mountain, Lincoln County and the City of Caliente are omitted from all of the analyses contained in the draft EA, despite the fact that the main rail route by which high-level waste will enter the state traverses the entire length of Lincoln County and bisects the City of Caliente. Since, by DOE's own projections, at least 70 percent of the waste will be shipped by rail, and since the Salt Lake City-to-Barstow (Union Pacific) line is the only one under consideration as a preferred route, most of the radioactive materials destined for the repository must pass through Lincoln County. In fact, the City of Caliente, which is literally divided in half by the railroad, may be the only area in Nevada where the "maximally exposed individual" (using DOE's definition) could actually be found since many businesses--and even the City offices--are as close as 60 to 100 feet from the rail bed. There are numerous other impacts directly associated with the continuous flow of radioactive waste through the County and City over a period of 30 years that must be examined if the EA is to be considered a reasonable and complete assessment of the effects of a repository on state and local conditions.

The treatment of socioeconomic conditions and impacts in the draft document likewise fails to consider other Lincoln County communities. Because the County borders the Nevada Test Site, it is possible that a number of repository-related workers will choose to live within County boundaries. If even a small percentage of the labor force locates in Lincoln County, there could be significant impacts on local socioeconomic conditions. For example, approximately .6 percent of the current Nevada Test Site work force resides in the small Lincoln County town of Alamo. If the same percentage of repository workers (using the work-force estimates arrived at by DOE) were to locate in Alamo, the town would experience a 13 percent increase in population--certainly a significant impact on a small rural community.

(2) No Consideration of Indian Communities and Issues

Another major deficiency in the draft EA involves the document's failure to consider repository impacts on Native American communities. The Moapa River Paiute Reservation and the Las Vegas Paiute Tribe will be directly and significantly impacted by the transportation of waste--both by rail and by road.

The Moapa Reservation encompasses portions of Interstate 15 and the Union Pacific rail corridor that will be used to ship waste to the repository. Because the rail line and roadway run parallel and in close proximity to each other through the reservation, Moapa may be the only community in the nation through which almost 100 percent of the radioactive materials destined for permanent disposal will pass. Yet the only mention of the reservation in the text (Sec. 3.6.4.2.1) indicates that the community is "distant from the repository," therefore unaffected.

The draft EA is also silent regarding the wider range of Native American issues and potential impacts. The Western Shoshone continue to claim the land upon which the repository is proposed to be built. This land holds an important place in Shoshone culture, religion, and way of life. The repository may energize significant conflicts that could cause problems for DOE and the Shoshone alike. Yet the issue is completely ignored in the document.

The impression one is left with after reading the material in the draft document is that the only possible effect of the project on Native Americans involves potential disruption of prehistoric sites. There is no consideration of present-day Indian concerns as these relate to cultural persistence, quality of life, anthropological issues, and Indian religious freedoms.

(3) Inadequate Treatment of Defense Wastes

All nine draft EAs evaluate defense high-level waste only in terms of the transportation costs and risks of shipping waste (a total of 6,720 canisters over 28 years) from the DOE Savannah River Plant (see p. 4 in A Preliminary Cost and Risk Analysis for Transporting Spent Fuel and High-Level Wastes to Candidate Repository Sites, by K. S. Neuhauser et al., SAND84-1795, October 1984, cited in Appendix A). However, defense high-level waste is currently generated and stored at three DOE sites: the Savannah River Plant, the Idaho National Engineering Laboratory, and the Hanford Reservation. As indicated by policy statements of authorized representatives of DOE, and by a report issued by the Mitre Corporation under contract with DOE (An Evaluation of Commercial Repository Capacity for Disposal of Defense High-Level Waste, DOE/DP-0020 (Draft), July 1984), disposal of defense high-level waste in a commercial repository appears practical and probable. According to the terms of the Nuclear Waste Policy Act, the President of the United States was to have evaluated the feasibility of comingling commercial and defense waste by January 7, 1985. Unless the President found, through such an evaluation, that defense waste was best disposed of in a defense-waste-only repository, the Secretary of Energy was to proceed promptly with arrangements for the disposal of such material in a commercial waste repository (see NWPA, Section 8(b)(1) and (2)). Since the President has not made a finding that defense wastes should be disposed in a defense-waste-only repository and since DOE's draft report on defense waste recommends comingling, all indications are that such wastes will be disposed in a commercial repository. In a discussion of such disposal, the Mitre report estimates that up to 20,000 packages of defense waste (or approximately 10,000 metric tons of heavy metal), will be emplaced in a commercial repository and require approximately 10 percent of the total underground area.

Accordingly, the draft EAs for all potential repository sites should contain an evaluation of repository design and planning assumptions based on the combined disposal of defense and commercial nuclear waste.

Similarly, the transportation impacts of shipping an estimated total of 20,000 packages of defense waste from all three DOE sites (as opposed to an estimated total of 6,720 packages from the Savannah River Plant) need to be identified and evaluated. Current cost and risk analyses based on shipping such wastes from only one facility (the Savannah River Plant) are inadequate and do not allow a reasonable comparative evaluation of potential repository sites (as required by the NWPA, Sec. 112(b)(1)(E)(iv).

(4) Failure to Consider MRS Implications

None of the nine draft EAs contains any discussion of a monitored retrievable storage facility (MRS) and the effect of such a facility on plans for repository design and waste transportation. The importance of an MRS, however, is evident in both the provisions of the Nuclear Waste Policy Act and in recent policy statements of authorized representatives of DOE. Failure to consider and evaluate impacts associated with an MRS may have significant effects on the ability of DOE to conduct "a reasonable comparative evaluation" of potential repository sites, as required by the Nuclear Waste Policy Act, Section 112(b)(1)(E)(iv). The use of an MRS facility as part of the waste management system will cause considerable changes in waste-package design, in assumptions about transportation, and in other areas of the repository program.

The Nuclear Waste Policy Act establishes MRS facilities as a recognized storage option designed to supplement, and not replace, a geologic repository (Sec. 141(a)(1) and (5)). Under additional terms of the Act, by June 1, 1985, DOE must complete a detailed study of the need for, and feasibility of, an MRS and submit a proposal to Congress for the construction of one or more such facilities. According to Section 141(b)(2) of the Act, the proposal to Congress <u>must</u> include:

> (C) site-specific designs, specifications, and cost estimates sufficient to (i) solicit bids for the construction of the first such facility; (ii) support congressional authorization of the construction of such facility; and (iii) enable completion and operation of such facility as soon as practicable following congressional authorization of such facility; and
>
> (D) a plan for integrating facilities constructed pursuant to this section with other storage and disposal facilities authorized in this Act.

The proposal is required to be supported by an environmental assessment that examines at least five alternate combinations of proposed sites (three, at the minimum) and facility designs (see NWPA, Section 141(b)(4)).

Statements by authorized DOE representatives have served to further clarify the important role of an MRS facility in the repository program. At a January 1985 high-level radioactive waste transportation meeting held by the Western Interstate Energy Board, at the February High-Level Radioactive Waste Transportation Business Plan Workshop sponsored by the DOE, and in discussions between DOE's Office of Civilian Radioactive Waste Management Director Ben Rusche and representatives of the Nuclear Regulatory Commission (NRC) (see transcript from NRC meeting of December 11, 1984, pp. 22-23 and 29-31), DOE representatives suggested that an MRS facility is to become part of an "integrated" program whereby facilities that were originally planned as surface facilities at a repository would be licensed and built separately, away from the repository and not subject to repository construction permits. Under such an "integrated approach," spent fuel would be shipped to an MRS facility to be packaged (after fuel-rod consolidation, if necessary) and subsequently shipped to a repository for disposal.

Such statements on the part of the Department of Energy, coupled with the statutory requirements for detailed, site-specific consideration of an MRS facility, indicate that the concept of an MRS is currently viewed as an integral part of the repository program. Accordingly, an environmental assessment of potential repository sites is incomplete without discussion and evaluation of an MRS on repository design and nuclear waste transportation. Use of an MRS for tasks originally assigned to a surface facility at a repository site (including spent-fuel-rod consolidation, packaging, and additional cooling) would presumably alter plans for repository design. Such issues should be addressed to ensure that all environmental assessments sufficiently evaluate and reflect the present status of planning for the repository program.

Use of an MRS that is located close to sources of spent fuel, with subsequent waste transport to a repository, will have notable transportation effects, including: altering routes between spent-fuel sources and a repository, greatly increasing the volumes of shipments traveling along probable routes from an MRS to a repository, promoting the development and use of a new generation of casks designed to accommodate consolidated spent-fuel rods, and increasing the potential use of unit trains for waste shipments. These, in turn, may affect the repository conceptual design, the type of handling facilities needed, the scheduling of waste emplacement, and other key factors.

Such factors could affect the comparative evaluation of repository sites and are integral to a reasonable and sufficient evaluation, as mandated by the Nuclear Waste Policy Act (Sec. (b)(1)(E) and (F)).

(5) Inadequate Treatment of Transportation

We find that the treatment of transportation in the draft EA is inadequate. Despite numerous and repeated requests from states, tribes, local governments, and the general public for a truly comprehensive approach to the subject (all made while the draft EA was being put together), the Department of Energy has steadfastly refused to do anything more than an overly general evaluation of national transportation impacts based on generic, averaged, and aggregated data.

The draft EA makes no attempt to evaluate route-specific conditions and variables that are crucial for any meaningful analysis of risk or for an adequate comparative evaluation of the various repository locations vis-a-vis transportation impacts, costs, and risks. Differences in such things as route- and area-specific accident rates, road and rail conditions, terrain, weather conditions and patterns, existence of potential or historical trouble spots, emergency preparedness of communities along specific routes, route-specific variations in population density, and other important route-specific considerations are completely ignored in the transportation analysis contained in the draft EA. It does not take a statistical expert to observe that there are major differences relative to all of the above variables between a repository site west of the Rocky Mountains and a site on the East or Gulf Coasts. Yet the analysis in the draft EA is done in such a way that the segment of I-70 across the Rockies in Colorado (with its <u>severe</u> gradients, road conditions, weather, and numerous closures) is exactly <u>equal</u> in terms of risk to an equal length of interstate that passes through level terrain and extremely moderate weather conditions.

The Nuclear Waste Policy Act clearly intends that transportation be used as an important element in making comparisons between sites. DOE's treatment of transportation in the draft EA fails to do that in any meaningful or adequate manner. Unless a route-specific analysis is done relative to <u>each</u> proposed repository location, there simply cannot be a viable comparison among sites.

The draft EA is likewise deficient in its approach to local and regional transportation impacts. Discussion of such impacts proceeds from a definition of "site" that is overly restrictive and fails to encompass localities and areas that will be most directly affected by repository-related transportation.

DOE addresses local transportation impacts only as they relate to areas immediately adjacent to the site itself. Regional impacts encompass only certain routes/areas within the state. In addition, the regional analysis is done using national accident-rate figures and other national aggregate data and assumptions instead of actual local (route-specific) information.

In describing the transportation "system" (highway and railroad) for the Yucca Mountain site, the draft EA includes only the roads between Yucca Mountain and the outer limits of the Las Vegas metropolitan area and the rail line (that is proposed--not even built) between Dike's Siding and the site. Lincoln County and the City of Caliente are ignored completely, as is the Moapa River Indian Reservation. The rail and highway networks within and through the Las Vegas area are also not included in any specific analysis (either in terms of risks or in terms of socioeconomic impacts to people residing along such potential waste-shipment corridors).

It is our contention that the "site" needs to be more broadly defined for transportation purposes if local and regional impacts are to be adequately addressed--and if Yucca Mountain is to be appropriately compared with other sites with regard to transportation variables. Such redefinition should include major rail and truck routes from the point where "funnel" effects of converging waste shipment begin to be strongly felt. At minimum, the local transportation-impact analysis should include each individual jurisdiction within Clark County (Las Vegas, North Las Vegas, Henderson, and Boulder City); other areas of Clark County; all of Nye County; all of Lincoln County; and the City of Caliente. Regional analyses should encompass all major rail lines and highways into the State that could conceivably be used to ship waste to the repository. Such regional analyses should use route-specific data for calculating risk and identifying other impacts. By narrowly defining the "site" for transportation purposes--as it does in the draft EA--the Department neatly avoids having to deal with many complex and potentially unfavorable issues relating to "local" and "regional" impacts that will occur as a result of large numbers of radioactive waste shipments coming into and through the state to a repository.

Another flaw in the treatment of transportation in the draft EA concerns the fact that risks are assessed only in terms of average volumes of waste shipments. The draft EA does not address the risks that will be associated with peak-volume shipments nor with conditions resulting from delays and bottlenecks that can be expected to occur during such shipments.

The entire transportation analysis done by DOE is based on the assumption that shipments from reactor sites (and other storage locations) to a repository will function with ultimate efficiency (a set number of shipments, evenly spaced around the clock). In the real world, shipments of such large volumes of waste (whether by rail or truck) will proceed in peaks and valleys, depending on such uncontrollable variables as weather conditions, equipment breakdowns/shortages, variations in waste-generation schedules, scheduling foul-ups, and the like. Such peak conditions could mean that trucks or rail cars will be lined up at the repository for hours or days waiting to be off-loaded, or that several rail cars (or trucks) could be delayed for lengthy periods at rail yards (or truck stops). Risk analyses, such as those performed for the draft EA, that do not consider the effects of peak conditions on exposure rates and other key elements in calculating risk will generate seriously understated risk assumptions. By using only average values in addressing potential transportation impacts, DOE effectively underestimates potential risks associated with waste shipments.

The analysis of transportation costs used to compare sites is likewise inadequate. There are major discrepancies between sites in the manner in which cost figures are arrived at. The Yucca Mountain draft EA specifically excludes certain transportation-related costs, such as the costs of constructing access roads. The draft EAs for the Utah and Hanford sites include such costs. The Utah EAs include estimates for physical security in transit--something that is lacking for Hanford and Yucca Mountain. Where such elements vary among analyses for the various sites, a defensible comparative evaluation is not possible.

Finally, a review of the consideration given to transportation variables in the ranking methodologies employed in Chapter 7 of the draft EA indicates that transportation factors cannot have a weight greater than 5.4 percent of the total equation. Consequently, even if transportation analyses for the various sites were adequate and comparable (which they are not), transportation variables would still have only minimal influence on the choice of sites for characterization.

Overall, the draft EA fails to adequately examine transportation effects (nationally, regionally, and locally) that are associated with a repository at Yucca Mountain (or at any other site). The data contained in the document do not allow for realistic assessments of risks and costs, nor do they provide a defensible basis for making a reasonable comparable evaluation among sites as required by the Nuclear Waste Policy Act.

Whether DOE agrees or not, transportation is a major issue with the potential to impact the entire repository program simply because people (nationally as well as locally) perceive the shipment of radioactive materials to be something that can directly affect their health and safety. Not only will people demand that transportation be shown to be safe, but they will also demand that DOE ultimately choose the safest site for a repository from a transportation standpoint. The Department must take concrete steps to demonstrate to states, local governments, and the general public that it is adequately addressing this issue. At times, those steps may not be what DOE perceives as necessary. However, given the issues, heightened visibility, and the tremendous amount of public concern generated, DOE may have to go much more than half-way in addressing demands for adequate assessment and planning. The draft EA does little to indicate that DOE is moving in such a constructive direction.

(6) Two-Phased Repository

The draft EA indicates that as an alternative repository concept the proposed Yucca Mountain repository would be constructed and operated using a two-phased approach whereby one portion of the repository would be completed and waste emplacement begun while the remaining parts of the facility were still being built. This concept was first proposed in DOE's draft Mission Plan. Such a proposal poses numerous health and safety issues that are nowhere addressed in the draft EA.

What, for example, are the implications of such a plan in terms of routine radiological exposure to construction workers and others engaged in building the repository while waste is being emplaced? What are the potential risks to workers associated with various accident scenarios relevant to waste handling and loading during concurrent construction and emplacement activities? What are the potential ramifications of simultaneous waste loading/storage and the ongoing blasting and other mining activities required for repository construction? These and other relevant issues must be addressed comprehensively in the final EA.

As presented in the draft document, the two-phased repository seems designed more for meeting DOE's perceived need to begin accepting waste at the repository by 1998 than for any legitimate design purpose. If that is the case, and if the two-phased approach is intended solely as a means of shortcutting waste-acceptance time-frames, the proposal may be seen as subjugating health and safety issues for the sake of expediency in meeting arbitrary and questionable deadlines. What is NRC's position on the licensing of a two-phased repository?

A complete discussion of the two-phased repository, including its impacts on all pertinent health and safety factors, needs to be included in the final EA if DOE is to adequately demonstrate the legitimacy of the proposal. The same discussion should also compare Yucca Mountain with the other eight sites in relation to this two-phased repository approach. If other sites are not being considered for simultaneous construction and emplacement, the reasons for such a decision must be clearly explained.

LAND AND WATER ISSUES

The manner in which DOE approaches land and water issues in the draft EA is piecemeal at best, blatantly misleading and inadequate at worst. Nowhere in the document are the complexities surrounding these issues addressed in a complete or comprehensive manner. Various aspects of each issue are contained in different parts of the draft EA (i.e., in Chapters 3, 4, 5, 6). However, no attempt is made to deal with the totality of land and water concerns in relation to the proposed repository and the exceedingly long-range implications inherent in such an undertaking.

For the most part, the draft EA deals only with current (i.e., present-day) conditions when describing land and water use in the area of the proposed site. There is no attempt to project long-range land/water needs (i.e., 100, 500, 1,000 years or more) and to examine the impacts of the repository program on area communities. There is, for example, no analysis of the impact that potential ground-water contamination resulting from a repository failure several hundred (or more) years hence could have on water use (and on the people using the water) at that time. Likewise, there is no rationale provided for DOE's proposal to withdraw 50,000 acres of BLM land from the public domain for the repository--nor is there any indication of exactly what land is being considered for such withdrawal or what such a scheme will do to present and future land-use patterns in the area.

Apart from the environmental and socioeconomic effects of the proposed repository stemming from land and water issues, there are also potential impacts to established institutional processes that are generally ignored in the draft EA. Preeminent among such institutional impacts is the implied displacement by DOE of the State's traditional jurisdiction over land and water. The discussion that follows represents an attempt to comment on these issues in an integrated fashion.

(1) Land

The Nuclear Regulatory Commission has promulgated the following repository requirement in 10 CFR 60.121: "The geologic repository operations area shall be located in or on lands that are either acquired lands under the jurisdiction and control of DOE or lands permanently withdrawn and reserved for its use."

The draft EA recognizes this requirement in Section 6.2.1.1.2 and identifies a "plan" to accomplish the land-use and withdrawal actions necessary for site characterization and for developing a geologic repository. The plan was developed by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project and is described in a DOE report: NVO-281, R. Richards and D. Vieth, "Land Use and Withdrawal Actions Necessary for and in Support of the NNWSI Project," U.S. Department of Energy, Nevada Operations Office, Las Vegas, September 23, 1983. The plan (if it can even be characterized as a plan) contained in the referenced report is simply an itemization of problems that must be overcome and contingencies that must be successfully dealt with. Nothing in Richards and Vieth or in the draft EA suggests that the Nellis Air Force Range or the Nevada Test Site enjoy a status akin to that of a federal reservation or enclave. The additional BLM land that has been identified for withdrawal obviously does not. Consequently, none of the lands have been reserved for DOE use, and permanent withdrawal is not presently even contemplated.

The Richard and Vieth report recognizes that the Nellis Range withdrawal authorization expired in 1975 and is before Congress for renewal, as required by the Engle Act (PL 85-337) and FLPMA (PL 94-519). Under a proposed extension of the withdrawal period currently awaiting Congressional approval, the Department of Defense (DOD) or the Air Force will continue to use these public lands under the administrative jurisdiction of the Bureau of Land Management (BLM) and the Fish and Wildlife Service (FWS). A cooperative agreement (which will expire on May 31, 1993) was entered into between DOE and BLM whereby DOE would have access to land (now used by the Air Force and administered by the BLM) that is needed for repository-related activities. Because of the unsettled condition of the Nellis Range segment, the validity of a permit negotiated between the Air Force and DOE to construct an exploratory shaft on the Nellis Range is uncertain.

The Richard and Vieth report states that in November 1980 DOE entered into a cooperative agreement with the BLM for two townships in Crater Flat, and that in September 1981 it entered into a similar agreement for 4,902 acres south of the Nellis Range. Both of these land segments were consolidated to permit exploration on these parcels. Other multiple-use activities on these lands were not curtailed.

The Nevada Test Site, which contains approximately 800,000 acres, has been temporary withdrawn by predecessor agencies to the DOE for conducting nuclear-weapons tests and related research in a series of withdrawals from February 1952 to August 1965. These withdrawals are currently under review by the BLM. Referring to the Nevada Test Site segment of the proposed Yucca Mountain site, Section 6.2.1.1.2 of the draft EA (p. 6-9) states:

> Pursuant to Public Land Order (PLO) 2568, December 19, 1961, this land has been withdrawn from all forms of appropriation under the public-land laws, including the mining laws, and is under the jurisdiction and control of the DOE. The DOI has jurisdiction and control over "the mineral resources and mineral and vegetable materials" of the land. DOE has control over all other surface and subsurface rights, including water rights from points of extraction on the land. The private acquisition of any surface or subsurface rights is presently precluded by virtue of the current public-land order.

The foregoing statement from the draft EA contains at best a series of half-truths and at worst outright falsehoods that must be addressed in the final EA, particularly in light of the following paragraph from PLO 2568:

> Authority to change the use specified by this order or to grant rights to others to use the lands, including grants of leases, licenses, easements and rights-of-way but excluding permits revocable at will, is reserved to the Secretary of Interior or his delegate.

If the DOE has arranged to be the Secretary of Interior's delegate, the final EA should reference this arrangement; otherwise, it does not appear that DOE has the jurisdiction and control claimed in the draft EA. Furthermore, it does not appear that the "jurisdiction and control" requirement of 10 CFR 60.121 is or can be satisfied without Congressional action.

The so-called "Plan" to acquire jurisdiction and control referred to in the draft EA is deficient insofar as it purports to satisfy the requirement of 10 CFR 60.121. According to Richards and Vieth (1984, p. 7):

> The plan to withdraw Federal land for a repository will be implemented if, and only if, the Yucca Mountain site is recommended to the Congress by the President for a repository and the recommendation is supported by the Congress. It is expected that the initial FLPMA land withdrawal request (with its 20-year limit) will be forwarded to BLM at the same time as the license application is sent to NRC. It is anticipated that permanent withdrawal via special legislation will not be requested until NRC approves the decommissioning and sealing of the repository. Until the requirement for retrievability of waste from the repository is no longer necessary, there is no reason (based on NRC regulations) to request Congress to effect a permanent withdrawal.

The draft EA ignores the fact that the NRC regulation, 10 CFR 60.121 must be satisfied prior to licensure. At present DOE cannot satisfy the requirement. At best, the DOE presently is simply a user of certain public lands known as the Nevada Test Site, which are temporarily withdrawn from the public domain. This status has little to do with jurisdiction. The draft EA fails to address the jurisdictional complications suggested by the referenced land-acquisition "plan," which proposes to maintain the nebulous jurisdictional status quo until the requirement for retrievability of waste from the repository is no longer necessary. At some future time, DOE expects Congress to approve permanent withdrawal and reservation of jurisdiction and control over surface and subsurface rights.

While DOE's expectation of favorable treatment by Congress may have some practical support, it totally ignores constitutional principles that limit Congressional action. For example, Article I, Section 8, Clause 17 of the U.S. Constitution provides for exclusive federal jurisdiction over withdrawn or acquired lands only in limited circumstances. In Surplus Trading Co. v. Cook, 281 U.S. 647, 650 (1930), the United States Supreme Court stated that "It is not unusual for the United States to own within a State lands which are set apart and used for public purposes. Such ownership and use without more do not withdraw the lands from the jurisdiction of the State."

The general principle emerging from the cases is that when lands areacquired or set aside for purposes not enumerated in Article 1 (such as for the repository) without the express consent of the State, the United States does so just as any other proprietor. A federal statute, 40 U.S.C. Subsection 255, provides that the head of a department of the government may secure from the state "consent to or cession of such jurisdiction, exclusive or partial, not theretofore obtained, over any such lands or interests as he may deem desirable and indicate acceptance of such jurisdiction on behalf of the United States. . . ." In Section 6.2.1.1.5, the draft EA seems to concede the necessity for exclusive jurisdiction by noting that "Once the land is under DOE jurisdiction, the DOE would be able to control access to it."

Control of access is inferred as a mandatory requirement of 10 CFR 60.121. The NRC regulation obviously requires more than that exercisable by an "ordinary proprietor"--it clearly requires the exercise of exclusive federal legislative authority and political jurisdiction over the site. The Nuclear Waste Policy Act provisions that envision state approval of the repository similarly contemplate a mechanism for state consent and suggest a requirement for complete and exclusive federal jurisdiction. The jurisdictional requirement is so important that it is unlikely that without the state's consent Congress would or, indeed could, constitutionally force the repository to be located within the state.

The draft EA blithely ignores these considerations by deferring them to the distant future. In this respect it is deficient. The conclusion in Section 6.2.1.1.5 of the draft EA states that "No impediments to eventual complete ownership [ownership is inappropriately equated with jurisdiction] and control by the DOE have been identified." This conclusion reflects a callous disregard for the constitutional role that a state plays in the federal system. It must be addressed in the final EA.

(2) Water

The fact that Yucca Mountain is not a Congressionally established reservation has a substantial impact on water rights that may be required for the construction and operation of a repository or any related activities. The federally reserved water-rights doctrine is not intended to authorize water usage on behalf of a federal agency in the absence of an established reservation. DOE, therefore, must acquire water rights from the Nevada State Engineer like any other appropriator.

In Section 3.3.3 (p. 3-30) the draft EA notes that "The ground water in the tuff aquifer underlying Yucca Mountain (see Figures 2-5 and 2-6) is part of the Alkali Flat-Furnace Creek Ranch ground-water basin, which discharges in Alkali Flat or Death Valley (Waddell, 1982)."

Figure 3-11 shows the direction of surface flow of water from the Yucca Mountain site through Amargosa Valley to Alkali Flat, a flow similar to the ground-water flow (see Fig. 2-5). In Section 3.6.3.3 (p. 3-74), the draft EA suggests that water usage in the Amargosa and Pahrump Valleys south of the proposed repository site presently exceeds supply so that "An overdraft (i.e., long-term withdrawal exceeding replenishment) has existed, and the State Engineer has opposed certification of new permits for irrigation." It is a requirement of Nevada law that the State Engineer must reject new applications for water rights for any purpose where there is no unappropriated water. The draft EA does not address this problem.

In Section 4.2.1.1.2 (p. 4-23) the statement appears that "Thordarson (1983) reports that the water level in well J-13 has remained essentially constant after long periods of pumping between 1962 and 1980. The large volume of water produced from this well (approximately 494,000 m^3 (400 acre-feet) per year), along with the minor drawdown during pumping tests (Young, 1972), suggest the aquifers underlying Yucca Mountain can produce an abundant quantity of ground water for long periods without lowering the regional ground-water table (Sections 6.3.1.1 and 6.3.3.3). Site-characterization activities are expected to use substantially less than 494,000 m^3 (400 acre-feet) per year." (See also Sec. 6.2.1.7.5.)

Whether or not DOE may acquire a Nevada water-right permit is a matter that must be decided by the Nevada State Engineer. The fact that the level in well J-13 remains stable during pumpage has nothing to do with a water right and little to do with whether prior water rights are being infringed upon in violation of State law.

Water usage is predicted at 180 acre-feet/year in Table 5-9 of the draft EA for vertical emplacement of a proposed repository. It is not stated in the draft EA whether water rights exist for well J-13 or, if so, what limitations are extant as to place of use, manner of use, diversion rate, or the consumptive use. These are facts that must be disclosed in the final EA in order to adequately assess the hydrologic impacts of locating a repository (Sec. 5.2.2) and the socioeconomic impacts due to repository water use (Sec. 6.2.1.7) particularly if existing water rights must be condemned to satisfy the water requirements (see Sec. 6.2.1.3.2).

The deficiencies of the draft EA are obvious with respect to withdrawal of ground water. Because of the foregoing considerations, the cryptic conclusion contained in Section 6.2.1.7.5 (p. 6-84) is insufficient as an environmental assessment. It states: "The regional effects of withdrawing ground water for a repository at Yucca Mountain are expected to be negligible." That statement must be reevaluated particularly in light of the fact that it does not appear that DOE has any present right to divert water for repository-siting purposes.

Overall, the draft EA is deficient in addressing the federal-state institutional processes associated with jurisdiction and control of identified land and water resources for repository purposes. These must be addressed in the final EA.

SOCIOECONOMIC ISSUES

The draft EA for the Yucca Mountain site is flawed in a number of important respects with regard to its treatment of socioeconomic issues and impacts. The document presents a "best-case" scenario that minimizes potential impacts to the social and fiscal systems of southern Nevada. It ignores risk, assumes unchanging demographics, and proceeds from the premise that all markets function with perfect information. It uses a model of questionable validity and ignores relevant differences between Clark and Nye Counties (and ignores the rest of the state entirely).

Perhaps the most obvious of the many deficiencies in the draft EA's treatment of socioeconomic issues involves the needlessly restrictive limitation of inquiry and analysis to the "bicounty" area of Nye and Clark Counties. Lincoln County and the City of Caliente are not even mentioned--despite the fact that both entities will experience significant impacts as a result of waste shipments by rail passing through populated areas. Likewise, the Moapa Indian Reservation is given only passing mention (the draft EA states that it will not be affected in any way since it is far removed from the proposed repository)--despite the fact that the Moapa Reservation encompasses both the main rail and road routes to the site. Local jurisdictions within Clark and Nye Counties are generally ignored in terms of city-specific or community-specific socioeconomic impact analyses. And social and economic consequences that have statewide implications--or that pertain to portions of the state outside the "bicounty area" (i.e., impacts to communities along northern, central, and eastern transportation routes)--are missing entirely from the draft EA.

The methodologies employed in the draft EA (and in supporting documents) to estimate such crucial elements of the socioeconomic-impact-analysis formula as direct and indirect labor-force numbers, settlement patterns of inmigrating workers, and even the number or percentage of inmigrants expected are either lacking altogether or are seriously deficient.

Nowhere is the calculation by which DOE arrived at direct repository employment explained. Such calculation is crucial because it drives a number of other key variables in the socioeconomic analysis, including total employment, which, in turn, provides the basis for projecting impacts on local communities (and on the state).

The fact that direct employment at the Yucca Mountain site is estimated to be almost 200 percent greater than for any of the other nine sites would seem to indicate that the Nevada employment figures are greatly overstated. The fact that there is no explanation in the draft EA as to how direct-worker estimates were arrived at may be seen to indicate that the numbers have been intentionally inflated. Such speculation is further fueled by the limited information that is available in reference material (especially McBrien and Jones, 1984) relative to labor-force calculations. Those estimates contain "contingency" factors of up to 40 percent and inflate employment numbers by another 15 to 18 percent because of the manner by which fringe benefits are incorporated into the equation.

Indirect employment figures are likewise suspect because of the use of a multiplier that is between 2-1/2 and 5 times larger than multipliers employed for any other site. State agency reviewers consistently questioned the applicability of such a large multiplier even for Clark County, which has a more diverse and sophisticated overall labor force than rural Nye County.

The draft EA consistently focuses on employment and income gains that will occur as the site is developed. It just as consistently ignores the declines in employment and the negative impacts on local revenues and markets that will occur as the project moves from construction to operations and from operations to closure.

The draft document assumes (incorrectly) that all markets function with perfect efficiency. The assumption inherent in the draft EA is that if 1,900 construction workers are needed, exactly that number will appear (no more and no less) at exactly the proper time. Conversely, the EA assumes that workers will all disappear on cue once they are no longer needed. Similar assumptions drive DOE's evaluation of housing, materials, and other markets. Such simplistic and shortsighted analyses ignore the complexities and interrelatedness of socioeconomic variables and tend to render meaningful evaluation impossible.

A final major area where the draft EA is seriously deficient involves the analysis of potential repository-related impacts on the primary sector of Nevada's economy--tourism. The tourism analyses contained in the EA and in supporting materials are superficial and largely irrelevant. The document attempts to infer that because impacts on tourism as a result of major hotel fires and the Three Mile Island incident were short-lived and minimal, a repository (and related shipments of nuclear waste passing through Las Vegas over 30 years) will have little effect on the state's tourism industry. Not only is such treatment of this crucial subject inadequate and misleading, but it also fails to differentiate between short-term, crisis-related events and the implications of a project that will be ongoing for 10,000 years. Likewise, any attempt to relate tourism at places like Harrisburg, Pennsylvania, to tourism at Las Vegas is superfluous.

Given the tremendous public concern about anything "nuclear" and the large amount of publicity a repository will generate, it is impossible to evaluate potential tourism impacts without direct assessments of risk perception and expected behavior on the part of potential tourists. DOE cannot legitimately draw any conclusions relative to the repository's effect on the state's prime industry based on assumptions inferred from unrelated situations and events.

In short, the conclusions relative to the qualifying, favorable, potentially adverse, and disqualifying conditions for socioeconomics contained in the draft EA are based on fundamentally flawed and inherently incomplete information. Nevertheless, DOE proceeds to conclude that a Yucca Mountain repository is not expected to generate any significant adverse socioeconomic effects that cannot be mitigated. Such a conclusion is unsupported even by the information contained in the draft EA and casts doubt on the integrity of the entire socioeconomic assessment process. The only conclusion that is justified by available data is one that acknowledges that there is not enough information at this time to predict whether there will be adverse impacts or whether those impacts can, in fact, be mitigated.

MAJOR TECHNICAL CONCERNS

The Nuclear Waste Policy Act stipulates that geological considerations shall be the primary criteria for the selection of sites for repositories. Assessments of the long-term performance of a high-level waste repository require the use of quantitative models; however, substantial uncertainties are associated with both the models themselves and the geotechnical input data necessary for their use. No matter how good the repository design or how excellent the site conditions, there will always be uncertainty as to the ability of the site to contain and isolate the waste over time. To mitigate the effects of large uncertainties arising from recognized inadequacies in the data and analytical models, a "conservative" approach to site assessment is necessary. DOE acknowledges this necessity in its siting guidelines, which require a "realistic, but conservative" approach to the assessment of site conditions. A review of the draft EA suggests that many technical analyses used to support guideline findings may be nonconservative and based upon an uncertain data base. There are a number of technical areas in the draft EA in which: (1) the data are insufficient to make realistic conclusions, (2) assumptions utilized in the absence of data are nonconservative, (3) technical evidence is inadequate to support purported findings, or (4) large uncertainties are present in some data that promote alternative hypotheses not discussed in the draft EA for analytical models. As a result, a central theme apparent throughout our technical comments is that consideration of data uncertainty is ignored in the draft EA. When this problem is coupled with the use of nonconservative assumptions, overly optimistic findings relative to the suitability of Yucca Mountain as a repository site are generated.

(1) Volcanic Activity

The favorable condition for the tectonic guideline (10 CFR 960.4-2-7) requires that the probability for disruption of the repository by igneous intrusion or hydrothermal activity be estimated for the 10,000-year postclosure period. The mean probability estimate presented in the draft EA is supported by neither the draft EA nor the supporting literature. The probability estimates do not consider geologic controls, tectonic patterns, and potential for hydrothermal activity.

In the draft EA (p. 6-222) and Crowe et al. (1982) the range of probabilities for basaltic eruptions at Yucca Mountain for a 10,000-year period is stated 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 the draft EA does not state 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 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.

Related to the probability for volcanic eruptions at Yucca Mountain, the assessment of volcanic hazards has been downplayed in the draft EA. It is important to understand large-scale patterns of volcanic activity in order to evaluate the potential for volcanic eruption at Yucca Mountain. Volcanic-hazard studies have concentrated on Crater Flat west of Yucca Mountain; however, the Crater Flat volcanics are part of a larger volcanic field extending from Death Valley to the Pancake Range in central Nevada. Other research has suggested that other portions of the volcanic field may be younger than the Crater Flat volcanics, thus the hazard may be greater than previously estimated.

The probability of hydrothermal activity, often associated with volcanic activity, is not considered in the draft EA. The upwelling of hydrothermal waters may intersect the repository and affect the isolation capability of the site. There are several indicators that suggest hydrothermal systems have existed and may still exist near Yucca Mountain, including: elevated water temperatures, high-temperature zeolites, and possible hydrothermal deposits observed in fault zones. Other reports suggest that hydromagmatic eruptions have occurred at Ubehebe and Lunar Craters, north and south of

Yucca Mountain. It should be noted (p. 2-14) that in 1979 DOE eliminated the Wahmonie site on NTS from future consideration as a repository partly due to the presence of warm springs and hydrothermal alteration.

(2) Tectonic Activity

The favorable condition for the tectonic guideline (10 CFR 960.4-2-7) requires the consideration of rates of tectonic processes operating within the geologic setting for the first 10,000 years after closure. Evidence presented in the draft EA does not support the finding that this condition is present at Yucca Mountain.

The principal assumption that the geologic history of the last 1-2 m.y. allows the prediction of future events must be tempered by the fact that, at least with regard to tectonics, the history is not completely understood at the present time. The evidence in the draft EA suggests that the nature and rates of igneous and tectonic activity may in fact be episodic or cyclic (p. 6-227). This observation is acknowledged in most of the current literature related to seismotectonics of the Basin and Range Province (Carr, 1984; Rogers et al., 1983; U.S. Geological Survey, 1984; Wallace, 1978). Consequently, the principle of "uniformitarianism" is applicable only if these episodes or cycles are reasonably well understood, especially if they are to be used to gauge activity over the next 10,000 years.

The draft EA evaluation of the favorable condition does not consider the probability of tectonic activity at Yucca Mountain. Based on the work of Rogers and others (1983) and the U.S. Geological Survey (1984), it could be reasonably inferred that since "there is a potential for significant seismicity on faults at or near Yucca Mountain . . . despite geologic evidence of general long-term tectonic stability in the last 10 million years" (draft EA, p. 6-227), there is also a high probability that significant tectonic activity could occur at least once at Yucca Mountain in the next 10,000 years. If the data of Carr (1984) are used (draft EA, p. 6-232) the recurrence rate of 2.5×10^{-5} events/yr/1,000 km^2 is equivalent to a rerupture time of 40,000 years/1,000 km^2. This rerupture time is the average time between surface faulting events randomly occurring within a 17-km radius (1,000 km^2) of the site. Since the faulting events will not be randomly distributed but rather will be confined to tectonic structures, it is likely that the north-northeast-trending structures of Yucca Mountain will be preferred sites of activity and exhibit rerupture rates significantly higher than the surrounding area, possibly greater than one event per 10,000 years. If the average displacement rate on the Windy Wash fault is used (0.11 m/1,000 yr; Carr, 1984), 1.1 m of displacement would occur on this fault during the next 10,000 years. This is comparable to a single magnitude 6.5-7 earthquake with normal displacement (Bonilla et al., 1984).

Based upon the above analysis and further comments by John Bell, Nevada Bureau of Mines and Geology, we find that there is <u>significant</u> potential for tectonic activity at Yucca Mountain during the next 10,000 years.

(3) Fault Activity

Preclosure and postclosure tectonics guidelines (10 CFR 960.5-2-11 and 10 CFR 960.4-2-7) require that the nature and rates of tectonic processes such as faulting and seismicity 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, DOE has made the unsupported assumption that active faulting is not present at Yucca Mountain. DOE has utilized this assumption in its findings on the disqualifying condition (10 CFR 960.4.2.7(d)) and the potentially adverse conditions (10 CFR 960.5-2-11(c)(2 and 3)). Our concerns with the disqualifying condition are discussed in greater detail in the comments on disqualifying conditions at Yucca Mountain.

Based upon an analysis of the potential for future fault activity at Yucca Mountain by Carr (1984), the draft EA states on p. 6-226 that "At present, a preliminary conclusion could be made that the north-trending faults at Yucca Mountain should be considered potentially active even though the absence of fault scarps and the near absence of seismic activity suggest that they are not active." We are concerned that contrary to the above conclusion, DOE makes findings relative to the tectonics of the site "under the assumption that the Yucca Mountain faults are not active . . ." (pp. 3-21, 6-231, 6-286, 6-288, and 6-289).

Relative to seismic activity and associated ground motion at Yucca Mountain, DOE has provided values for maximum ground acceleration at the site assuming the Yucca Mountain faults are not active. There is no presentation of values for maximum ground acceleration assuming the Yucca Mountain faults are active. This omission underestimates the potential seismic hazard at Yucca Mountain and seriously misrepresents the findings relative to tectonics.

From the opposite perspective, our review of the draft EA and relevant literature finds the seismic record is too short, and the geologic evidence is too incomplete to allow a determination of fault capability at Yucca Mountain. It is unreasonable to assume that Yucca Mountain faults are inactive. Design parameters, such as maximum credible earthquake and maximum anticipated vibratory ground motion, are underestimated since they assume Yucca Mountain faults to be inactive. The evidence for lack of surface displacements at or near Yucca Mountain in the last 40,000 years is equivocal and incomplete and is not sufficient to allow the conclusion to be drawn that faulting at Yucca Mountain is unlikely during the preclosure period. DOE's findings on tectonics should be reevaluated.

(4) Geohydrology

The geohydrology of Yucca Mountain encompasses a host of issues related to the acceptability of the unsaturated zone for a high-level nuclear waste repository. It has been postulated that the arid climate of the unsaturated zone may prove acceptable for such repositories; however, there is little detailed knowledge of the geohydrology of such environments. The siting guideline for geohydrology (10 CFR 960.4-2-1) requires the present and expected geohydrologic setting to be compatible with waste containment and isolation, and will comply with the requirements for releases to the accessible environment and releases from the engineered-barrier system.

DOE's proposed site within the welded and highly fractured tuff of Yucca Mountain constitutes an extremely complex and difficult environment to confidently assess and characterize. The draft EA clearly shows that the moisture regimen in the unsaturated zone of Yucca Mountain is still essentially unknown. What little information is known from possible analog environments, such as Rainier Mesa (see Thordarson, 1965; Henne, 1982; or Jacobson, 1982), is not particularly encouraging with respect to satisfying the geohydrology guideline. Given the complexity of the unsaturated zone and the lack of information on the unsaturated-zone conditions, the conclusionary statements in the draft EA relative to satisfying geohydrology guidelines are unfounded.

From a detailed review of the draft EA and supporting literature it is clear that the existing data base and general understanding of site conditions are so limited that unequivocal conclusions are not possible. While the data base and fundamental knowledge of the site are deficient, these deficiencies are misused to create misleading quantitative results. The conceptual model of the unsaturated zone (Montazer and Wilson, 1984) is essentially unsupported by sufficient in-situ data or relevant data in appropriate analog environments. Montazer and Wilson acknowledge that a number of conceptual models are applicable to Yucca Mountain but concede that the model selected is based on their perception of site conditions. It is, therefore, little more than subjective opinion.

The pre-waste emplacement ground-water travel-time of more than 10,000 years, along any path of likely radionuclide travel to the accessible environment, is open to serious question. Analyses using existing data demonstrate that the unsaturated-zone travel-times could be very prolonged, as postulated by DOE in the draft EA, or travel-times could be much shorter, as calculated by the DRI in our comments on disqualifying conditions. The travel-time estimates presented in the draft EA are highly suspect and essentially meaningless when hydraulic gradients, effective porosities, bulk hydraulic conductivities, matrix hydraulic conductivities, and true travel-paths are not well known. Some of these properties and parameters can vary from less than one order of magnitude to as much as three or four. The associated calculations of travel-time also may vary accordingly in magnitude. The confidence that should be placed on such calculations in the absence of other independent evidence is very low, <u>not</u> high as stated in the draft EA.

The draft EA concludes that the host rock is free-draining and therefore is a favorable repository condition. The draft EA has not demonstrated with data that the host rock provides free drainage. It is acknowledged that due to the extensive fracture systems, free drainage is probably present; however, observations reported in backup references note the presence of localized zones of saturation (perched water). Evidence of perched water were observed in drill holes USW H-1, UZ-1, and UZ-4. DOE should evaluate whether or not the evidence of local zones of saturation implies an absence of free drainage, and then revise the EA to reflect accurately the findings relative to the favorable condition on free drainage.

In summary, DOE's findings relative to the geohydrology of Yucca Mountain have not been demonstrated by the evidence presented in the draft EA. We request that DOE either revise the findings to accurately reflect the current level of knowledge and the uncertainty inherent in the data or clearly demonstrate the presence of positive geohydrologic conditions.

(5) Climate Changes

The qualifying condition for climate change (10 CFR 960.4-2-4) requires that the site be located where future climatic conditions will not lead to loss of isolation. Two conditions are considered appropriate to this guideline: increase in water-table elevation and increase in moisture flux. An evaluation of past climatic maxima conditions is applicable for assessing future effects on the repository. There is some question of the validity of DOE studies to date and the ability to extrapolate climatic changes into the future with reasonable assurance. There is insufficient information presented in the draft EA or in backup literature that supports a finding that future climatic conditions at Yucca Mountain will not lead to loss of isolation.

There is no reliable way as yet of relating precipitation to infiltration even in the modern arid setting, much less during a full-glacial period (climate maxima). Because of possible differences in vegetative cover and seasonality of precipitation, greater precipitation during a full-glacial period might result in proportionally greater infiltration than would otherwise be expected from estimates presented in the draft EA. How greater infiltration can be translated into increased moisture flux through the subsurface is even more speculative. DRI comments address this concern in greater detail.

Estimates of water-rise at Yucca Mountain are theoretical and not based on hard geological evidence. Winograd and Doty (1980) calculate a 30-m maximum rise in water-table elevation in Frenchman Flat. However, Czarnecki (1984) estimates a 130-m rise in water-table elevation at Yucca Mountain and postulates perennial flow in Fortymile Wash. Czarnecki acknowledges that the uncertainty in his calculation is not supported by direct geologic evidence. Given the uncertainty in the estimations, a conservative 40-m increase in the "predicted" maximum water-table rise of Czarnecki would saturate the repository, thus possibly impacting the site's ability to contain and isolate the waste.

(6) Geochemistry

The geochemistry guideline (10 CFR 960.4-2-2) requires the present and expected chemical characteristics of the site be compatible with waste containment and isolation. Critical considerations with respect to geochemistry are potential sorption characteristics of the host rock and along transport pathways, and the geochemical interactions between radionuclides and the aqueous phases. Based upon a review of the draft EA and the supporting literature, there is insufficient data to assess the sorption potential, retardation, and radionuclide transport rates and direction to the accessible environment. DOE's findings relative to the geochemistry guideline are in some cases unsupported by the references.

The draft EA identifies potential transport paths as matrix and fracture conduits and proposes 1 mm/yr flux for matrix flow and an "unknown" higher flux for fracture flow. Various cited references acknowledge that actual flux rates have not been measured, especially in the critical unsaturated zone. More importantly, no flux values have been estimated under possible pluvial climatic conditions. Without reasonable estimates of flux rates and transport direction, no rational assessment of potential sorption or retardation can be made.

We question the use of J-13 well water in experiments and studies as being representative of water in the unsaturated zone. Short residence-time of unsaturated-zone water, non-equilibrium of water with the host rock, and the potential for soil-zone leaching all argue against the similarity of unsaturated-zone water and J-13 well water. Therefore, the geochemical models presented in the draft EA that utilize J-13-derived parameters are suspect and bring into question the findings derived from those models. The comments of DRI further discuss the problems connected with the use of J-13 well water.

The geochemistry discussion in the draft EA fails to consider the effect of soluble salts in the moisture of the unsaturated zone under elevated temperature conditions. When the canisters raise the repository temperature, moisture will be driven from the near field with possible desalting of the moisture. This desalting may produce carbonate precipitates that could significantly influence uranium and plutonium complexing, thus affecting sorption effectiveness. Upon repository cooling the reintroduction of fresh moisture into the salt precipitates could produce brines that may adversely affect waste-canister integrity. Tests using J-13 well water cannot predict these results.

Sorption behavior of the authigenic mineral components (zeolites and clays) are partially dependent upon their cation composition. Since the draft EA literature indicates that the cation composition of the zeolites varies with stratigraphy and geography at Yucca Mountain, it is expected that the sorption capacity of zeolites will also vary. There is no discussion of the variability in the draft EA and how this variability might influence the performance of the site.

The reversibility of zeolite and clay dehydration does not indicate that sorption characteristics will remain similar after rehydrating. The release of certain cation species and the entrapment of others during dehydration may affect a significant change in behavior with respect to rehydration and sorption. General statements in the draft EA concerning this issue simplify a complicated topic without adequately considering the important aspects that may be responsible for driving the chemical reactions.

We have serious concern about repository containment with respect to vapor-phase transport. The concern stems from the potential of open fractures extending to the ground surface, and from the potential for convective flux. The present structure of Yucca Mountain is not a closed system; it is potentially open. Noble gases released from the waste package could be transported to the environment. Tritium certainly is soluble in water vapor and is transported by this mechanism. The behavior of the other radionuclides is unknown. Studies currently underway at the University of Arizona should be described in the draft EA as they relate to vapor-phase transport. A conceptual model of deep unsaturated zones proposed by Ross (1984) identifies a significant component of upward-moving water vapor. The simplistic statements in the draft EA on vapor-phase transport (p. 6-188) fail to adequately address the applicability of the subject to Yucca Mountain or the state of scientific knowledge on vapor-phase transport in the unsaturated zone.

(7) Radionuclide Retardation

DOE, in its finding that favorable conditions for radionuclide retardation (geochemistry guideline 10 CFR 960.4-2-2) are present at Yucca Mountain, uses inappropriately applied data in the conclusions. The references cited in the draft EA calculate retardation factors based on the assumption of saturated, porous flow and equilibrium conditions. The assumption of porous flow is questionable because of the uncertainty in flux and flow mechanisms. Retardation factors based on measurements from batch experiments could lead to unreasonably high estimates of the actual sorptive capacity of the host rock, and thus to unrealistically high retardation factors. Consequently, the estimates of radionuclide releases may be unreasonably low.

The overestimation of the retardation factor for unsaturated flow coupled with the possible overestimates for fracture flow versus matrix flow in highly fractured tuff suggest the evidence presented in the draft EA are insufficient for the findings made.

(8) Mineral Stability

Various aspects of host-rock mineral stability are addressed in the guidelines on geochemistry (10 CFR 960.4-2-2) and rock characteristics (10 CFR 960.4-2-3 and 10 CFR 960.5-2-9). The evidence presented in the draft EA and supporting data in the cited references is contradictory and suggest that DOE should reconsider its "positive" findings relative to host-rock mineral stability.

Data on the areal distribution and abundance of the secondary minerals is contradictory if followed through the DOE literature. Several reports (Bish et al., 1982; Vaniman et al., 1984) suggest abundant zeolites and clay minerals in the Topopah Spring Member at the repository horizon. Sorptive minerals appear to be found throughout the repository horizon in varying amounts, and it seems difficult to predict with any accuracy the absolute amount of these minerals at the repository horizon based on the few drill holes in the exploratory block. In drill holes USW G-1, G-2, and UE 25a-1, Bish et al. (1982) indicate the groundmass of the central and lower Topopah Spring has a high clay (smectite) content. Vaniman et al. (1984) report that smectite abundances may be as high as 6 percent in the repository horizon. Levy (1984) reports data from hydrological drill holes indicate sorptive minerals are present in the repository horizon; however, Bish et al. (1984) contradicts these data by reporting less alteration and sorptive materials for the repository horizon than previous literature. Vaniman et al. (1984) also indicate that zeolites occur above the basal vitrophyre in USW G-1 (10 to 20 percent) and G-2 (30 to 50 percent). Vaniman et al. (1984, p. 19) states: "Even where zeolite abundances at this level are very small, as in USW GU-3, the zeolites are concentrated along fractures and voids . . . and therefore may be important for waste element sorption along potential flow paths." Bish et al. (1984) indicate zeolites and clays are also found in the

Calico Hills tuff in abundances of 70 to 90 percent. These units are within 70 m of the proposed repository horizon, where Braithwaite and Nimick (1984) predict the temperatures to exceed 80°C. However, zeolites and smectite minerals become unstable on increase in temperature, particularly under low water-vapor conditions (Bish et al., 1982; Boles, 1971; Smyth, 1982). These various references do not present a clear picture of secondary mineral abundance and distribution.

Stability and rates of reaction for zeolites and clays are not well known. Dibble and Tiller (1981) report data that indicate slow reaction rates for fluids in equilibrium with zeolites. Conversely, Vaniman et al. (1984) indicate that zeolites at Yucca Mountain probably formed at fast rates. Furthermore, Bish et al. (1982) question the applicability of literature data to zeolite and clay mineral reactions because of variations in mineralogical and chemical composition, and geologic environment.

Bish et al. (1982) report the transition from zeolite to analcime is accompanied by a volume reduction of approximately 20 percent. If the abundance of zeolites and clays (70 to 90 percent) in the Calico Hills tuff below the repository horizon as reported by Bish et al. (1984) is accurate, then a zeolite volume reduction initiated by a temperature increase could affect repository rock stability.

In summary, the potential reduction in sorptive capacity of rocks along the flow path from the repository to the accessible environment and in fractures in the repository horizon that are thought to be important to retardation questions the positive findings for geochemistry. Dehydration reaction of smectites lining fractures in the repository horizon and dehydration of zeolites in the tuffaceous beds of the Calico Hills would reduce significantly the ability of the host rock to retard the migration of radionuclides and therefore affect the finding for postclosure rock characteristics. The volume reduction that accompanies mineralogical changes affecting the zeolites, clays, and cristobolite could adversely affect the finding for preclosure rock characteristics.

(9) Rock Stability

The preclosure guideline on rock characteristics (10 CFR 960.5-2-9) considers the support and maintenance requirements relative to the stability of the host rock. DOE finds the host rock requires only minimal support for underground openings, and no extensive maintenance of openings is required. The evidence presented in the draft EA and in the supporting references does not support these findings.

The estimated quality of the host rock is poor. According to Dravo (1984) in drill hole USW G-4, the best core index from the repository horizon is 72 percent, which translates into Rock Quality Designation (RQD) of approximately 25-30 percent. This low level of RQD would tend to suggest the need for more than minimal support for the underground openings.

Reliance on rock mass classification systems for arriving at the underground support system may not be appropriate. The classification systems mentioned in the draft EA (p. 6-266) were developed for single tunnels, and the reliability of these systems has not been adequately verified for mines.

In addition, the joint characteristics needed to estimate rock-classification ratings were obtained from only one on-site drill hole and other non-specific data (Dravo, 1984).

The effects of the uncertainties resulting from the lack of data on fractures have not been adequately taken into account in the evaluation of support requirements or the stability of openings.

The presence of geologic anomalies such as the lithophysae, faults and breccia, and fracture fillings has not been adequately taken into account in evaluating support requirements or opening stability.

The thermal effects on the integrity of fully grouted bolts during preclosure have not been adequately considered.

The use of the G-tunnel experience as a basis for concluding that minimal support will be sufficient has not been adequately justified. Although some similarities between the G-tunnel rock and the host-rock formations may exist (Tillerson and Nimick, 1984), a comprehensive analysis of the similarities has not been presented in the draft EA. Also, the Grouse Canyon tuff encountered in G-tunnel is relatively lithophysae-free and has not been subjected to high repository temperatures.

The limitations associated with the Johnstone et al. (1984) analyses and the effect of resulting uncertainties on the evaluation of roof-support requirements and opening stability in heated conditions have not been adequately considered. It is concluded in the draft EA (p. 6-267) that "The analyses completed to date indicate that the stresses and displacements that are expected to result from the heat emitted by the waste would not lead to significant stability problems in the drifts." However, the referenced thermal analyses (Johnstone et al., 1984) pose several limitations, such as: (1) the model does not accommodate changes in mechanical properties of rock due to elevated temperature; (2) the thermomechanical prediction has not been verified by field data; (3) the in-situ stress data used in the analyses may not be fully applicable because the measurements were based on stress data from only one hole in the saturated zone; and (4) the rock properties used in the analyses are based on laboratory test data and, therefore, do not adequately account for the rock-mass discontinuities and lithophysal cavities.

These deficiencies in the rock-stability analyses suggest that artificial supports may be required for underground openings, and extensive maintenance of those openings could be required. DOE should reassess its findings on rock stability.

(10) Natural Resources

The human interference technical guideline (10 CFR 960.4-2-8) and the natural resources guideline (10 CFR 960.4-2-8-1) address the possibility of future human intrusion of the repository due to the attraction of valuable natural resources. The evidence presented in the draft EA does not support the conclusions that no valuable natural resources are present that would attract human interference. Conversely, available evidence suggests the potential of natural resources at Yucca Mountain that may be attractive for future exploitation.

The evidence is as follows:

1. Yucca Mountain is located at the eastern edge of a buried caldera, which is mineralized along its western and northern boundaries. Common sense would suggest the eastern boundary is also mineralized.

2. Drill-hole data from Yucca Mountain indicate gold and silver mineralization is encountered at depth (Spengler et al., 1981). Since many of the deep tuffaceous units are altered, possibly hydrothermally, and pyrite is ubiquitous in these units, other occurrences of mineralization are highly probable. It appears that no detailed studies of the drill core for mineral resources have been performed and no systematic geochemical samplings of surface outcrops or drill cores for assessments of "indicator" elements have been done.

3. The assessment of mineral-resources potential at Yucca Mountain by Bell and Larson (1982) was strictly a literature search with no ground-truth examinations. The draft EA does not reflect the data uncertainty inherent in literature studies.

4. The geothermal potential at Yucca Mountain is unknown. Above-normal ground-water temperatures are suggestive of a thermal source, possibly below current drilling depths. Geothermal temperatures lower than the requirements for power-plant use do not negate the resource for other lower-temperature uses.

5. Ground-water quality beneath Yucca Mountain is well within current water-quality standards for domestic consumption. The statement in the draft EA (p. 6-237) that there is no credible potential for use of Yucca Mountain water resources is unfounded. Since agricultural areas near the site (Amargosa Valley) are fully appropriated, any future development of the area for agriculture, industry, or domestic use may necessitate the import of water. Yucca Mountain is a possible source for future water supplies.

6. The draft EA suggests there is no possibility of contamination of the deep carbonate aquifer because of an upward gradient from the carbonate aquifer to the alluvial-tuff aquifer. This statement ignores the possibility that in the future the deep carbonate aquifer may be tapped for water supplies for southern Nevada and could reverse the upward gradient. This change could adversely impact the ground-water flow systems important to waste isolation.

The above evidence suggests Yucca Mountain may have some mineral potential; but the potential is unknown presently, and there may be some potential for future exploitation of ground-water supplies. The findings presented in the draft EA are unsupported and should be revised to reflect the above evidence.

(11) Exploratory Shaft

In the draft EA, DOE indicates it proposes to locate the exploratory shaft and accompanying surface facilities in Coyote Wash near the eastern edge of the repository block. The exploratory shaft will be utilized during site characterization to investigate and test the potential host-repository horizon. We question the location selected for the exploratory shaft for the following reasons:

1. There is no discussion in the draft EA of the exploratory-shaft site-selection process. The decision to site along the eastern edge of the repository block which could potentially jeopardize a thorough characterization of the western portion of the block raises questions about the selection process. The discussion of site-characterization plans in the draft EA is insufficient to assess the completeness of underground investigations. We believe that, in the absence of a documented exploratory-shaft site-selection process, the Coyote Wash site may not be the "best" shaft site for completely characterizing the repository block.

2. Since the exploratory shaft is proposed to be constructed in Coyote Wash and would in all probability become an integral part of the disposal facility if it is built at Yucca Mountain, the use of the 100-year-storm event to design flood protection is questionable. With a 100-year-return period, that event has a 1 percent probability of occurrence during any given year. If that event or a greater event did occur during the proposed characterization period, it could result in negating the viability of the site through introduction of large quantities of water directly into the repository block. It would seem prudent, given the significance of the proposed waste repository, to base the level of protection for the facility on the "Probable Maximum Precipitation" (PMP) concept that is widely used in hydrologic design, specifically when considering dam safety. It would appear that this potential site is at least as important as the numerous small dams throughout the country that are required to meet the "PMP" safety standard. At a minimum, DOE should redesign the runoff diversions in Coyote Wash.

3. We have great concern with the design of the proposed surface-facility sewage lagoon and rock-storage pile. Seepage of effluents into the subsurface is totally unacceptable to the State (see comments of the Nevada Department of Conservation and Natural Resources, Division of Environmental Protection). Seepage is unacceptable for two reasons: (1) contamination of the subsurface is against current State environmental-protection laws and (2) introduction of additional moisture into the subsurface may affect underground tests of natural moisture conditions. Introduction of additional water in an attempt to hasten evapotranspiration only compounds the infiltration problem. Also, a review of surface-facility layouts presented in the draft EA suggests that flood diversion channels will exit into the sewage

lagoon and the rock-storage pile. There appear to be no provisions in the design of these containment structures to accommodate a "probable maximum precipitation" event, or even a 100-year-flood event.

We request two changes be made in the design of the surface facilities:

1. All waste-containment structures be lined and monitored, or the waste fluids be trucked to an appropriate disposal site.

2. All flood-diversion channels be designed for a 500-year-storm event or a probable maximum precipitation event, and the diversions extend down Coyote Wash and away from all surface facilities.

(12) Repository Design

DOE proposes to site the repository surface facilities approximately 1 mile east of the proposed repository block. DOE concludes that this area will be subject to only minor and infrequent flooding and that this flooding can be mitigated during repository construction and operation. Based on this conclusion, the draft EA finds that (1) surface characteristics that could lead to the flooding of surface facilities are not present at the site and (2) there is the absence of surface-water systems that could potentially cause flooding of the repository.

Review of the draft EA and supporting flood analyses presented in the draft EA indicates that the information presented is not adequate to support the conclusions; the DOE acknowledges that a potential for site flooding exists and that engineering measures will be required for flood protection. The DOE bases its findings with respect to the guidelines on the ability to implement flood protection measures that mitigate flood effects. The guidelines, however, address the question of site flooding rather than the feasibility of engineering measures to control flooding. Hence, it appears that consideration of potential flooding of surface facilities at this site may alter the conclusion that the favorable condition is present and that the unfavorable condition is not present. The DOE should reconsider the findings associated with surface flooding.

In describing the potential host rock for the repository, the draft EA concludes that there is sufficient lateral and vertical flexibility in the placement of the repository. We find the information in the draft EA is not adequate to make such conclusions. The draft EA indicates that the repository block contains approximately 2,200 acres but that 15 percent of this area may not be suitable for the repository because of faults and breccia. However, these faults and breccia in all probability will not be concentrated in one area but will be randomly distributed over the repository block. Couple the random distribution with the distinct possibility that more faults and breccia are present than expected, then it is highly possible that the lateral extent of the host rock is insufficient. The draft EA should analyze the effects of this possibility.

The draft EA also indicates that emplacement is proposed for the "relatively lithophysae-free" zones (containing less than 15 to 20 percent lithophysae). The draft EA indicates that at higher lithophysae concentrations (greater than 30 percent) mineability and ground stability of the host rock may be questionable. There is no documentation to support these conclusions. In addition, there are no data presented on the relative distribution of "lithophysae-free" zones and their extent. The extent of these zones raises questions about the adequacy of the Topopah Spring for emplacement of the proposed volume of waste. The presence of high lithophysae zones also calls into question the vertical flexibility of the host rock. The draft EA should describe the vertical distribution of lithophysae-free zones and whether this distribution is sufficient for emplacement of the waste volume.

In the draft EA DOE presents a two-stage repository-design alternative to the primary single-stage design. If DOE intends to further pursue the two-stage concept, then the impacts of such a concept must be fully considered in the EA. We see many health and safety impacts of a two-stage repository that are not present in a single-stage concept.

(13) Postclosure Performance Analysis

A review of the preliminary postclosure performance analysis presented in the draft EA suggests that many of the analyses used to support findings may be nonconservative in spite of repeated assertions in the draft EA that conservative performance analyses have been performed. Conservatism in the analyses is required in order to mitigate the effects of large uncertainties arising from recognized inadequacies in data and analytical models. The siting guidelines also require that a "realistic, but conservative" approach be taken.

Nonconservatism has been noted in many areas such as geohydrology, geochemistry, and waste-package performance analyses. These examples exhibit varying types of nonconservatism in the analyses, in assumptions, in use of data, and in selection of expected postclosure conditions. Findings on technical guidelines that support the postclosure system guideline depend on analyses that allow for uncertainties by using conservative approaches and assumptions. Nonconservatism in the analyses supporting the postclosure technical guidelines lessens the assurance in the findings on these guidelines, and hence the postclosure performance analysis. The draft EA should be revised to consider a realistic but conservative preliminary postclosure performance analysis.

(14) Disqualifying Conditions

Chapter 2 of the draft EA summarizes the findings for each of the 17 disqualifying conditions contained in the siting guidelines. Details of the evaluation of Yucca Mountain against the disqualifying conditions are presented in Chapter 6. The siting guidelines note that each disqualifying condition describes a condition that is considered so adverse as to constitute sufficient evidence, without further consideration, that a site is disqualified. Thus, the presence of a single disqualifying condition is enough to eliminate a site from further consideration. The siting guidelines further indicate that most of the 17 disqualifying conditions pertain to conditions whose presence or absence may be estimated without extensive data gathering or complex analysis. DOE has found that no disqualifying conditions exist at Yucca Mountain. While we have found no hard evidence to demonstrate the presence of "fatal flaws" (disqualifying conditions) at Yucca Mountain, there is evidence that suggests that some disqualifiers may be present at the site. The disqualifying conditions in question are tectonics, geohydrology, offsite installations and operations, and socioeconomic impacts.

Postclosure Tectonics (10 CFR 960.4-2-7(d))

The disqualifying condition states:

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.

DOE finds the site is not disqualified because the nature and rates of fault movement or other ground motion are not likely to cause loss of waste isolation. Low water flux and long ground-water travel-times are cited as providing additional assurance of isolation. The available evidence suggests, to the contrary, that the data base is incomplete and often conflicting, and that a reasonable interpretation of the available information is that a large earthquake accompanied by surface faulting could occur near or within the repository during the lifetime of the facility.

The evidence supporting this interpretation is as follows:

1. Regional studies (Algermissen et al., 1983; Carr, 1984; Rogers et al., 1983) show that Yucca Mountain lies within an area of relatively high seismic activity and, therefore, should be considered as seismically active (U.S. Geological Survey, 1984, p. 78).

2. Seismic data suggest that north-northeast-trending faults are susceptible to slip in the current stress field (Rogers et al., 1983). Stress measurements taken at the repository site suggest that the stress field is close to that at which fault failure might be expected (Healy et al., 1984). Explosion-induced tectonic strain release on north-northeast-trending faults suggests that the Yucca Mountain faults may also be tectonically stressed to near the rupture point (Rogers et al., 1983). Taken together, these data suggest that the potential for significant seismicity and renewed movement on faults exists and should be considered (Rogers et al., 1983, p. 27; U.S. Geological Survey, 1984, p. 72).

3. Lack of surface (fault) rupture is not sufficient evidence to discount active faulting at Yucca Mountain (U.S. Geological Survey, 1984, p. 78). The evidence of Swadley et al. (1984) does not completely preclude the presence of capable faults. Although no demonstrable movement less than 40,000 years old is documented on Yucca Mountain faults, stratigraphic controls on Holocene deposits were absent at many locations (U.S. Geological Survey, 1984, p. 41) indicating that the evidence is at best equivocal.

4. The estimated peak ground acceleration (0.4 g) at Yucca Mountain is too low based on a reasonable interpretation of future tectonic events. Based on the conclusions of Rogers et al. (1983) and the U.S. Geological Survey (1984) that Yucca Mountain faults should be considered active, the draft EA statement (p. 6-231) that "Under the assumption that Yucca Mountain faults are not active, the most likely peak deterministic ground acceleration at Yucca Mountain is estimated to be 0.4 g . . ." is untenable. If a large (M = 6-7) earthquake were to occur on a Yucca Mountain fault, peak ground accelerations approaching or exceeding 1.0 g could be possible.

5. The estimated recurrence rate of 2.5 earthquakes in 100,000 years per 1,000 km^2 (draft EA, p. 6-232) yields a rerupture time of 40,000 years per 1,000 km^2. This is an estimate of the activity occurring randomly within a 17-km radius (1,000 km^2) of the site. Since previous work has established that Yucca Mountain faults may be preferred sites of tectonic activity, rerupture times at Yucca Mountain could be significantly shorter than 40,000 years. The recurrence rate (2.5×10^{-5} events/year/1,000 km^2) is also comparable to rates measured in areas of Holocene (and historic) faulting in western, central, and north-central Nevada (Bell, 1984a, b; Wallace, 1978).

   Using an average displacement rate of 0.11 m/1,000 years on the Windy Wash fault (Carr, 1984), 1.1 m of slip would be anticipated in the next 10,000 years. This is equivalent to at least a single earthquake of M = 6.5-7 (Bonilla et al., 1984).

6. Low ground-water flux rates and travel-times (>20,000 years) are not tenable arguments against radionuclide release in the event of fault-induced disruption. These parameters have been calculated on the basis of present geohydrologic conditions and do not consider the probability of increased precipitation, elevated water table, or the effects of tectonic activity such as fracturing or regional deformation. They are also based on incomplete and unsubstantiated hydrologic evidence as described in comments by Desert Research Institute.

In summary, the evidence relative to the disqualifying condition is incomplete and equivocal. Previous work, in fact, suggests that there is a significant potential for tectonic movement; this may result in loss of waste isolation. It is clear that there is a substantial body of evidence that suggests that Yucca Mountain does <u>not</u> meet the postclosure tectonics disqualifying condition and, therefore, should be disqualified from further consideration.

Preclosure Tectonics (10 CFR 960.5-2-11(d))

The disqualifying condition states:

> **A site shall be disqualified if, based on the expected nature and rates of fault movement or 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.**

DOE finds that the site is not disqualified because reasonably available technology is expected to be sufficient to construct an exploratory shaft, and to safely construct, operate, and close a repository; the expected nature and rates of fault movement or other ground motion are not expected to adversely affect the construction of the exploratory shaft or repository construction, operation, and closure. The available evidence does not support the finding made in the draft EA. The evidence is, at best, incomplete and equivocal.

Existing evidence fails to demonstrate that the faults at and near Yucca Mountain should not be considered capable by Nuclear Regulatory Commission criteria. The evidence for lack of faulting in the last 40,000 years is incomplete; the evidence for lack of recurrent faulting in the last 500,000 years has not been addressed.

It is not reasonable to assume that all important fault scarps have been detected (draft EA, p. 6-290). Fault studies to date have not utilized several commonly accepted state-of-the-art investigative techniques in tectonic analyses for nuclear facilities. Substantial geologic evidence (Carr, 1974, 1984; Rogers et al., 1983; Scott and Bonk, 1984; Scott et al., 1984; U.S. Geological Survey, 1984) suggests that many of the faults at and near Yucca Mountain are predominantly strike-slip, rather than dip-slip in nature. The character of strike-slip faulting is such that surficial evidence may be difficult to recognize. In addition, large predominant scarps may not be present if faulting, even if dominantly dip-slip, is distributive in nature. Scott and Bonk (1984) show that Yucca Mountain is highly faulted and fractured; if a large Holocene faulting event had occurred, it may have resulted in numerous small scarps being distributed across a broad zone.

Based on existing literature, it is unreasonable to attribute the greatest potential seismic hazard to an earthquake of magnitude 6.8 on the Bare Mountain fault. The U.S. Geological Survey (1984, p. 75) stipulates that this interpretation is based on the assumption that Yucca Mountain faults are inactive and that should active faults be discovered at or near the site, the potential for damaging earthquakes and considerably larger accelerations is possible. In addition, other published studies suggest that the calculated magnitudes are too low. New statistical relationships (Bonilla et al., 1984) suggest that the Bare Mountain fault could generate at least a magnitude 6.9 earthquake. Algermissen et al. (1983) include the Yucca Mountain geologic setting in an area that could experience a magnitude 7.3 earthquake.

The seismic record is too short and the geologic evidence is too incomplete to allow a determination of fault capability at Yucca Mountain according to accepted criteria. Based on existing literature, it is unreasonable to assume that Yucca Mountain faults are inactive. Design parameters, such as maximum credible earthquake and maximum anticipated vibratory ground motion, are underestimated since they assume Yucca Mountain faults to be inactive. The evidence for lack of surface displacements at or near Yucca Mountain in the last 40,000 years is equivocal and incomplete, and is not substantial enough to allow the conclusion to be drawn that faulting at Yucca Mountain is unlikely during the 90-year preclosure period. The evidence suggests that fault movement and ground motion could adversely affect repository construction and operation, and the site should be disqualified.

Geohydrology (10 CFR 960.4-2-1(d))

The disqualifying condition states:

> **A 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.**

DOE finds the site is not disqualified on the basis of present understanding that the most likely flow time to the accessible environment is more than 20,000 years. The Desert Research Institute finds that by utilizing the data presented in the EA and a conservative approach to the variability of key model parameters, the ground-water travel-time can vary from less than 1,000 years to greater than 34,000 years. The minimum travel-time based upon the DRI calculations does not meet the disqualifying condition.

The conceptual model used in the draft EA to calculate ground-water travel-times appears adequate to describe some of the available data gathered to date. We are concerned, however, that other, more-or-less favorable models could have been chosen to fit all the available data. In general, it does not appear that enough data have been presented (or are available) both in the draft EA or in the cited references to judge the validity of the adopted conceptual model. The draft EA has not presented any other conceptual models that might fit the existing data base. Unfortunately, the available data make any conceptual model difficult to prove or disprove. The limited number of deep, vadose-zone drill holes (2) where fracture water would be easily detected is not sufficient to statistically sample the vadose zone. Since available data are insufficient to overcome the low probability of encountering fracture water, it is surprising that only limited attention is paid to it. Since several conceptual models potentially fit the present sparse data base, the draft EA should report the wide range of conceptual models and their associated likelihoods.

The use of parametric values derived from core data in calculating travel-times is misleading due to spatial variability of the data; the draft EA typically reports a single value for each hydrologic parameter. For example, the draft EA does not make use of the variance of hydraulic conductivity in deriving travel-time calculations with representative uncertainty. This problem is not unique to the draft EA; it is also common to much of the Yucca Mountain support documents (Montazer and Wilson, 1984; Weeks and Wilson, 1984; Sinnock et al., 1984). The range of measured conductivities presented in the draft EA references spans four orders of magnitude. If travel-times are calculated using the range of measured conductivities, the travel-times also range over four orders of magnitude.

In order to further demonstrate the effect of data variability on calculations of ground-water travel-times, data presented in the draft EA for matrix flow (Table 6-17, p. 6-139) were subjected to a simple statistical analysis to develop a range of values (see DRI comments for the details of the calculations). For simplicity, only hydraulic conductivity was varied in the calculations; other parameters may not be as significant as hydraulic conductivity. Results are the following:

	Travel-Time (Years Min.)	Travel-Time (Years Max.)
Topopah Spring	978	23,218
Calico Hills (zeolitic)	1,404	34,247
Calico Hills (vitric)	7.2	169

Therefore, the range of unsaturated-zone travel-times, considering only matrix flow, may or may not meet the disqualifying conditions established in the siting guidelines. However, if a component of fracture flow is also considered (we believe fracture flow is present at Yucca Mountain), ground-water travel will be faster, possibly by orders of magnitude, and resulting minimum ground-water travel-times will be lower.

It is acknowledged that little unsaturated-zone data are available to base a finding that the ground-water travel-time along any likely pathway exceeds 1,000 years. The great variability of the limited data indicates that travel-times could also be less than 1,000 years. The EA, at a minimum, should recognize and acknowledge that there is insufficient information to make a finding on this disqualifying condition. In the absence of no finding, the EA must recognize the large variability of travel-times and state that the site may or may not meet the disqualifying condition. Alternately, the Secretary of Energy may indicate that more data are necessary to make a reasonable determination and request more data be gathered. Presently, no reasonable finding can be made.

Offsite Installations and Operations (10 CFR 960.5-2-4(d))

The disqualifying condition states:

> **A site shall be disqualified if atomic energy defense activities in proximity to the site are expected to conflict irreconcilably with repository siting, construction, operation, closure, or decommissioning.**

DOE finds the site is not disqualified because engineering design and coordination of repository schedules with NTS schedules would prevent irreconcilable conflicts caused by atomic energy defense activities in proximity to the site. The State finds no support in the draft EA for this conclusion.

To support the finding, the draft EA indicates that (1) DOE will coordinate activity schedules so no underground activities will occur during nuclear-weapons tests and (2) future weapons-testing activities will be located no closer than 14 miles from Yucca Mountain. Section 6.2.1.5 (p. 6-31) implies that DOE will set the atomic-testing schedule so as to minimize impacts on repository construction and operation; the State believes the opposite. The weapons-testing program will set the schedule, and DOE will be required to abide, as the local miners do.

There is no documentation to support the conclusion that future weapons testing will come no closer than 14 miles to the site. Historically, nuclear-weapons testing has taken place in the eastern portion of the Nevada Test Site, some 40+ miles from Yucca Mountain. In recent years the weapons-testing program has moved large-yield testing activities to the western portion of the Test Site because of a diminishing amount of undisturbed land in the eastern part (Yucca Flat). The area now dedicated to large-weapons testing is Pahute Mesa, approximately 25 miles north of Yucca Mountain. A general trend emerging from the thirty years of weapons testing on NTS is that testing requires undisturbed land. Most of the still-undisturbed land is now located in the western portion of the Test Site, some of it very near Yucca Mountain. There needs to be some assurance that future weapons testing will not intrude on a repository at Yucca Mountain. There are many other locations in the United States to place a nuclear-waste repository, but few (if any) other locations acceptable for nuclear-weapons testing. Atomic-energy defense activities beyond the near term are unknown; and, therefore, no conclusion relative to a possible future conflict with a Yucca Mountain repository can be made. Since there is some uncertainty about the level and location of future testing, the draft EA should evaluate the minimum stand-off distance necessary to maintain repository integrity during all phases of repository activity.

A conclusion that atomic-energy defense activities will not conflict with repository activities is tentative at best. We believe that unless the DOE has written documentation from the defense-weapons testing program that nuclear testing will <u>not</u> conflict irreconcilably with repository activities, a finding that the site is not disqualified cannot be made.

<u>Socioeconomic Impacts (10 CFR 960.5-2-6(d))</u>

The disqualifying condition states that:

> **A site shall be disqualified if construction, operation, or closure would significantly degrade the quality, or significantly reduce the quantity of water available for human consumption or crop irrigation.**

DOE finds the site is not disqualified because repository water use is not expected to lower the regional ground-water table or reduce water quality.

A major issue in this regard is <u>not</u> only whether repository water <u>use</u> will have a deleterious effect on area water supplies but also whether it can be demonstrated that long-term (10,000 years) storage of highly radioactive materials only slightly above the water table will not eventually cause contamination of (and thereby degrade) water quality. The draft EA does not demonstrate that the repository will be benign with regard to future water use. Until such a conclusion can be made with scientific certainty, the finding that the site is "not disqualified" is unsubstantiated.

NNWSI AREA-TO-LOCATION SCREENING

Acceptability of the NNWSI area-to-location screening activity and the choice of the Topopah Springs tuff at Yucca Mountain depends heavily upon the validity of the data used in the siting study (Sinnock and Fernandez, 1982) and the credibility of those applying the screening technique. These studies are outlined in Section 2.2.4, "Confirmation of Site Selection by a Formal System Study" (p. 2-15). Although not contemporaneous, the general idea and the basic structure of the approach used appears to be better than most studies up to the point of development of the 31 attribute maps and the 9 host-rock maps. If the study had been structured and done after the Nuclear Waste Policy Act was signed in early 1983 (as should be required), there would possibly have been a few different attributes (e.g., depth to ground water) or other categories developed that would focus more directly on the DOE guidelines versus those used in 1981-1982. However, all of the most important attributes appear to have been considered in the 1981-1982 study.

Although the NNWSI area-to-location screening study may give the DOE confidence that the serendipitous identification in 1979 of the Topopah Springs tuff at Yucca Mountain was a good choice, the study does not demonstrate that the Topopah Springs tuff at Yucca Mountain was the best choice. In fact, the Yucca Mountain site would probably not have been considered if DOE had restricted its search to the area within the existing physical boundaries of the NTS or to those media that in 1981-1982 were shown to have the highest potential for isolation and containment. It can be demonstrated from the data and analysis presented in Chapter 2 that from a purely geological standpoint, there are several sites potentially equal to or possibly better than the Yucca Mountain site within the boundaries of the NTS (e.g., northeast Jackass Flats). If all significant potential environmental, socioeconomic, and institutional impacts are given due consideration, the potential for finding superior candidate sites within the existing NTS boundaries is great (e.g., Calico Hills-Upper Topopah Wash).

The Sinnock and Fernandez (1982) study stresses that isolation and containment of the waste are the most important upper-level objectives; that radionuclide migration potential and containment processes are the most important mid-level objectives; and chemical processes, ground-water flow, mechanical processes, and geochemical retardation are the most important of the lower-level objectives. Using contrived weighting factors that are of questionable merit, the authors ignore their own data by selecting a media (Topopah Springs densely welded tuff) that ranks at the bottom of these categories at a site (Yucca Mountain) with one of the higher potentially overall environmental impacts. With respect to radionuclide migration and chemical retardation, the Topopah Springs tuff is shown to have an overall sorption rating that ranks eighth out of the 15 potential host-rock media considered. The data are not linear, however, and of the seven host-rock media that are better, granite, nonwelded Calico Hills tuff and argillite (found over the entire area) are considerably better. Of even greater importance may be the sorption capacity for plutonium and other transuranic elements. These elements, because of their long half-lives and high toxicity, are the principal reasons that consideration of a time-frame of 10,000+ years for isolation from the accessible environment is required by NRC regulations. For densely welded Topopah Springs tuff, the measured sorption capacity ranks it third lowest out of the 15 potential host-rock media considered (granite and argillite measured highest). When the sorption ratios are normalized, the Topopah Springs tuff drops to second lowest out of 15. In terms of another important attribute, hydraulic transmissivity, the Topopah Springs tuff is one of the least favorable while nonwelded zeolitic tuff, argillite, and granite are the most favorable host rocks. In terms of hydraulic retardation, another important parameter, the Topopah Springs tuff is arbitrarily ranked as being of average favorability (5 on a scale of 1 to 10) by using a curve to fit highly subjective step-function data. If a more appropriate linear fit were used, the Topopah Springs tuff would be below average (3 on a scale of 1 to 10). There are numerous additional examples of how the impact of serious negative factors was overwhelmed in the study by the weighting process.

As to the credibility of the study, it is questionable whether the appropriate "experts" were involved and, therefore, whether the subsequent weighting scheme developed is valid. In this regard, it is also questionable whether any numerical weighting scheme is valid if the weighting does not consider the tradeoffs between conflicting attributes (e.g., number of pupfish lost versus the hydraulic conductivity, etc.) and if the results cannot be replicated independently by the appropriate decision-makers. The formal site-selection process used by DOE will not fit either of these two criteria.

One major problem with the formal site-selection process described in Sinnock and Fernandez (1982) is the makeup of the so-called "experts" in the site-evaluation working groups and those making up the poll participants. Of those participants in the actual decision process (i.e., preparation of favorability graphs and weighting assignments), there is an obvious lack of expertise in the environmental, social, and political sciences. The National Environmental Policy Act (NEPA), which forms the basis for reviewing the decision-making process, requires that agencies of the federal government "utilize a systematic, interdisciplinary approach that will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making, which may have an impact on man's environment." Whether NEPA will be subsequently shown to be a legal requirement or not in the site-selection process is a separate issue. At this point, the technical background and experience of the participants is most definitely not representative of the disciplines necessary for the site-selection process described in Sinnock and Fernandez (1982) to meet even the fundamental intent of NEPA, let alone pass the more rigorous judicial review that will ultimately occur.

A second major problem with the formal site-selection process of Sinnock and Fernandez (1982) is the weighting scheme that was utilized. The approach utilized is essentially a modified Delphi procedure (N. C. Dalkey, 1969, "The Delphi Method: An Experimental Study of Group Opinion," RN-5888-PR, The Rand Corporation, Santa Monica, CA), which was developed solely for the purpose of combining judgments of experts in the same field. While useful as a guide in the preliminary stages of a study, the Delphi method breaks down rapidly when used to combine the opinions of experts from diverse and/or non-related fields or when dealing with conflicting objectives and value trade-offs (R. L. Keeney and H. Raiffa, 1976, "Decisions with Multiple Objectives: Preferences and Value Trade-Offs," John Wiley & Sons). It is our opinion that both of these conditions are such an integral part of the site-selection process that failure to address them within the Sinnock and Fernandez (1982) framework essentially negates the approach.

Intuitively, the choice of Topopah Springs tuff beneath Yucca Mountain as a candidate site appears to be technically sound; however, the studies done by DOE (as referenced in Section 2.2.4, p. 2-15) after that intuitive choice was made (1979) do not support the decision that Yucca Mountain is the best site available within the NTS or in the immediate adjacent areas. The fact that the reference studies in Section 2.2.4 confirm the 1979 DOE decision is not surprising. Given that many of those involved in the 1979 choice of Yucca Mountain also participated in the 1981-1982 studies, we would be more surprised if the results had not agreed. The DOE must develop a rationale under its own guidelines (10 CFR 960) and appropriate supporting data to reasonably demonstrate that Yucca Mountain is better than any other site actually on the Nevada Test Site from all standpoints.

CONTENT, FORMAT, AND PROCESS OF THE DRAFT EA

(1) Lack of Adequate Consultation

The draft Environmental Assessment for Yucca Mountain is the product of a process that involved almost no consultation between the Department of Energy and affected states and tribes despite repeated requests by states and tribes for ongoing, meaningful participation.

It is our contention that the draft EA could have been improved significantly had states been involved from the beginning in defining the parameters of the report; in identifying major issues; in determining data needs, and research and analysis tools and strategies; in developing the methodology for ranking sites; and in numerous other areas.

Unfortunately, the document, as it currently exists, is a reflection of the one-sided (some might say biased) process that created it. It consistently paints an overly optimistic picture of the Nevada site while minimizing or dismissing negative implications and data that do not readily support a positive assessment of the site and its potential impacts on the State, local communities, and the environment.

One State reviewer pointed out that the draft EA contains numerous structural and conceptual flaws that severely limit its utility and cast considerable doubt on the validity of the conclusions it contains.

This reviewer cited the noticeable dearth of hard data to support many of the document's more vital conclusions. The draft EA contains unsubstantiated assumptions with regard to almost every aspect of the site. In many cases, evidence presented in one section of the document can be seen to contradict assumptions and conclusions made in other sections. There is a noticeable lack of continuity from section to section and chapter to chapter. It is almost as if data used and assumptions/conclusions made in one area are simply disregarded if they conflict with conclusions to be drawn elsewhere. Numerous examples of this disparity between data and conclusions are contained in the State's specific comments included in Chapter 2 of this compilation.

(2) Unsubstantiated Conclusions and Assumptions; Unavailable Reference Materials

As a scholarly research document of analytic intent, the draft EA falls far short of even modest expectations. Apart from the inconsistencies of data collection and evaluation noted above, the text contains numerous instances of statements of fact, assumptions, and conclusions that are wholly unsupported by evidence presented in the text or in cited reference materials. In addition, a large number of purportedly factual statements are shown to be supported by personal or written communications that are not contained in the document's reference sections nor are they available for review. There are accepted formats and rules governing the citing of personal and written communications as well as unpublished materials that should be followed in any scholarly writing effort. When an important conclusion or fact is referenced, in parentheses only, as being a "personal communication," one has no way of knowing if that communication involved a telephone conversation, a letter transmitting hard scientific data, or a conversation in a supermarket checkout line.

References used in support of draft EA data or conclusions should consist solely of written materials that can be reproduced and scrutinized by document reviewers. Each such piece of material should be cited in appropriate reference and bibliographic sections of the document. If the material is such that it has not been written down or is unavailable for review, that reference should not be included in the text; and the conclusion, assumptions, or facts it supports should be deleted.

(3) Poor Document Format

Many reviewers criticized the format of the draft EA, noting the difficulties encountered in dealing with the extremely small type; juxtaposed pages, tables, and maps; and the scattering of information about various subject areas throughout numerous sections of the document. Many maps were seen to be incomplete and, in many cases, inconsistent with information contained in the text. (The City of North Las Vegas, for example, does not appear on any map contained in the draft EA even though it is referred to throughout the socioeconomic portions of the report.) A more utilitarian format, one that promotes rather than discourages internal document consistency and readability, might improve the overall quality of the final EA and assist its authors in identifying more readily the major and debilitating flaws that pervade the draft document. This assumes, of course, that the intent of the document is to clarify, examine, and otherwise resolve major issues in a truly objective manner. If the intent is, in reality, to discourage widespread readership and to cloud matters sufficiently to provide cover for a lack of adequate information, then the current draft EA format serves its purpose well.

(4) Potential Subcontractor Conflicts

The subcontracting process used by DOE to prepare the draft EA may, of itself, have contributed--at least partially--to the problems reflected in the document. Contractors employed to work on--and even draft--the EA are the same ones who will be engaged by DOE to carry out characterization activities should the site be selected. As such, these contractors would seem to have vested interests in presenting as optimistic a picture as possible of the site and of its impacts on the State and local communities.

(5) Interrelationship of the EA and Other Key Documents

As envisioned by the Nuclear Waste Policy Act, the Environmental Assessment was to have been one of a series of interrelated documents or milestones designed to organize and focus the repository site-selection process. Other key documents include the Siting Guidelines, the Mission Plan, the report to Congress concerning comingling of defense wastes, the decision document relative to a Monitored Retrievable Storage facility, and the Site Characterization Plan. While the EA is intimately and inextricably related to other milestones in the repository decision-making process, it has an especially significant relationship with the Mission Plan. The Mission Plan was designed (under the NWPA) to precede the Environmental Assessment and to establish time frames, set parameters, and lay out technical and conceptual designs for the program. As such, it should provide the foundation for the Environmental Assessments.

Instead of following the logical sequence of document development set forth in the NWPA, DOE has chosen to deal with each one in relative isolation. The Siting Guidelines, which were to have been the basis for the EAs, were not finalized until December 1984. The EAs, which were released on December 20, 1984, were actually written <u>before</u> the Guidelines were completed and issued.

Section 121 of the Nuclear Waste Policy Act requires the Administrator of the Environmental Protection Agency (EPA) to promulgate generally applicable standards for the protection of the environment from offsite releases of radioactive materials disposed of in a geologic repository. A requirement for compliance with these standards is contained in DOE's Siting Guidelines.

To date, EPA has failed to promulgate such standards. Consequently, the Guidelines cannot be fully applied in the nomination of candidate sites as required by the Act. Nevertheless, DOE chose to prepare and issue draft EAs without the final EPA standards.

Likewise, the final Mission Plan is not scheduled to be completed until late May (1985). Yet, DOE proceeded to develop and issue the draft EAs without the benefit of a final Mission Plan.

Such obvious juxtaposition of milestones established by the Act can be seen to have adversely affected the quality of the work done by DOE to date--especially the quality of the information contained in the draft EAs.

PRELIMINARY DETERMINATION THAT SITES ARE SUITABLE FOR DEVELOPMENT AS REPOSITORIES

Chapter 6 of the draft EA is entitled "Suitability of the Yucca Mountain Site for Site Characterization and for Development as a Repository." Section 6.1.2 of the draft EA describes the evaluation of site suitability to include "(1) site identification as potentially acceptable, (2) nomination as suitable for characterization or recommendation for characterization, and (3) recommendation for development as a repository." Section 6.2, "Suitability of the Yucca Mountain Site for Development as a Repository: Evaluation Against the Guidelines That Do Not Require Site Characterization," states: "This section presents preliminary evaluations of the Yucca Mountain site against the eight technical guidelines and the two system guidelines that do not require data from site characterization as a prerequisite to their application" (emphasis supplied).

Section 6.3 of the draft EA, "Suitability of the Yucca Mountain Site for Site Characterization: Evaluation Against the Guidelines That Do Require Site Characterization," states: "This section presents preliminary evaluations of the Yucca Mountain Site against the twelve technical and the two system guidelines that require data from site characterization for a determination of compliance" (emphasis supplied). The title to Chapter 6 and the title to Sections 6.2 and 6.3 belie the Department's interpretation that it is possible to make a preliminary determination that a site is suitable for development under those guidelines that do not require site characterization prior to site characterization. However, §114(f) provides that "a preliminary determination that such sites are suitable for development as repositories consistent with the guidelines promulgated under §112(a)" cannot be made until "site characterization has been completed under §113." A preliminary determination that sites are suitable for development as repositories should occur only in connection with the publication of a final environmental impact statement under §114(f), not an environmental assessment under §112(b)(1)(E). Certainly the Department should not be allowed, at a later date, to rely on its findings in the draft Environmental Assessment as satisfactory compliance with §114(f), in the likely event that characterization will show one or more sites unsuitable.

CONCLUSIONS REGARDING LICENSABILITY OF THE YUCCA MOUNTAIN SITE

The overriding objective of the Nuclear Waste Policy Act of 1982 is to isolate the nation's high-level radioactive waste from the accessible environment for thousands of years. The Act directs the Department of Energy to accomplish this objective by siting and constructing two deep geologic repositories in locations that will assure long-term isolation. The actual test that will ultimately determine if DOE has accomplished its mission will be reflected in the thousands of years of postclosure experience with the decommissioned repository.

Because it is impossible to judge actual performance over such a lengthy span of time from a vantage point in the present, DOE must rely on institutional analyses, before the fact, to guide it in choosing sites and otherwise making plans that will afford the highest probabilities for successful containment of these materials.

The institutional analyses that the Nuclear Waste Policy Act requires involve: (1) pre-established radioactivity-release limits around which any site-selection methodology must be designed; (2) objective guidelines for determining overall site suitability; (3) conservative and objective application of those guidelines against objectively gathered data of sufficient volume and reliability to guarantee credibility of conclusions; (4) comparative analyses of all available siting options, notwithstanding institutional inertia; and (5) proof that sites ultimately selected will be safe from a public health and environmental standpoint and will meet the standards of licensing imposed by the Nuclear Regulatory Commission.

We believe that the Department of Energy's nuclear waste program to date does not assure that the best sites, in terms of the ability to isolate nuclear waste, will finally be selected. Pre-established radioactivity-release limits are not yet established and have, therefore, not been used in developing siting criteria; the siting guidelines themselves are not objective; and data of insufficient reliability and volume have been relied upon in the draft Environmental Assessments to draw conclusions as to the adequacy of sites. In addition, many important issues relative to the Yucca Mountain site have not been analyzed at all (certain local and Indian government concerns, monitored retrievable storage) while others have been inadequately addressed (volcanic activity, tectonics, fault activity, geohydrology, climate change, geochemistry, radionuclide retardation, mineral stability, host-rock stability, natural resources, transportation, defense waste, the two-phased repository approach, socioeconomic issues, land and water issues). Certain sites initially under consideration have been arbitrarily excluded from the required comparative evaluation while crucial siting decisions have been colored by earlier site choices that were based on non-geologic considerations.

Such defects in institutional analyses suggest that it may be difficult for DOE to demonstrate that the Yucca Mountain site can meet requisite health, safety, and environmental criteria. In fact, DOE's site-selection process may ultimately produce a site that is not licensable under NRC standards. Comments of NRC staff relative to the draft EA for Yucca Mountain suggest that this may very well be the case in terms of the Nevada site. Generally, these comments indicate that (1) the full range of uncertainty that exists about factors affecting site suitability is not recognized in DOE's discussion supporting the draft EA's findings, and (2) the draft EA makes conclusions and findings that are not supported by existing data or that existing data indicate are not conservative.

NRC's comments regarding fault activity at Yucca Mountain, volcanism and hydrothermal activity, ground-water travel-time calculations, free drainage of host rock, ground-water chemistry of the unsaturated zone, and other geochemical and hydrologic issues suggest that there may be significant problems in licensing because all of the issues raised relate directly to the isolation capacity of the site.

State comments on the draft EA identified many of the same problems and issues the NRC staff has focused attention on. In reviewing the draft document for Yucca Mountain, it is readily apparent that the entire approach to institutional analysis DOE has employed to date must be corrected if the technical analysis is ever to lead to the selection of a licensable site--one that can be shown to be capable of isolating high-level radioactive waste for thousands of years while adequately protecting the environment and guaranteeing the health and safety of the public.

PART II

SPECIFIC COMMENTS

SPECIFIC COMMENTS ON THE EXECUTIVE SUMMARY

1. Introduction

P. 1: The description of a geologic repository should include a discussion of the retrievability requirement in terms of: (1) the length of time the retrievability option must be kept open; (2) the purpose of retrievability; and (3) how retrievability could affect repository design, construction, operation, and closure.

2.1 Decision Process

P. 4: This section, in the final environmental assessment, should describe the public-comment period including the date of the release of the draft EA and the length of that comment period. The fact that DOE received numerous requests for extensions of the public-comment deadline and the rationale for DOE's refusal to extend the period should also be included. Many interested reviewers did not receive the draft EA for review until the middle or end of January. Consequently, the time for actual review was reduced to approximately 60 days. The State of Nevada did not receive all of the references requested until two days <u>after</u> the close of the public-comment period, making it impossible to complete the review within the DOE-established time period.

2.2.2 Grouping of Sites by Geohydrologic Setting

P. 5: Last paragraph states "The proposed repository horizon at the site is hydrologically distinct because it is in the dry unsaturated zone above the water table." This statement is inconsistent with data presented in Section 6.3.1.1.3(5), pp. 6-125 to 6-126. The term "dry unsaturated zone" is inappropriate; "vadose zone" is the correct term.

This section should discuss the unique problems inherent in comparing a tuff site in the unsaturated zone to sites in other geologic media (especially those in a saturated environment).

2.2.3 Selection of the Preferred Site in the Great Basin

P. 6: The implications of Yucca Mountain as the <u>only</u> site identified in the Great Basin should be discussed. The discussion should include a description of other potentially acceptable sites in the Great Basin and how Yucca Mountain compared to those other sites.

2.2.4 Suitability of the Yucca Mountain Site for Development as a Repository

P. 6: In the Table of Contents for this section the major heading "2.2 Preliminary Finding and Determination" could suggest that DOE has made the "preliminary determination of suitable" of Yucca Mountain as a repository site. This language is very similar to that which is contained in Section 114(f) and requires that the Secretary of Energy, after site characterization, make a preliminary determination that such sites characterized are suitable for development as repositories.

DOE has committed publicly to the NRC that the Secretary of Energy will not make this preliminary determination of suitable until after site characterization is completed. Therefore, the title of this section should be revised to make clear that DOE is not, at the time of the publication of the final EA, making this determination of suitability.

2.2.6 Preliminary Decision on Nomination

P. 7: The evidence contained within the draft EA and related references does not support DOE's findings that Yucca Mountain should be nominated as suitable for characterization. Our comments support this assertion.

2.2.7 Comparative Evaluation of Sites Proposed for Nomination and Order of Preference

P. 7: DOE, in violation of the Nuclear Waste Policy Act, has not complied with Section 112(b)(1)(E)(iv), which requires "a reasonable comparative evaluation by the Secretary of such site with other sites and locations that have been considered." This requirement mandates that DOE compare all sites considered, not just those nominated. The rationale that the guidelines support DOE's decision to compare only five sites is questionable since the guidelines are the subject of current litigation regarding this matter.

3. The Site

P. 7: The draft EA appears to distort the description of Yucca Mountain when it states that the site is on the Nevada Test Site. All references throughout the draft EA should be corrected to clearly indicate that the site in not located on NTS.

The statements indicating that tectonic activity is decreasing and that there have been low levels of seismicity during the historical record are false and should be corrected.

P. 10: The draft EA states that "At Yucca Mountain, most precipitation apparently evaporates before it can infiltrate deep enough for ground-water recharge. The average annual precipitation near the site is about 6 inches per year; only a small fraction (3 percent or less) of that amount reaches the depth proposed for the repository." The last portion of the statement is not based on fact; it is unknown how much of the precipitation reaches the depth proposed for the repository.

The second paragraph states that "The movement of ground water in the unsaturated zone is typified by a very low flux of water moving downward mainly through the intergranular pores of the tuff layers." There is no direct field data available concerning the nature of flux in the vadose zone (unsaturated zone). The statement is therefore plagued by supposition and is unsupported. Montazer and Wilson (1984) indicate that there is a current lack of knowledge of the hydrology in the vadose zone. Overall, the description of the hydrologic environment and processes contained in the draft EA are not supported by the references.

5. Regional and Local Effects of Repository Development

P. 12: The statement that "any adverse effects on . . . socioeconomic conditions would be minimal" is unsupported and is likely not true.

P. 13: The description of the economic benefits projected to accrue to Nye and Clark Counties is very misleading because the labor-force estimates contained in the draft EA are significantly overstated. If benefits to local communities are to be projected, they should be clearly labeled as speculation. The negative economic consequences of a repository should also be discussed in relation to such positive impacts in order to provide a balanced, objective summary.

P. 14: The statement that "Legal impediments in California and Arizona could affect the transportation of waste in Nevada" needs further description and clarification.

6.1 The Structure of the Guidelines

P. 14: The last sentence reads as follows: "In order to achieve the specified level of containment and isolation, the site must allow for the use of engineered barriers." That statement is entirely inconsistent with the consideration of engineered barriers allowed by the siting guidelines in §960.3-1-5.

6.2 Summary of Site Evaluations Against the Postclosure Guidelines

P. 15: Statements regarding the expectation for ground-water flow are unfounded as are descriptions of the occurrence of zeolite minerals. Likewise, expectations regarding mineral resources are not supported by available data.

P. 15: The sixth paragraph states that "because the repository would be in the unsaturated zone and thus have little exposure to the ground water, the presence of the oxidizing ground water may not significantly affect the lifetime of the canister or the movement of radionuclides, even though they may be more soluble. In addition, many canister materials, when exposed to oxidizing conditions, form protective coatings that would prolong the lifetime of the canister." The degree of exposure to water is unknown. The statement that because the repository is in the unsaturated zone and therefore would have little ground-water exposure does not indicate its potential exposure to vadose-zone water.

P. 16: In the second paragraph, the following statement is made: "The time of ground-water travel from the disturbed zone to the accessible environment is conservatively estimated to be more than 20,000 years and possibly as long as 4.7 million years." The time for ground-water travel, assuming a pore flux without fracture transport from the disturbed zone to the accessible environment, is estimated to be more than 20,000 years and possibly as long as 4.7 million years. However, the nature of the flux in the vadose zone is unknown, especially since fracture flow is also feasible. The main reference concerning this topic is Montazer and Wilson (1984), which describes a conceptual hydrologic model for the vadose zone and states (p. 4): "Many uncertainties remain to be resolved concerning hydrologic conditions and processes. As a result, most of the concepts presented are intentionally descriptive and conjectural, with little quantitative basis provided."

6.3.1 Radiological Safety

P. 16: It is important for the final EA to state that because the applicable radiological standards (EPA draft 40 CFR 191) are <u>not</u> final, DOE is unable to determine if the standards can be met.

P. 17: In the second paragraph, the potential danger to underground personnel during routine weapons testing requires elaboration since the actual danger (e.g., shock failure of the host rock) is never clarified. Such considerations should be discussed in relation to the potential disruption of the integrity of the proposed repository during construction and emplacement periods.

7. Comparative Evaluation of Sites Proposed for Nomination

P. 18: The final EA should discuss why DOE chose not to select a <u>single</u> ranking method.

SPECIFIC COMMENTS ON CHAPTER 1

PROCESS FOR SELECTING SITES FOR GEOLOGIC REPOSITORIES

1.1.2 The Nuclear Waste Policy Act of 1982

P. 1-3: The description of the requirements of the Act upon DOE should include the statement that in addition to the preparation of site-characterization plans for NRC review, these plans are also required to be submitted to the governor and legislature of the state in which such candidate site is located.

P. 1-6: The paragraph describing the screening of sites in basalt and tuff should be expanded to include a more complete discussion of the Comptroller General's report including the actual reasons for looking at the federal reservations. It should also explain why the Idaho Falls and Savannah River Reservations were not examined. There should also be a discussion of the Comptroller General's reasons for recommending consideration of federal reservations together with an examination of the factors/reasons that are present and valid for Yucca Mountain.

1.2 Summary of the Overall Decision Process

P. 1-7: Page 1-7 shows that, for salt, original screening was done in four regions, including the Salina Basin of Michigan, Ohio, Pennsylvania, and New York. The last sentence of page 1-7 reads "After proceeding to the location phase, further screening of the Salina Basin salt deposits was deferred, and the last three regions were selected for further study." Why was further screening of the Salina Basin deferred?

1.2.3 Sites in Basalt and Tuff

P. 1-10: This section must include a description and rationale for the exclusive examination of Hanford and the Nevada Test Site. What sites were examined at the Savannah River and Idaho Nuclear Engineering Laboratory Reservations? If DOE did not utilize a host-rock approach in evaluating sites on federal reservations, then all federal reservations should have been examined, evaluated, and compared. The absence of such an evaluation at the other reservations suggests that Hanford and NTS were selected arbitrarily.

The draft EA likewise fails to justify the original decision to examine Yucca Mountain since it is not on the Nevada Test Site. As such, it was not included in the GAO land-use screening recommendation nor has it been screened using the host-rock approach. A detailed discussion of these issues should appear in the final EA.

1.2.3.2 Tuff in the Southern Great Basin, Nevada

P. 1-12: The title of this section suggests that other tuff sites in the southern Great Basin were examined. The final EA should describe those other tuff sites that were examined in the southern Great Basin area.

The draft EA states that the argillite under Syncline Ridge was not evaluated further due to the "geologic complexity" of the area. How and in what ways is this particular formation more complex geologically than Yucca Mountain? (The draft EA also describes Yucca Mountain as geologically complex.)

P. 1-13: The paragraph that describes the surface mapping of Yucca Mountain, the presentation to the National Academy of Sciences, and the USGS letter of February 5, 1982, needs considerable elaboration. First the reference cited for the NAS presentation and related response (DOE 1980d) is erroneous because neither document contains the claimed information. Additionally, on August 1, 1984, in a letter to Dr. Vieth, the State of Nevada formally requested a copy of the presentation that DOE-NVO made to the National Academy of Sciences regarding tuff, as well as the Academy's response. To date this request has not been fulfilled.

1-14: The last paragraph of Section 1.2.3.2 discusses the process used to screen Yucca Mountain against other sites on the Nevada Test Site (NTS). How does the decision to retrofit data and information to support a decision that had already been made bear on the credibility of the entire screening process? Such a "screening" process cannot be expected to contribute to the public's confidence in an objective site-selection effort. This situation needs further description and explanation.

1.2.4 Nomination and Recommendation of Sites for Characterization

P. 1-14: Among other things, the guidelines (10 CFR 960.3) require DOE to: "6. Perform a reasonable comparative evaluation under each guideline of the sites proposed for nomination."

This step is in violation of Section 112(b)(1)(E)(iv) of the Nuclear Waste Policy Act that requires "a reasonable comparative evaluation by the Secretary of such sites with other sites and locations that have been considered." This section requires DOE to compare all nine potentially acceptable sites, not just the nominated five. Additionally, the inclusion of the word "locations" in Section 112(b)(1)(E)(iv) requires DOE to compare other locations as well. The final EA must contain a comparative evaluation of all nine sites identified as potentially acceptable. Otherwise, it will be legally deficient. The fact that the siting guidelines did not disqualify any sites only serves to reinforce the necessity for comparing all sites.

1.2.5 Final Steps in the Site Selection Process

P. 1-15: This section should be rewritten to articulate that site characterization does not begin after the President's approval of sites, but only after (1) the development and submission of a draft site-characterization plan to the NRC and to each host state, (2) receipt of NRC'scomments, and (3) the conduct of public hearings in each state on the draft plan.

1.3 Evaluation of Potentially Acceptable Sites Against the Disqualifying Conditions and Grouping into Geohydrologic Settings

P. 1-15: Section 1.3.1 begins as follows: "Having evaluated the nine potentially acceptable sites against the disqualifying conditions in the guidelines, the DOE has found no evidence to support a finding that any of the sites are disqualified." Such an evaluation of itself is not sufficient to satisfy the requirements of the Act. Each of the environmental assessments, including those for the four sites not nominated, contains a comparative evaluation of the five nominated sites only. This is a violation of the clear statutory requirement that each site must be comparatively evaluated with "other sites and locations that have been considered" (emphasis added). (See comment relative to Section 1.2.4, p. 1-14.)

1.3.1 Evaluation Against the Disqualifying Conditions

P. 1-15: The information in the draft EA and referenced documents does not support DOE's finding that Yucca Mountain is not subject to disqualification under certain guidelines. The disqualifying conditions for tectonics (preclosure and postclosure), proximity to atomic-energy defense facilities, geohydrology (ground-water travel time), and natural resources (mineral-resource potential) may be present.

The final EA should indicate that these disqualifiers may be present at Yucca Mountain.

1.3.2 Diversity of Geohydrologic Settings and Types of Host Rock

P. 1-16: The draft EA points out that: "Sections 960.3-1-1 and 960.3-1-2 [of the siting guidelines] specify that, to the extent practicable, sites recommended as candidate sites for characterization shall be located in different geohydrologic settings and shall have different types of host rock."

The document ignores the phrase "to the extent practicable" and transforms a desirability for diversity in settings and rock type into a mandate. This requirement is one of DOE's own creations--not one imposed by statute or even by the guidelines.

SPECIFIC COMMENTS ON CHAPTER 2

DECISION PROCESS BY WHICH THE SITE PROPOSED FOR NOMINATION WAS IDENTIFIED

P. 2-1: The first two paragraphs leave a misimpression with the reader as to the early site screening and decision process. The decision to look at the Nevada Test Site (NTS) for suitable sites was based upon a GAO recommendation in 1979 to review DOE lands already dedicated to nuclear activities. Land use was primary in these early studies, and only previously contaminated lands were intended for consideration. Geologic media of granite, argillite, and tuff were reviewed in early site screening, not "nine types of rock" as stated in the EA. The decision to locate a repository in the unsaturated zone was not made until 1982, long after Yucca Mountain was selected as the only potential site. Siting in the unsaturated zone was not part of the early siting criteria utilized to assess sites. There is no documentation that other unsaturated zone sites were considered at NTS. The text should be revised to clearly explain the early siting decisions, objectives, and plans at NTS.

P. 2-1: This section of the draft EA explains that DOE's search for sites in Nevada was concerned with identifying suitable geologic conditions rather than with existing land-use considerations. However, in Chapter 1 of the draft EA, there is a great deal of discussion describing land use (i.e., already-contaminated lands) as the primary focus in the search for sites. The draft EA seems to describe one rationale for site screening (i.e., land-use considerations) to justify examining the Nevada Test Site in Chapter 1 and an entirely different rationale (i.e., geologic or host-rock conditions) in Chapter 2 to justify moving off the Nevada Test Site to "find" Yucca Mountain. It appears that DOE utilized a land-use approach to justify looking at NTS; but when no suitable sites were identified, the entire site-screening rationale was changed, focusing upon suitable host-rock conditions to justify arriving at Yucca Mountain. The result is an extremely contradictory and confusing account of the screening process for the Nevada site.

P. 2-1: The draft EA goes on to state that "Nine types of rock in 15 alternative locations at or near the NTS were identified as potentially suitable for a repository." In the second sentence it is stated that "eventually, a rigorous program of screening led to the selection of welded tuff and Yucca Mountain in southern Nye County, Nevada, as the preferred host rock and the preferred location, respectively" (emphasis added). These two sentences are misleading and contradictory. We certainly had the impression that the original decision to find a site at NTS was to be confined within the immediate boundary of NTS and Yucca Mountain was not given consideration. We also get the impression that the "rigorous" program of screening was done to justify the choice of welded tuff and Yucca Mountain after the fact and did not, as stated, lead to the selection of welded tuff and Yucca Mountain. These statements should be changed to more accurately reflect the process that was actually followed.

Also in the second paragraph the draft EA states that "Among the attractive attributes of Yucca Mountain were its location in a closed hydrologic basin, the ability to locate the repository in the unsaturated zone (above the water table), and the excellent thermal-mechanical and radionuclide-retardation properties of tuff." In regard to being located in a closed hydrologic basin, everything in the NTS is in a closed hydrologic basin. This particular attribute does not apply to Yucca Mountain since it is not located in a strictly defined closed hydrologic basin. The second part of the statement regards the excellent thermal-mechanical and radionuclide-retardation properties. What is the basis for this statement? In Sinnock et al. (1984), the previous source document for these statements, there are no specific attributes listed either for thermal-mechanical or radionuclide-retardation for any of the host rocks considered. On the contrary, in Figure 40 on p. 122 of Sinnock et al. (1984), the densely welded Topopah Spring tuff is shown to be generally of average rank on four of the seven categories shown, a lower rank in two of the seven categories shown, and a higher rank in two of the seven categories shown. Of the two high-ranking categories, one (coefficient of linear expansion) is a two-stage attribute listing subjectively whether the rock type is either prone to contraction or expansion. The second category relates to mineral stability of the host rock type. The Topopah Springs tuff is shown to have more stable mineral content than most of the other rocks. With this we would readily agree; however, the value of this attribute in an unsaturated system is unclear. Of the two unfavorable attributes, both seem to be related to radionuclide-retardation properties. The Topopah Springs Member is shown to be at the low end of the scale for stratigraphic setting related to retardation by sorption and for hydraulic transmissivity. Both of these attributes would appear to contradict the statement made in the text. In Table 9 on p. 145 and in Table 10 on p. 147 (Sinnock et al., 1984), the Topopah Springs densely welded tuff is shown to be at the low end of the scales used for sorption relative to all of the other host rocks considered. This again is a direct contradiction to the statement that is made in the draft EA on p. 2-1 at the end of the second paragraph. The last sentence on p. 2-1, second paragraph, is also misleading when it states that the ability to locate the repository in the unsaturated zone was an attractive attribute of Yucca Mountain. The technical basis for selection of the unsaturated zone was not developed until 1982, after the so-called screening studies were completed.

P. 2-1: The second paragraph attempts to characterize DOE's site screening on NTS and the subsequent arrival at Yucca Mountain as an objective and scientifically sound process. As Chapter 1 of the draft EA implies, the screening of sites on NTS would be better characterized as one of trial and error, with Yucca Mountain selected as a last resort. The formal screening and evaluation appear to have been completed after Yucca Mountain had been selected as the preferred location.

P. 2-1: The first paragraph states that "The NTS and its vicinity seemed attractive as a potential repository location because the land was withdrawn from public use, the NTS itself was under DOE control, and some of the land was contaminated with radioactive material from nuclear-weapons tests." This same comment could apply to the Idaho Nuclear Engineering Laboratory (INEL) and the Savannah River Plant (SR). Why were these sites not considered? In addition, there is land available that has been contaminated in New Mexico from earlier bomb and missiles tests. Why were these lands not considered?

P. 2-1: In the third paragraph, DOE states: "The data thus collected indicated that the site is indeed suitable for both long-term and near-term objectives, . . ." What are the long-term and short-term objectives? Is DOE implying that the Yucca Mountain data indicated suitability for a repository after only a very cursory examination? Since the issue of prejudgment about a Nevada site and the selection of Yucca Mountain is of major concern, DOE should revise this paragraph to clearly state what is meant by "suitable for both long-term and near-term objectives."

P. 2-1: The fourth paragraph implies that a favorable attribute for Yucca Mountain is the fact that the site is on federal land under the control of three separate agencies. This appears to be an important factor in the DOE decision to justify the choice of NTS in general and the Yucca Mountain site in particular. This is shown further on Table 2-4 on p. 2-32, where 100 percent of the socioeconomic weight is assigned to land use and no weight is given to any impact on the local economies or lifestyles, a point we will comment on later. There seems to be some ambiguity in the DOE weight for land use relative to the other sites being considered outside of Nevada. While it is true that at Hanford and Yucca Mountain the federal ownership and control of the land were an important part of the DOE decision, the same is not true of the other sites. There is no federal land available in the site area chosen in Deaf Smith County, Texas, or in the immediately surrounding area that is required for a repository. Yet this condition is considered favorable in regard to this site. In the case of Davis Canyon, there is no private land involved since all the land is under control of the BLM. However, this was considered a very unfavorable condition in relation to the Utah site. This dichotomy among the various sites needs to be explained.

P. 2-1: The fifth paragraph states that "Both the Nuclear Waste Policy Act and the DOE siting guidelines (10 CFR 960.3-2) <u>require</u> such an evaluation [against the disqualifying conditions] as a step in the nomination process that <u>must</u> be applied to all potentially acceptable sites" (emphasis added). The DOE siting guidelines were required by the Act and are therefore subordinate to the Act itself. This statement appears to be misleading in this regard. In addition, the guidelines were not finalized until December 1984. Once they were established, the siting process should have started over in order to assure that those guidelines are met and that the siting study used to justify Yucca Mountain is valid.

2.1 Regional Setting of Yucca Mountain

P. 2-3: The description of the area surrounding Yucca Mountain paints a picture of aridity and desolation--a place with little water, few people, and marginal soil and land potential. That description may be misleading in terms of future growth (over the next 100 to 500 years). The Great Basin is not all desert; the mountains often have substantial rainfall and are forested. There is water potentially available in deep aquifers. The site area is characterized by relatively mild climatic conditions and terrain that is amenable to a variety of possible uses (i.e., the Amargosa Valley). It is reasonably close to a major and rapidly growing metropolitan area (Las Vegas) and may be a natural location for suburban expansion in years to come. The site area also has many agricultural and recreational uses and shows potential for mineral exploitation.

Someone describing the Las Vegas Valley 150 years ago might have used words similar to those the EA uses to characterize the area west of Yucca Mountain. Given the time-frames involved with a repository project, it would be more appropriate for the EA to examine the regional setting of the area in terms of potential--not just current--attributes.

P. 2-3: We suggest that an appropriate figure such as Figure 3-2 on p. 3-3 or something from a good physiography text be used to illustrate the statements in the second paragraph. The third sentence states that no streams or rivers flow out of the region, the region being the Great Basin. This statement is true only of the central part of the Great Basin and not the northern or southern part, where the site is located. In the southern part of the Great Basin, the Colorado River would certainly be considered a major stream by most scientists. In the fourth sentence of the same paragraph, the statement regarding agricultural potential is also inaccurate if it is meant to imply that the entire Great Basin has limited agricultural potential. There are many parts of the Great Basin, particularly at the northern end, where water applied to the soil results in extremely high yields for many crops.

P. 2-3: The third paragraph makes a general statement in the third sentence that most of the mountain-range cores are made of gneiss and granite. While this is true for most cases in the southern part of the Great Basin, it is not appropriate for the entire Great Basin. In addition, the statement that these rocks are part of the crystalline shield of the North American continent is certainly controversial. There are many who feel that the edge of the North American shield is much further to the east, and that the gneisses and granites found in the Great Basin might be part of the Cordilleran Complex. In addition, the implication that most of the crystalline rocks in the Great Basin are gneiss and granite more than a billion years old is not supportable. Not all gneiss and granite in the Great Basin are a billion-plus years old, and not all billion-plus-year-old rocks in the Great Basin are gneiss and granite.

P. 2-3: The fourth paragraph indicates that volcanism ceased 10 million years ago. Volcanism did not cease 10 million years ago in the Great Basin, but has continued up to the present. Cinder cones in Crater Flat, adjacent to Yucca Flat, are much younger than 10 million years. Because there is no volcanic activity today does not mean the area is <u>not</u> volcanically active.

P. 2-5: The first paragraph states that tectonic activity has "waned" in the last 10 million years in the Great Basin. Tectonic activity has not "waned" in the last 10 million years. There is some evidence that suggests activity is greater today than in the past.

P. 2-5: The second paragraph indicates that geologic processes have ceased at Yucca Mountain. There is no evidence to indicate that the geologic processes discussed have ceased, are not operating today, or will not continue into the future. Yucca Mountain is in a geologically-active area.

P. 2-5: The third paragraph states that the deep water table provides a unique opportunity for placing a repository in the unsaturated zone, where there is limited water available. The implication that this was the first consideration for sites at the NTS and Yucca Mountain, in particular, is not true.

Most precipitation occurs during winter months; the highest evaporation rates occur during the summer months. Annual averages of evapotranspiration and precipitation are inaccurate and misleading. Postulated extreme event/ antecedent moisture conditions may be more meaningful than average precipitation/evapotranspiration.

The last sentence states that most precipitation evaporates before it is able to seep deeply into the rocks of the unsaturated zone. What documented studies or empirical evidence were used to support this statement?

P. 2-5: In the fourth paragraph, the draft EA states that the welded-tuff and lava-flow aquifers of the volcanic sequence transmit water primarily through fractures. In the last sentence of the same paragraph, a statement is made that the bedded tuff store and transmit water chiefly through interstitial pores. These statements are contradictory. If the welded tuff does transmit water through the fractures, in order for the geochemistry to be supportive the zeolites would have to be along the fracture zones. If the presence of the zeolites is mostly in the interstitial pores it would seem that the bedded tuff would be more advantageous to use than welded tuff.

P. 2-5: The last paragraph considers the distance of recharge and discharge points from the site. We suggest that numerical values be added to help understand the significance of these statements.

2.2 Identification of Yucca Mountain as a Potentially Acceptable Site

P. 2-11: In the second paragraph of this section, the draft EA states that the screening studies of steps 4 and 5 used objectives very similar to those specified in the guidelines. The paragraph goes on to state that the identification of Yucca Mountain as a potentially acceptable site was consistent with the siting criteria formulated by DOE's NWTS program (DOE, 1981a) and is consistent with 10 CFR 960. These statements are misleading. DOE 1981a was not formally reviewed by the states nor was it approved by anyone other than DOE. Screening studies using objectives "very similar" to those specified in the guidelines are not satisfactory. There needs to be a reevaluation of the entire area based specifically on the approved guidelines as required by the 1982 Nuclear Waste Policy Act.

2.2.1 Selection of the Nevada Test Site as an Area of Investigation

P. 2-11: In this section DOE appears to contradict earlier assertions (see the first paragraph of Chapter 2) by emphasizing a land-use approach to site screening on NTS as opposed to the suitable-host-rock approach that the draft EA had indicated was being utilized. The draft EA refers to DOE

(1982a) as the source for the host-rock approach. DOE (1982a) is a draft document that was not finalized. Was this document ever finalized? What input was provided by the NRC or the involved states? The paragraph goes on to state that in 1977 the program was expanded to consider prior land use as an alternative basis for initial screening. The prior-land-use approach considered the advantage of locating a repository on land already withdrawn and committed to long-term institutional control. Why were only the Nevada Test Site and the Hanford Reservation considered? What were the reasons for rejecting the Idaho Nuclear Engineering Laboratory, Savannah River Project, Oak Ridge National Laboratory, and other federally controlled lands? The paragraph goes on to state that because the Nevada Test Site was already dedicated to nuclear operation, it was a logical area for investigation for a potential repository site. The major nuclear operations on NTS have been weapons tests. It is likely that this activity would make the site less suitable than other federal sites such as Hanford, Idaho, Savannah River, and Oak Ridge. In the last sentence of this paragraph, it is stated that because of the prior land use at the Nevada Test Site (bomb testing), there is a firm reason for concluding that the government will continue to provide strict institutional control over future access to the site. We agree that this is quite probable where the tests have been conducted. What guarantees can the DOE give that the same control will be exercised over areas not dedicated to weapons testing and not even part of the Nevada Test Site, such as Yucca Mountain? What is the justification for taking additional land out of the public domain if, in fact, there are sites within the Nevada Test Site area that will be under strict institutional control and that may be as suitable or even more suitable than the Yucca Mountain site given additional empirical data that could be collected.

P. 2-12: The 1977 U.S. Geological Survey proposal for NTS should be cited as a reference. That document did <u>not</u> address siting a repository in the unsaturated zone. The recommendation to consider the unsaturated zone was made in a letter from the USGS to DOE in 1982. The text should accurately reflect the proper timing and scope of USGS recommendations.

On p. 2-12 it is stated that the water table is at great depth, as much as 500 meters (1,600'), below the surface. This statement is only true for Yucca Mountain, and this value was not known at that point in the siting process (1977). In addition, the depth is not representative of the entire Nevada Test Site. In the second sentence the statement is made that this "provides the opportunity to build a repository in the unsaturated zone where the rock containing a repository would not generally release water to drill holes or tunnels." The use of the unsaturated zone was not seriously considered until early 1982. The third sentence states that "This lack of water would minimize the corrosion of the waste canister, the dissolution of the waste, and the transport of radionuclides from the repository." This statement is not supportable and is out of sequence time-wise.

The statement is also made that some of the geologic materials occurring on the NTS are highly sorptive so that radionuclides would be chemically or physically absorbed by rocks, making it extremely difficult to move in solution. This statement can be made for all of the sites under consideration and is not unique nor most applicable to Yucca Mountain. In the case of Yucca Mountain, the material is not the most sorptive nor does it have the highest potential for radionuclide retardation. According to the statements regarding Attribute 29: Geochemically controlled stratigraphic setting, on p. 143 in Sinnock et al. (1984), the sorptive values for densely welded tuff (Topopah Springs) is among the lowest to be found of all the candidate host rocks of the NTS.

The same section states that "With the very low rate of precipitation, the amount of moving ground water is also low, especially in the unsaturated zone." This same statement could be made with regard to the Hanford, Davis, and Lavender Canyon sites since the same conditions exist there. In addition, when DOE reevaluates alternative sites that are under control of the federal government, similar statements should be added for Idaho.

P. 2-12: The second paragraph states: "The NNWSI project was organized to consider the general suitability of the NTS for a repository and to identify locations, if any, on the NTS or adjacent areas that might be suitable for a repository." It is our impression that at the time of the formation of the NNWSI project only the NTS was considered and that no adjacent areas were to be considered. What is the justification for including adjacent areas? Reference the documentation for these statements.

2.2.2 Restriction of Exploration to the Southwestern Part of the Nevada Test Site and Adjacent Areas

P. 2-12: In the first paragraph, reference is made to a task force and its findings relative to the compatibility of weapons testing and waste disposal.

The State of Nevada requested a copy of these findings in an August 1, 1984, letter to Dr. Vieth. To date, the State has not received a copy of the findings. Additionally, this task-force report should appear as a reference to Chapter 2.

As previously noted, the draft EA fails to define the legal basis for examining sites off or adjacent to the Nevada Test Site. The document should clearly explain the foundation for this perceived authority and discuss why DOE never approached the State for agreement to go off-site--as the 1979 DOE memo from M. Gates to S. Meyers promised that they would.

P. 2-14: The first paragraph needs to be modified. In 1977, there were two granite sites, one granite-argillite site, one argillite site, and one tuff site under consideration.

The draft EA states: "It was concluded in July 1978 that the geologic complexity of Syncline Ridge would make characterization difficult." This same conclusion could have been reached about Hanford in 1978 and is still considered a major problem by the USGS in 1985. What is the complexity at Syncline Ridge that makes it worse than the Hanford situation? The statement goes on to imply that the Syncline Ridge area would be possibly so difficult that it could not be understood to the degree necessary to license a repository. Yucca Mountain is also geologically complex. What data give the DOE any more confidence about the Yucca Mountain area given the extensive faulting and fracturing, and geophysical opaqueness of welded tuff?

The EA should cite the documentation for the decision by the Assistant Secretary of Defense Programs that deemed Syncline Ridge unacceptable because of its proximity to weapons testing. This reference needs to be supplied in its entirety as an appendix to Chapter 2.

The draft EA also states: "At this juncture, the program refocused on the area in and around the southwest corner of the NTS." A statement needs to be added to document specifically when this decision was made and the basis for that decision.

The last sentence states that the area evaluated included some BLM land west and south of the NRDA and a portion of Nellis Air Force Range west of the NRDA. What was the basis for extending this evaluation?

2.2.3 Selection of Yucca Mountain as the Primary Location for Exploration

P. 2-14: The first sentence in this section states that a preliminary list of potential sites in and near the southwestern part of the NTS was compiled in August 1978. What is the reference for this list; and what was the basis for the selection of Calico Hills, Yucca Mountain, and Wahmonie as the most attractive locations for conducting preliminary borings and geophysical testing?

P. 2-14: The second paragraph in this section states that the first exploratory hole by the NNWSI project in the southwestern NTS was started in 1978 to explore for granite beneath the Calico Hills. At the top of p. 2-15, it is stated that in the summer and fall of 1978 the first exploratory hole was drilled at Yucca Mountain. If the statement in the first paragraph is true that the preliminary list of potential sites was not compiled until August 1978, then what was the justification for proceeding with the drilling program?

P. 2-14: Relative to the Wahmonie location, the draft EA states that studies indicated that the granite that occurs at the surface would be only marginally large enough for a repository at the depth needed. What was the reference design used to support this decision?

Separately on the Wahmonie location, the text states ". . . local surface deposits from warm springs indicate upward seepage of ground water, possibly from great depths. For these reasons, Wahmonie was eliminated from consideration in the spring of 1979." A review of work done by Swadley, Hoover, and Rosholt (1984) suggests that similar deposits were encountered in trenches excavated along faults at Yucca Mountain. Mineralogic analysis of these deposits by Los Alamos National Laboratory (David Vaniman, personal communication) suggests a high-temperature origin for the silicate fraction. If warm-spring deposits are cited as a reason for eliminating the Wahmonie area, why are the presence of such deposits at Yucca Mountain not considered a disqualifying condition? Consistency in screening decisions is important for demonstrating a credible process.

P. 2-15: In describing early Yucca Mountain studies, the text states that the first hole drilled more than 600 meters (2,000') deep confirmed the presence of thick beds containing highly sorptive materials. What was the nature of this highly sorptive material? Did the material occur along fractures or within the matrix? Why is the presence of this highly sorptive material not reflected in Attribute 29: Geochemically controlled stratigraphic setting, as discussed on pp. 143-152 of Sinnock et al. (1984)?

P. 2-15: In the first paragraph, the draft EA states that preliminary surface mapping indicated the existence of generally undisturbed structural areas possibly large enough for a repository. What were the surface-mapping methods used to support this conclusion if, in fact, there were no stratigraphic data available prior to this point?

P. 2-15: Continuing on the early Yucca Mountain studies, the text states that because tuff previously had not been considered as a potential host rock for a repository, a presentation was made to the National Academy of Sciences Committee for Radioactive Waste Management in September 1978 to solicit their views on the potential advantages and disadvantages of tuff as a repository rock. If this meeting was not held until September 1978, what was the justification for beginning the exploratory holes outside of the NTS in the summer of 1978? The statement goes on to imply that the concept of investigating tuff as a potential host rock was supported. Was this meeting documented? If so, the EA should cite, and DOE should provide, references for the NAS Committee for Radioactive Waste Management recommendation of tuff as a repository medium and the USGS recommendation of Yucca Mountain as a possible repository location. These recommendations are <u>not</u> included in the list of references and have not been made available to the State for review.

P. 2-15: The draft EA states that in July 1979, technical peer review meetings on host-rock investigations; on geologic and hydrologic investigations; and on tectonic, seismic, and volcanic investigations were held by the NNWSI project. Was the participation by the State of Nevada invited? Why not?

The draft EA indicates that these review meetings were attended by nationally known experts as well as prominent experts from Nevada. In what fields were these participants expert? What is the basis of being nationally known? Known by whom? Who was responsible for the choice? Who were the prominent experts from Nevada? In what way was the State of Nevada involved with either identifying the experts from Nevada or as a participant?

<u>2.2.4 Confirmation of Site Selection by a Formal System Study</u>

P. 2-15: A review of this section reveals that Yucca Mountain was selected as the preferred location for study some two years prior to the site screening at the southwestern area of the NTS. The USGS recommendation and DOE concurrence for selecting Yucca Mountain occurred in April 1979, while other sites on NTS were eliminated in 1982. This would seem to infer that the Department had prejudged and preselected Yucca Mountain in apparent violation of the legal mandate to examine sites on existing federal reservations. It appears that DOE began examining a site outside the Nevada Test Site <u>before</u> it was known whether or not a suitable site existed within the NTS boundaries.

P. 2-16: The first paragraph is a contradiction in terms. It is stated that "Many assumptions were quantified during the screening study, and the validity of the results and conclusions clearly depended and continues to depend on the reasonableness of these assumptions." It hardly seems appropriate to use the same data for quantifying assumptions that one uses to determine the reasonableness of these same assumptions.

P. 2-16: The last paragraph states that "The attributes used to evaluate locations with respect to each of the lower-level objectives were weighted to allow the relative importance of various types of physical conditions to be distinguished." How does DOE know a priori what the relative importance of the various types of physical conditions will be without a design that has been finalized or without any data on waste disposal in the type of material being considered? What was the basis for giving so little weight to any of the environmental impacts at this point in the siting process? It would seem that at this stage the environmental considerations should outweigh the physical considerations. If, in fact, no potentially suitable host-rock area could be found within acceptable environmental areas, then and only then should DOE consider loosening the environmental criteria.

P. 2-31: In Table 2-4 under the level 3 criterion, why has no consideration been given to wind loading on surface facilities? Why has not consideration been given to availability of natural resources and the siting of surface facilities? Why has not consideration been given to existing corridors or transportation systems? This last factor has become particularly important in the public's mind as evidenced during the recent EA hearings. We would submit that a considerable amount of re-analysis should be provided.

P. 2-32: In Table 2-4 under "socioeconomic impacts," why was no consideration given for the impact on the local economies or on the lifestyles? Under "institutional impacts," why was no consideration given to State issues such as ownership of the Yucca Mountain site or meeting State regulations?

P. 2-40: Table 2-14 attempts to support the choice of the northern Yucca Mountain site as the obviously superior site among those considered. We disagree! If one gives appropriate consideration to some of the environmental attributes, it would appear that the choice of northeastern Jackass Flats would be preferable overall to Yucca Mountain. In addition, the northeastern Jackass Flats site is totally contained within the NTS and would require no further withdrawal of public land. Other sites within the NTS that would appear to be more environmentally acceptable overall and at the same time provide acceptable containment would be Little Skull Mountain and Central Jackass Flats.

P. 2-41: The draft EA discusses the favorable environmental, surface terrain, and hydrological attributes of the northeastern Jackass Flats site. The paragraph goes on to state that, however, this location is not underlaid by any of the host rocks considered. What kind of rock does underlay the northeast Jackass Flat site? There must have been some indication of rock type for the site to be considered in the first place. Given the favorable environmental and hydrological attributes, why was not a borehole placed in this site prior to excluding it from further consideration?

P. 2-43: The EA should cite and provide the quoted letter from the USGS to DOE-Nevada Operations Office of February 5, 1982. In the letter the authors suggest there is a potential for fracture flow in the unsaturated zone. If there is no fracture flow, there is <u>no advantage</u> to siting a repository within fractured media.

P. 2-45: At the bottom of the page, the text states that vertical ground-water travel-times were estimated to be thousands of years. If this estimate is 1,000 years, it may be too low. If the estimate is 100,000 years, it may be quite adequate. What are the numeric estimates of vertical travel-times? What is the range of travel-time estimates? In light of the statement in the third sentence that considerable uncertainty existed in the estimates for all of the rock units, and the statement in the fourth sentence that the travel-times varied as much as six orders of magnitude, it would seem that the conclusion that the Topopah Spring Member ranked highest because it is located in the unsaturated zone and is further from the water table than the Calico Hills unit may not be supported.

2.3 Evaluation of the Yucca Mountain Site Against the Disqualifying Conditions of 10 CFR Part 960

P. 2-46: In the second paragraph the following statement is made: "Almost all of the 17 disqualifying conditions pertain to conditions whose presence or absence may be estimated without extensive data gathering or complex analysis. . . . Because no disqualifying conditions are judged to exist at Yucca Mountain on the basis of the information collected and analyzed to data, the DOE has carried out the remaining steps . . . for the nomination of sites as suitable for characterization."

It is difficult to understand how DOE can make a finding of no disqualification relative to Yucca Mountain based upon the disqualifying conditions contained in the siting guidelines without extensive data gathering or complex analysis. It would seem that in the absence of this data gathering and analysis, DOE can only conclude that there is insufficient information available to substantiate the absence or presence of certain conditions. For example, the determination of ground-water travel-times (a disqualifying condition that includes the travel of moisture through nearly 1,500 feet of rock, entry of that moisture into the ground-water system, and a calculation of the speed at which ground water would travel to the accessible environment) can only be made after extensive data gathering and analysis.

DOE's own estimate of ground-water travel-time from Yucca Mountain to the accessible environment is in a reference (Montazer and Wilson, 1984) that contains the following caveat: "Many uncertainties remain to be resolved concerning hydrologic conditions and processes. As a result, most of the concepts presented are intentionally descriptive and conjectural, with little quantitative basis provided. However, for the sake of directness and simplicity of expression, the model is presented as if it were a true expression of the facts. The authors recognize, and the reader should be aware, that the proposed model probably is not the only reasonable description that could be made at this point, and it certainly is subject to revision and quantification as more data become available."

Compounding this situation is the fact that the EPA standard, which establishes the boundary of the "accessible environment," has not been issued. Although previous versions of the standard established this boundary at 10 kilometers from the repository site, the most recent version establishes it at only 2 kilometers from the site.

P. 2-50: In Table 2-8 under 10 CFR 960.5-2-6(d): Socioeconomic Impacts, the disqualifying condition requires a site to be disqualified if construction, operation or closure would significantly degrade the quality, or significantly reduce the quantity of water available for human consumption or crop irrigation.

The draft EA determines that the Yucca Mountain site is not disqualified because "repository water use is not expected to lower the regional groundwater table or reduce water quality" (emphasis added).

A major issue in this regard is not only whether repository water use will have a deleterious effect on area water supplies, but also whether it can be demonstrated that long-term (10,000 years) storage of highly radioactive materials only slightly above the water table will not eventually cause contamination of (and thereby degrade) water quality. The EA does not demonstrate that the repository will be benign with regard to future water use. Until such a conclusion can be made with scientific certainty, the finding that the site is "not disqualified" under 10 CFR 960.5-2-6(d) is unsubstantiated.

Geohydrology (10 CFR 960.4-2-1(d); Section 6.3.1.1)

P. 2-52: The draft EA states that DOE expects the ground-water travel-time from Yucca Mountain to the accessible environment to be more than 20,000 years. Other estimates, considering the uncertainty in measuring hydrologic parameters, suggest that this travel-time may be less than 900 years.

Therefore, there is some evidence to suggest that the disqualifying condition is present. It is inappropriate and extremely premature for the EA to conclude that it is not.

P. 2-53: Regarding the disqualifying condition under erosion, the text states that the site shall be disqualified if site conditions do not allow all portions of the underground facility to be situated at least 200 m below the directly overlaying ground surface. This condition will be met only if the facility is vertically emplaced. If any part of the ramp is considered a part of the underground facility for lateral emplacement, this criterion may not be met.

P. 2-53: Regarding dissolution, the text states that elevated temperatures are expected near the waste canister. What is the basis of this statement? What is the maximum temperature expected from five-year-old waste?

P. 2-53: Under the tectonics disqualifying condition, the text states that a site should be disqualified if, based on the geologic record during the Quaternary period, the nature and rates of fault movement are expected to be such that a loss of waste isolation is likely to occur. The discussion states that 16 faults have been identified within the 10-km radius (6.2 miles) that may have had small displacements during the Quaternary period. Since the criteria use the Quaternary period, the final part of that sentence regarding the last 40,000 years is inapplicable. If these small displacements represent motion on any type of faults other than pure normal faults, the source earthquakes could well be significant and, if repeated, could cause potentially serious disruptions to the facility. The EA should provide a discussion of the specifics for each one of these faults and the evidence for and against movement during the Quaternary period.

P. 2-53: At the bottom of the page under tectonics, the text states that earthquake damage to underground facilities is generally less than surface damage. What is the basis for this statement? Is the statement applicable to fractured tuffaceous rocks? What is the empirical data regarding potential damage to the proposed repository design? What other similar facilities have ever been tested for this seismic design?

The text further states that even if the waste canister were damaged, water is required to dissolve radionuclides from the waste form and to transport these radionuclides from the repository to the accessible environment. There are other radionuclides such as Iodine-129 that can be transported outside of an aqueous environment. On p. 6-302 in Table 6-41, the inventory of Iodine-129 is shown to be well in excess of the maximum permissible concentration under 10 CFR 20. Since the inventory is in error (five-year-old waste should be used as the basis of the inventory), there is reason to doubt the validity of the other assumptions in this statement.

P. 2-54: At the top of the page, the text states that the expected flux of less than 1 mm/yr through the repository has been shown to be insufficient to transport waste in quantities that could exceed release limits at the accessible environment, even if some waste materials were released from the repository immediately after closure. What type of flux does this statement refer to? The statement that this "flux" through the repository has been shown (Sec. 6.4.2) to be insufficient for transport contradicts the statement that is actually made in Section 6.4.2. In the first sentence under Section 6.4.2 on p. 6-303, the EA states that this section presents a <u>preliminary performance analysis</u> for the proposed Yucca Mountain waste type and disposal system. The first sentence at the top of p. 6-304 states that because of limitations in the data base and analytical methods, this preliminary analysis is <u>not intended</u> to demonstrate compliance with postclosure system guidelines; rather, it is intended to supplement the evidence that <u>will</u> be used to establish whether the Yucca Mountain site is suitable for site characterization. If, in fact, this "flux" cannot be demonstrated during site characterization, we assume that the site will be disqualified.

Further, at the top of p. 2-54, the draft EA states that travel-times of greater than 20,000 years provide additional confidence that radionuclides will not be released to the accessible environment in excess of limits specified. What is the basis for the statement that travel-times are greater than 20,000 years? Does this refer to only hydrological transport? Does this refer to vapor transport alone? Does this refer to a combination of vapor transport and hydrological transport?

P. 2-54: Regarding potential for human interference, the DOE seems to conveniently ignore the exploration, mining, and extraction for underground cavities in which to conduct nuclear bomb tests. Although no natural mineral resources have been extracted and moved off-site, the site in and of itself is a valuable resource to the Department of Defense. In addition, the last two sentences of the explanatory paragraph are illogical. These sentences state "The U.S. Geological Survey has also mapped the entire area by physical inspection of the ground surface, and it is extremely unlikely that unknown excavations exist at the site. Consequently, no significant pathways have been created between the projected underground facility and the accessible environment." Without some knowledge of the effect of underground testing on the Yucca Mountain site, even the blessing of the USGS cannot preclude the possibility that significant pathways have been created or pathways that existed (i.e., active faults) have not been enhanced by the underground testing.

P. 2-55: The draft EA states that the State of Nevada has an existing emergency-preparedness plan covering radiological emergencies. This plan identifies the agencies and individuals to be notified in event of a radiological emergency, providing guidance for participants and established procedures for requesting and providing assistance. It then states that such a plan <u>can</u> be developed for the operation of a repository at Yucca Mountain. This statement infers a level of confidence that may not be justified at this time.

P. 2-55: Under Offsite Installations and Operations, the text states that a site should be disqualified if atomic energy defense activities in proximity to the site are expected to conflict irreconcilably with repository construction, operation, closure, or decommissioning. What guarantees can be provided either by DOE or DOD that any future testing will never compromise the proposed site? Will the DOD agree to release any and all claims on the land within the accessible environment?

P. 2-58: Regarding preclosure tectonics, the draft EA states that a site shall be disqualified if, based on the expected nature of the rates of fault movements or underground 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 discussion goes on to state that the Yucca Mountain has had no significant surface displacements for the past 250,000 years and shows no unequivocal evidence of surface displacements for 40,000 years. It is obvious that these statements have been prepared by someone who has never been through the NRC licensing process. If these statements were made in conjunction with a nuclear-power-plant license, they are by definition defining a "capable" fault. Unless the DOE can show to the contrary that there has been no unequivocal evidence of movement within the last 2 million years, the faults regardless of their "significance" may likely preclude effective licensing of this site.

The discussion of preclosure tectonic conditions focuses only on the design-related tectonic factors. The key issue here concerns operation and closure, and the possible waste transport. This would seem to warrant considerably greater discussion in light of the probable presence of active faults at Yucca Mountain. There is no discussion of the potential for surface rupture and the resultant impacts to surface facilities and transport systems. The effects of subsurface fault movement on underground openings, emplacement activities, and general worker safety has not been considered. In addition, there is no discussion of the effect of fault movement on retrievability.

At the end of the Tectonics section, the text states that an estimated return period for large earthquakes is 900 to 30,000 years, which is well beyond the period of concern for repository activities. Unfortunately, this statement is false. As stated by DOE's own criteria, the repository activity extends through operation and into closure. The EA criteria address radionuclide transport up to 10,000 years. Both of these conditions are well within the range of 900 to 30,000 years.

SPECIFIC COMMENTS ON CHAPTER 3

THE SITE

3.1 Location, General Appearance and Terrain, and Present Use

P. 3-1: DOE should revise this section to clearly state that Yucca Mountain is not on the Nevada Test Site.

Pp. 3-1 to 3-4: In describing the proposed repository site in relation to the rest of the state, the draft EA focuses on Yucca Mountain itself (its elevation, location, etc.). However, the "site" actually encompasses a far greater area (at least according to DOE's projections for land withdrawal). The final EA should describe the site in total--including all land surrounding Yucca Mountain that will have to be withdrawn from public use as well as land needed to construct access roads and the proposed rail spur.

Figures 3-1 and 3-2 should also be revised to clearly show the exact parameters of the proposed repository zone (the site plus land that will be withdrawn as part of the repository project). These two figures should also depict the repository zone in relation to the boundaries of the towns of Amargosa and Beatty.

References for the BLM Cooperative Agreements and the Department of the Air Force permit, together with the environmental assessments associated with each document should be cited in the reference section of the EA and copies provided to the State for review.

3.2.1.1 Caldera Evolution and Genesis of Ash Flows

P. 3-6: This section of the draft EA describes caldera evolution and genesis of ash flows at Yucca Mountain. Two comments are appropriate in this section.

First, the general descriptions of calderas and caldera-forming eruptions is based on literature more than 15 years old. Recently an issue of the Journal of Geophysical Research (Vol. 89, September 1984) was devoted to the subject of calderas and associated igneous rocks. Especially informative are papers by Walker on caldera shape, size, and growth; by Novak on the Kane Springs Wash volcanic center, Nevada; by Elston on the calderas of southwestern New Mexico; by Henry and Price on the calderas of the Trans-Pecos area of Texas; and an excellent review article by Lipman. A general theme of many of these papers is that many calderas do not resemble the classic caldera: a nearly circular crater with a central resurgent dome and post-caldera domes arranged above a caldera ring fracture. Calderas may in fact range in shape from half-grabens to elongated sag structures. It is not suggested that calderas described in the aforementioned literature occur at Yucca

Mountain. The point is that the most current technical knowledge should be utilized.

Second, volcanic hazards were down-played in the draft EA. It is important to understand large-scale patterns of volcanic activity in order to evaluate the potential for volcanic eruption at Yucca Mountain. Volcanic hazard studies have concentrated on Crater Flat just to the west of Yucca Mountain (work by Crowe and others). The Crater Flat volcanics are part of a larger volcanic field extending from Death Valley to the Pancake Range in central Nevada. An important question is whether the style and timing of eruptions recorded at Crater Flat is characteristic of the entire field. If it is not, then the potential for volcanic eruption may have either been over- or underestimated. It is important to determine whether other types of volcanic eruptions are important in this field. Are hydromagmatic eruptions common? They occurred to the north and south of Crater Flat (Ubehebe Crater and Lunar Crater). Has this type of eruption been considered when calculating the potential of future eruptions? Such issues must be addressed and satisfactorily resolved before any conclusions can be drawn concerning the potential for volcanism at Yucca Mountain.

3.2.1.4 Tuffaceous Beds of Calico Hills

P. 3-11: In discussing the Calico Hills Member the draft EA states "It thickens to nearly 306 m (1000 ft) to the north (drill hole USW G-2)." Maldonado and Koether (1983) report a thickness of only 288.7 m for the Calico Hills member at USW G-2. Discrepancies in data such as this are reflective of a less than scholarly (even inaccurate) job of research, integration, and compilation that is totally unacceptable in an undertaking of this type.

3.2.1.5 Crater Flat Tuff

P. 3-12: The text indicates the Tram Member is 154 to 327 m thick in drill hole USW G-2. Maldonado and Koether (1983) report a 104 m thickness for the Tram in USW G-2. Again, such discrepancies indicate sloppy data integration and document compilation.

3.2.2 Structure

P. 3-14: Fleck (1970) and Carr (1974) reason that major motion ceased 10 million years ago along the Las Vegas shear zone. Extensional faulting in Yucca Flat plus seismic activity between the Las Vegas shear zone and the historically active Walker Lane disturbed zone suggest that Yucca Mountain is located in a tectonically active area.

The section on structural geology and tectonics completely omits the possibility that low-angle normal faults may exist either beneath or within Yucca Mountain. In nearby areas, low-angle faults are important structures. For example, detachment structures (low-angle normal faults) are recognized in the Specter and Spring Mountains to the southwest of the NTS (Wernicke and others, 1984) and in the Sheep and Desert Ranges to the southeast of the NTS (Guth, 1981). Guth estimates that the area to the west of the Sheep Range extended almost 100 percent during the Miocene. Most of this extension was accommodated on low-angle detachment faults and not by classic basin-and-range-style block faulting. Near the surface in the Sheep and Desert Ranges, fault patterns are similar to those at Yucca Mountain (high-angle normal faults dip steeply to the west); however, at depth these normal faults may flatten and join a master detachment structure. Guth speculates that the Sevier-age (late-Cretaceous) thrust fault in the Desert Range may have been reactivated as a Tertiary detachment. He further speculates that this detachment surface may lie 1500 m below sea level.

It is important to determine fault geometry at depth at Yucca Mountain. Do the faults flatten with depth? If so, is there a detachment fault at depth? If such low-angle faults exist at Yucca Mountain, are they shallow enough to affect underground water flow? If Yucca Mountain lies within the upper plate of such a detachment, which rocks form the lower plate? It is important to understand how the Yucca Mountain block relates to basement geology. If Yucca Mountain has been detached from the basement, previous interpretation must be modified.

P. 3-14: The statement is made that "Moreover, some surface displacements at Pahute Mesa and Yucca Flat north of Yucca Mountain and along a trend between the Las Vegas Valley shear zone and the Walker Lane shear zone have been triggered by nuclear explosions"; and on p. 3-21, "Surface faulting in response to nuclear tests has been observed at Pahute Mesa and Yucca Flat."

Since surface faulting has occurred due to activities at the Nevada Test Site, it is reasonable to assume that underground faulting has occurred and will continue to occur. These additional faults could affect the velocity of the ground water and the likely paths it will follow. This possibility could cause a significant increase in travel-time, which could result in contaminated water reaching population centers within 10,000 years. If that increase in flow velocity were occurring at the present time, the site would be disqualified.

P. 3-15: Figure 3-5 shows locations of calderas, late Cenozoic normal faults, and a "few" strike-slip faults in the Yucca Mountain vicinity. There appears to be no figure in draft EA that shows the "rest" of the strike-slip faults in the Yucca Mountain vicinity. It is difficult to assess regional fault patterns and the relationship to the site when the information provided is incomplete.

P. 3-18: Figure 3-8 illustrates the location of the primary repository and possible expansion areas. Nowhere in the draft EA are these expansion areas discussed. If these areas are to be given serious consideration, potential impacts from characterizations of these areas must be addressed.

P. 3-19: The draft EA states that "One moderately sized fault, informally designated the Ghost Dance Fault, occurs within the primary repository area." Define what is a moderately sized fault. Is its size based on amount of displacement or fault length, or some other consideration? The potential impact of this fault on the proposed repository and repository performance should be discussed at length.

P. 3-19: The draft EA indicates that faults with evidence of lateral displacements (strike-slip motion) are only found north of the repository block. This conflicts with referenced reports (Spengler and others, 1979; and Spengler and others, 1981) that report slickensides in drill holes USW G-1 and UE 25 a-1. The EA should discuss the ramifications of strike-slip faulting within the repository block (as documented by USW G-1).

P. 3-19: The draft EA states that trenches across faults show "no unequivocal" evidence of movement within the last 40,000 years. The phrase "no unequivocal" is unclear, a double-negative, and connotes deception by DOE and its contractors. The State suggests that DOE revise this section to clearly reflect current knowledge on the age of fault movement as observed in trenches.

P. 3-19: The draft EA indicates the Ghost Dance Fault is thought to have between 8 and 21 m (26 and 69 ft) of vertical displacement. There appears to be no field data to support such a range of displacements. Given the uncertainty inherent in these numbers, it is important to determine the impacts of large displacements at the repository horizon and how that offset might affect repository design. The data presented in the draft EA seriously understate the potential faulting at the site and overstate the level of confidence that can be scientifically applied to the information that is presented.

P. 3-19: The draft EA states: "Displacement of Quaternary alluvium within about 10 to 20 km of the site is limited to a few very small degraded scarps less than a meter or so in height." The references do not support this statement. The U.S. Geological Survey (1984, Fig. 28) show numerous Quaternary faults within 20 km of the site, including Bare Mountain, Crater Flat, and Rock Valley fault systems, all of which have prominent scarps. The Bare Mountain scarp is about 4 m high, and the Solitario Canyon scarp is about 2.5 m high (Swadley and others, 1984, pp. 15, 18). Suggestions that such scarps are "very small, degraded" features are not consistent with the evidence.

3.2.3 Seismicity

P. 3-20: Figure 3-9 (Historical Seismicity in the Western U.S.) does not explain what the dots represent. The south boundary of the Southern Nevada East-West Seismic Belt (dashed line) should be located further south and should include the Yucca Mountain site. The evidence presented on Figure 3-9 clearly supports this change. Carr (1984) includes the Rock Valley seismicity, south of Yucca Mountain, in his delineation of the Seismic Belt. In addition, a seismic risk map of the conterminous United States prepared by the U.S. Geological Survey (see comments by John Schilling, Nevada Bureau of Mines and Geology) clearly indicates that Yucca Mountain is in a "major" seismic risk area.

P. 3-21: The draft EA states that geologic field evidence suggests that Yucca Mountain has been relatively stable for the past 11 million years. This statement conflicts directly with other statements in the draft EA (i.e., data on basaltic volcanism in Crater Flat, which ranges in age from 300,000 years to 3.7 million years; fault movement on Yucca Mountain documented to be 40,000 to 270,000 years old, and possible movement younger than 40,000 years old; and recorded seismicity). A conclusion that the site is stable is clearly not supported by field evidence.

P. 3-21: The second paragraph states that "Under the assumption that Yucca Mountain faults are not active, the peak deterministic acceleration computed at Yucca Mountain, resulting from the maximum earthquake is approximately 0.4g." The assumption that Yucca Mountain faults are not active is not valid nor is it supported by the existing literature. This statement is also incongruous in relation to another statement on the same page: ". . . until there is a better understanding of seismic cycles and of why seismically stable and unstable areas exist within the same structural province, earthquakes near Yucca Mountain should be considered possible."

P. 3-22: The letter from G. N. Owen, URS/John A. Blume & Associates, Engineers to J. L. Younker, Science Applications International Corporation, dated August 21, 1984, which discusses design and construction of nuclear facilities in tectonically active areas, should be cited in the reference section of the EA and a copy should be provided to the State for review.

P. 3-22: The draft EA states: "The age and length of fault displacements may not be reliable indicators of future earthquake size and frequency. . . ." Age of faulting, particularly in the Basin and Range Province, <u>is</u> an accepted parameter in neotectonic studies (see for example, Wallace, 1978) and is the only parameter that can be used to establish long-term slip rates. The statistical relationship between earthquake magnitude and fault length has been shown by Bonilla and others (1984) to have a very high correlation coefficient (r^2 = 99%) for some historic earthquakes in the United States.

<u>3.2.4.1 Energy Resources</u>

P. 3-22: No drill holes at or near Yucca Mountain are of sufficient depth to evaluate the geothermal potential. Warm ground-water is an indicator of possible geothermal resources, especially in close proximity to recent volcanics. Frequently in geothermal exploration drilling the thermal gradient is not linear; sharp increases in gradient occur at depth. Consequently, there is no foundation for the statement in the draft EA that "There is no evidence that Yucca Mountain contains any commercially attractive geothermal . . . resources." More research is needed before any conclusion can be drawn.

<u>3.2.4.2 Metals</u>

P. 3-23: The potential for metals exploitation cannot be assessed based on the evidence presented. Bell and Larson (1982) is a literature study; no rudimentary ground examination or geochemical sampling was performed. The comments of John Schilling, Nevada Bureau of Mines and Geology, identify additional literature that should be included. Most of the calderas in Nevada are mineralized. Crater Flat Caldera has ore deposits (and thus mineral potential) around its edge. There are known mineralization, prospects, and mines on the west and north flanks of the caldera. The eastern and southern flanks are buried beneath tuff and alluvium; however, these flanks can be expected to contain mineralization. Indeed, Spengler et al. (1981), in a reference cited in the draft EA, report gold and silver values from the Lower Tram Tuff in drill hole USW G-1. The true mineral resource potential of Yucca Mountain is presently unknown.

Reserve estimates of gold at the Sterling Mine are incorrect. Correct reserve estimates are 10,000 lbs. The mine is not considered small in terms of reserves.

The statement in the draft EA that "Yucca Mountain is not considered to have any potential for the development of metal resources. . . ." is unfounded given the current level of knowledge about the area.

P. 3-23: Natural resource exploration has been banned within the Nevada Test Site for the past 30 years. Therefore, the use of mines and prospects as indicators of economic resource potential is inappropriate.

3.2.4.3 Nonmetals

P. 3-24: It should be noted that the Bare Mountain Mining District contains the largest fluorite mine in Nevada and produces enough fluorspar for Nevada to rank number three in U.S. production. This is further evidence of significant mineralization within the vicinity of Yucca Mountain.

3.3.2.1 Ground-water Movement

P. 3-28: The statement that "Most of the annual precipitation . . . [at Yucca Mountain] is returned to the atmosphere by evaporation and plant transpiration" is poorly supported. A critical issue in this discussion is the quantity of water available for percolation to the vadose zone. Montazer and Wilson (1984) state that "probably less than 1 mm/year percolates through the matrix. . . ." This value has never been measured at Yucca Mountain and is consequently unsupported. Montazer and Wilson (1984, p. 2) state: "Average annual precipitation at Yucca Mountain is estimated to be 150 mm per year, of which about 0.5 to 4.5 mm per year becomes net infiltration." Nowhere do Montazer and Wilson (1984) report 1 mm/year for infiltration or percolation. The 1 mm/year figure is net flux.

The statement that most of the annual precipitation is returned to the atmosphere needs to be supported with data. Montazer and Wilson (1984, p. 52) state: "Many of the processes incorporated in the model are based on the presumed substantial difference between the relatively slow percolation rate in the Tonopah Spring welded unit beneath the block and the relatively larger net infiltration entering the system. However the net infiltration at Yucca Mountain principally is based on an application of regional analyses; thus, the rate is uncertain. Further definition of this rate is required to assess the accuracy of the flow condition described by the model."

P. 3-28: The statement is made that "Because water cannot move in the direction of higher hydraulic head, it is concluded that ground water in the tuff aquifers beneath Yucca Mountain does not enter the carbonate aquifer." Even if this statement is accurate (which it may not be), should the carbonate aquifer be the future source of water for Nevada, the hydraulic heads would change and the water originating at Yucca Mountain could conceivably enter the carbonate aquifer.

3.3.3 Present and Projected Water Use in the Area

P. 3-30: The title of this subsection is misleading since the discussion that it highlights deals only with current water use in the vicinity of the site. There is no assessment of water needs or utilization in the future.

Given Nevada's rapidly expanding population (the state was the fastest growing state in the country from 1970-1980) and the fact that much of that population (and much of the growth) has been in the southern part of the state, it is not unreasonable to assume that significant demands for additional water will be made as expansion continues during the next 50, 100, 500, or more years. Is it possible, for example, that water to support a booming Las Vegas Valley could be obtained from the aquifer beneath Yucca Mountain sometime in the next few centuries?

In addition, the possibility of rapid growth in the Amargosa Valley could significantly impact water usage in the area. Assuming that southern Nevada's population continues its rapid growth, the Amargosa Valley area is one that might be heavily impacted. It lies along a major transportation route (Highway U.S. 95); it is relatively close to metropolitan Las Vegas; and there is water potentially available in deep aquifers. Any analysis of water use in the final EA should consider the impacts of various growth scenarios on future water needs and potential utilization.

Note: An interesting aside to this discussion involves comparing the Las Vegas area as it was, say 150 years ago, with the Amargosa Valley today. Both places could be characterized by large desert expanses, sparse populations, and little or no apparent potential for rapid growth. Obviously, had there been a Department of Energy in 1835, and had that department attempted to estimate future water (or land) use in the Las Vegas Valley based on conditions that existed at the time, those estimates would have been considerably wide of the mark.

Pp. 3-30 and 3-31: The text indicates that the aquifer beneath Yucca Mountain may be connected to the aquifer in Amargosa Valley, where wells pump ground-water for domestic and agricultural use. If future studies document this connection, then there may be potential for contamination and health impacts to Amargosa Valley. Total water-use for the project is expected to cause only a very localized drawdown of regional water tables. Specific water-use figures for the program are not presented, so the magnitude of impacts on future water supplies cannot be assessed.

P. 3-31: The EA suggests that aquifers down-gradient from Yucca Mountain are declining due to extensive irrigation in Amargosa and Pahrump valleys. There is no discussion of the impact of these declining water tables on DOE's proposed water supply, and vice versa.

3.4.1 Land Use

P. 3-32: The draft EA discusses land use only in relation to present utilization patterns. It does not attempt to project what future land use will be (with and without a repository). Comments made relative to the need for a future-oriented analysis for water use apply equally to land-use issues (see above comments concerning Sec. 3.3.3). The final EA should contain a comprehensive discussion of both current and projected land-use patterns in the area of the site.

3.4.1.1 Federal Use

P. 3-32: The possibility that federal (i.e., DOE) activities involving the shipment of large quantities of highly radioactive materials through the state could result in the contamination of large tracts of range or agricultural lands is not discussed in the EA.

Even in the absence of major accidents that result in contamination, individual users of public lands in the vicinity of the site will incur substantial losses that are not addressed in the EA. There may be in excess of 78 square miles withdrawn from public use (plus additional withdrawals for new roads and rail lines). In addition, the BLM priority of multiple uses for public land may be seriously jeopardized should major development occur as a result of the repository and related projects. Existing land-use patterns could be dramatically altered.

The EA approaches the analysis of federal land use much too narrowly. It considers only the implications of federal use vis-a-vis the actual site. The final EA should assess federal land-use impacts in totality, including implications for all public lands in Nevada and any wide-ranging policy changes that may occur as a result of repository-related decisions or actions.

3.4.1.2 Agriculture

P. 3-32: The statement in this section of the EA that the Oasis Valley, the Amargosa Desert, the Ash Meadows area, and the Pahrump Valley are not considered to contain prime agricultural land is misleading and short-sighted. The Nevada Department of Agriculture points out that current trends--in the U.S. as well as in Nevada--suggest that more and more prime agricultural land will be put to other uses (subdivisions, industrial developments, etc.) while "marginal" lands (such as Oasis Valley, Pahrump, and Amargosa) become increasingly important in agricultural production.

The discussion of agricultural land use in the area around the site considers only present conditions. It does not (but should) consider future agricultural land use based on possible growth scenarios for the area. For example, prices of agricultural land could be increased as a result of subdivision or related commercial developments, thereby altering the character of the Pahrump and Amargosa Valleys from primarily agricultural regions to more urban/agriculture areas. Such a change would significantly increase the cost of agricultural operations.

3.4.1.3 Mining

P. 3-35: The discussion of land use for mining activities in the area of the site is inadequate. It refers only to the existing picture of mining in the region. It does not address the future potential for mineral exploration and extraction. (See comments relative to Sec. 3.2.4.)

3.4.1.5 Private and Commercial Development

Pp. 3-35 and 3-36: The final EA should examine the potential for private and commercial development in the area in the event that a repository is located at Yucca Mountain. In addition, the impact of future residential and commercial land development upon agricultural land and operations should be discussed in some detail. Unless development is evaluated in terms of potential future directions, any discussion of the issue is superfluous. The final EA must also discuss how planned development might impact the declining water supplies discussed on p. 3-31 and how water withdrawals for repository use might further contribute to those declining water supplies.

3.4.2.3 Special Interest Species

P. 3-41: The statement that "No plant or animal on the Nevada Test Site or in the study area (Figure 3-14) is currently listed, nor is one an official candidate for listing under the Endangered Species Act of 1973" is incorrect. Both the Mojave fishhook cactus (Sclerocactus polyancistrus) and the desert tortoise (Gopherus agassizii) are candidate species for federal endangered species taxa review (Federal Register, Vol. 47:5454 and Vol. 48:53640). The final EA should include a description of proposed mitigation strategies to protect these species.

3.4.6 Archaeological, Cultural, and Historical Resources

P. 3-47: The number and types of prehistoric sites in the Yucca Mountain vicinity would seem to suggest that the area has experienced something more than casual or transient occupation. How do the type and quantity of archaeological findings on and near Yucca Mountain compare with findings in other areas of the state? Is there reason to believe that the region surrounding the proposed site is in any way unique or especially significant in terms of Nevada's prehistory? Such questions should be addressed in the final EA. (See also the comments of the Nevada State Department of Conservation and Natural Resources in Chapter 4 of this compilation.)

P. 3-51: The report by URS/John A. Blume and Associates, 1982, "Survey of Historic Structures: Southern Nevada and Death Valley" should be cited in the reference section of the EA and a copy should be provided to the State for review.

3.4.7 Radiological Background

P. 3-51: The draft EA does not discuss the effects past weapons testing activities have had on background radiation levels in the area. A specific question that needs to be addressed is whether it is even possible to obtain accurate and reliable background radiation measurements given the amount of "artificially" induced radiation in the soil from bomb testing and other NTS activities. The final EA should examine this relationship in detail.

The draft EA notes that measurements of radioactivity in the principal NTS ground-water system during the 1983 measuring period showed only minor concentrations of tritium and other radionuclides. However, the text fails to identify whether Yucca Mountain is part of the NTS ground-water system and what the level of radioactivity is in Yucca Mountain ground water. There are also references to "other radionuclides" in the NTS ground water that are not defined. These should be clearly identified.

The draft EA also notes that some surface radioactivity remains from nuclear propulsion-systems tests performed on NTS. Jackass Flats, adjacent to Yucca Mountain, was the site of many of the nuclear propulsion tests. Is surface radioactivity resulting from tests in Jackass Flats present at Yucca Mountain?

3.5 Transportation

P. 3-56: The description of the existing and projected transportation network contained in this section of the EA is overly restrictive. It deals only with the elements of the transportation system between the site itself and the outer limits of the Las Vegas metropolitan area (for trucks) and between the site and the junction with the Union Pacific rail line at Dikes Siding (for rail). No consideration is given to the network of roads and rail lines within the Las Vegas area. Likewise, no mention is made of transportation routes into the Las Vegas area from the east, south, and west. Transportation alternatives to the site from the north are likewise not discussed.

The final EA should examine all aspects of the state's current and projected transportation system within <u>each</u> local jurisdiction (i.e., the City of Las Vegas, the City of North Las Vegas, the City of Henderson, Boulder City, and the City of Caliente) as well as county-wide for Clark, Nye, and Lincoln counties.

<u>Note:</u> Lincoln County and the City of Caliente are not even mentioned in the draft EA's discussion of transportation (or anywhere else), despite the fact that the main rail route to the site bisects the County and passes through the center of the City.

One way DOE might broaden its description of the transportation network would be to expand its definition of the term "site" for transportation purposes. Such an augmented description of the Nevada "site" would include all of southern Nevada (including Clark, Nye, and Lincoln counties); the major truck and rail corridors leading to Yucca Mountain from the northwestern and northeastern borders of the state; and even those areas immediately adjacent to Nevada (especially in Utah and Arizona) where major funnel effects of converging waste shipments begin to be felt (i.e., from Salt Lake City in the east and from the junction of I-40 and I-17 in Arizona). A case can also be made for including portions of I-15 and I-40 in California as part of the "site" when defined in broad, regional terms for transportation purposes. Such redefinition would assure that all local and regional impacts associated with waste shipment are identified and addressed.

3.5.1 Highway Infrastructure and Current Use

P. 3-56: As indicated above, the description of highway infrastructure is too narrow to encompass all aspects of the state's road transportation system potentially affected by a repository. The final EA should include an analysis of all possible routes (secondary and state roads as well as interstates) that might be used for transporting high-level radioactive materials into and through the state. Such a discussion should include identification of probable "trouble spots" (i.e., congested areas, bottlenecks, areas that are historically poorly maintained, areas of difficult or potentially adverse terrain or weather conditions, road segments subject to flooding, etc.).

In short, the information presented in Section 3.5.1 should enable readers to clearly understand (1) all the various possible road transportation routes for waste coming into the state, (2) all possible alternative routes through the Las Vegas area, (3) all possible routes to the site from other directions (especially from the north), and (4) all potential problem areas that currently exist in the described network. Displaying such an analysis in map form would provide graphic and readily understandable information that visually links possible truck transportation routes to the relevant aspects of the state's geography.

The Yucca Mountain project could mean Pahrump Valley and the corridor along U.S. 95 north of Las Vegas will expand. DOE assumes that settlement patterns of the new employees will be typical of Nevada Test Site employees of the past. Because of distances, difficulties in the commute, and the need for cost-effective housing, however, areas projected to grow by small degrees may actually boom. In one respect, growth in these outlying communities could behave much like mining towns in Nevada's past. The perception of growth will draw in a variety of people all eager for new economic opportunities. In the long run the proposed project could make areas like Pahrump Valley into detached suburbs of the Las Vegas metropolitan area.

Growth in these outlying areas would strain the existing transportation network, and there will be a need for new roads. A cycle will be started where better transportation increases growth, which strains transportation facilities and creates a need for a better transportation network. The project could put the State in the position of having to obtain the funding to plan, build, and maintain the transportation network this project will ultimately call for.

Finally, some alternate routing of waste disposal trucks must ultimately be agreed upon. This would, more than likely, take the form of getting trucks around heavily populated Las Vegas Valley and would result in increased use and related impacts to secondary roads. In looking at the existing highways, there are two possible candidates. First, if State Route 164 west of Searchlight were upgraded, trucks coming from the south, or I-40, north on U.S. 95 would not have to travel completely through the Las Vegas Valley if they were diverted onto S.R. 160 via I-15 and S.R. 161. Second, a bypass of Hoover Dam must be considered.

Examination of such growth and routing potential (both with and without a repository) and the attendant effects on highway infrastructure, especially in southern Nevada, should be considered as part of the analysis continued in the final EA. There should be a comprehensive discussion of future, as well as current, highway infrastructure and usage.

3.5.2 Railroad Infrastructure and Current Use

P. 3-60: As indicated above, any description of infrastructure and use (be it for roads or rail) should deal with future (projected) as well as current conditions.

The description of the rail system serving the Yucca Mountain site is sketchy and incomplete. As suggested in the comments relative to the transportation network in general (Sec. 3.5) above, the "site" needs to be more broadly defined to encompass key elements of the rail network that bear directly on the shipment of waste into and through the state, including rail corridors through Lincoln County and through the northern, central, and eastern portions of the state. The "site" might also include areas outside Nevada proper, where major "funnel" effects begin to be strongly felt (i.e., the rail corridor from Salt Lake City through southeastern Utah and, possibly, rail corridors adjacent to Nevada in Arizona and California).

The draft EA also fails to describe the rail system in terms of performance characteristics (i.e., including such elements as accident rates along the various sections of track, areas with historical problems such as flooding and road-bed erosion, etc.) and potential trouble spots (such as major crossings, bridges, difficult terrain, weather conditions, etc.).

The document (p. 3-62) indicates that "because of its centralized traffic control system, good maintenance, and frequent sidings, the Salt Lake City to Barstow section of the Union Pacific line should be at the high end of this range" (referring to 25-54 trains daily as determined in WESTPO, 1981). This is a judgmental statement not supported by specific study. A specific evaluation of the Union Pacific line through Nevada is needed before any firm conclusion on line capacity can be drawn. This is particularly necessary as certain sections of the line through Nevada may be shown to require capital improvements in order to bring the entire line up to a sufficiently high traffic capacity necessary to service shipments of nuclear waste to NTS.

An analysis should be done to determine the frequency and magnitude of accidents/incidents that have occurred on that portion of the railroad between Las Vegas northward to the Utah border. Specific attention should be paid to the area of Caliente, Nevada.

Even if the Union Pacific Railroad (UPRR) is a well maintained Class-A mainline as noted in the draft EA (although there is serious question regarding the appropriateness of that designation), the present state of the art in safety devices does not preclude a serious derailment accident from occurring but merely warns the train crew of possible problems.

One specific area not addressed in the draft environmental assessment concerns an industry trend to eliminate the need for a caboose at the end of each train, more for economic reasons than operating or safety consideration. The cabooses are being replaced with electronic monitoring devices that record certain operating characteristics on the train. A recent incident occurred on the UPRR mainline in southern California when equipment broke loose on a flatcar and swung transverse to the train, taking out wayside signals and crossing warning gates for several miles before the train could be stopped. This points out the fact that the electronic equipment is not infallible and that perhaps a manned caboose could have discovered the problem sooner and <u>prevented</u> a more serious problem. A derailed car can also be dragged many miles, taking out anything in its path until the entire train derails. Current trends indicate a possible change in state law amending the "full crew law" allowing the railroad companies to operate trains with a minimum five-man crew (NRS 705.390). This action combined with the removal of cabooses does not allow observation or contact with the rear of the train. Such a situation could have serious consequences in the case of a train carrying high-level radioactive waste and points up the need for a comprehensive analysis in the final EA of railroad-industry operational trends and what these might mean for future shipments involving nuclear materials bound for a repository in Nevada. An examination of state and federal laws relative to rail operations and safety should also be included in the final document.

Another area of concern not addressed in the draft EA involves alternate rail system routes for nuclear waste shipments across Nevada. The Southern Pacific line, for example, that bisects the cities of Reno, Lovelock, Winnemucca, Battle Mountain, Elko, and several smaller communities is not currently maintained to the same standard as the Union Pacific line from Salt Lake City to Barstow. The accident risk factor for this (and other) lines is also higher since it contains many more at-grade crossings (167 in Nevada alone).

The "written communication" from Ms. N. Nunn, Marketing Manager, Union Pacific Railroad Company, Omaha, Nebraska, 1983, that was noted in the last paragraph on p. 3-60 and again in Table 3-10, p. 3-62, should be formally cited in the reference section of the EA, and a copy should be provided to the State Nuclear Waste Project Office.

<u>3.6 Socioeconomic Conditions</u>

P. 3-63: The discussion of socioeconomic conditions contained in Chapter 3 (and throughout the document) includes only Clark and Nye Counties, and those only in the aggregate. The City of North Las Vegas does not appear on any maps in the draft EA. Lincoln County and the City of Caliente, which encompass the Union Pacific rail line along which at least 70 percent of the waste destined for a repository will be shipped (according to DOE's estimates), are not even mentioned. In this regard, Figure 3-21 should be retitled to reflect the "Tricounty area surrounding Yucca Mountain." The Moapa River Indian Reservation, which borders the major transportation corridors to the site, is likewise ignored.

In terms of describing social and economic conditions with regard to the potential siting of a repository in Nevada, it may be useful to define the entire state as the "site" for the purpose of socioeconomic analyses. While certain local and county conditions are especially relevant to the repository project (employment, population, community services, and infrastructure), there are broader, statewide conditions that should be described--and included as part of the analysis of impacts later on. These include: the overall character of the state's economy (especially the emphasis placed on tourism and gaming); the relationship of various sectors of the state's social and economic fabric to counterpart components at the county and local levels (such as social services, education, welfare, employment and unemployment services, etc.); and the relationship of state government and state finances to local and county governments. Because certain elements of state and local functioning tend to be so tightly interwoven, it is difficult--even misleading--to attempt to describe one without describing its relationship to the other.

Another criticism that pertains to the entire treatment of socioeconomic conditions in the draft EA has to do with the source documents used to obtain data that is presented. In many cases references for conclusions are not cited. In others, source documents that are referenced do not substantiate data quoted in the draft EA. The McBrien-Jones report (1984) data on Clark and Nye County employment figures and trends is an example. Even though figures are developed, it is never demonstrated how numbers are arrived at. Finally, some information is referenced as having been obtained from newspaper articles. While newspapers may be valuable tools for identifying direction for study and spotting helpful sources of data, they should not be relied upon in a scholarly research document as primary sources of socioeconomic information, especially when that information is readily available from more reliable and generally accepted sources.

Overall, the information contained in the draft EA relative to socioeconomic conditions reflects haphazard data collection and generally shoddy data integration and analysis.

3.6.1 Economic Conditions

P. 3-63: The draft EA shows hotel/gaming/recreation employment at 121,000 but the date is not specified. In 1984, annual average hotel/gaming/recreation employment according to the State Department of Employment Security was 114,800--or 28.5 percent of total employment. The EA also lists other key "employers" but does not address mining, which has a significant dollar value contribution to the state economy.

The second paragraph of 3.6.1 states: "Combining real per-capita income projections from the OBERS forecast of the Bureau of Economic Analysis, U.S.

Department of Commerce, with the most recent University of Nevada, Reno, (UNR) population forecast shows that Nevada real personal income expected to more than double between 1984 and 2000, growing at an average annual rate of 4.8 percent."

This statement is typical of many contained in the socioeconomic sections of the EA. It describes a conclusion reached by somehow integrating diverse sources of information. Yet nowhere is it explained how (i.e., by what methodology) the data are combined to reach the claimed result.

3.6.1.1 Nye County

P. 3-63: The EA states that in 1980, 6,700 workers were employed in Nye County, but by 1982 there were 7,508 workers. State Department of Employment Security (ESD) records place 1982 employment at 8,640 jobs. Note that the draft EA interchanges jobs, persons, and employment--mixing labor force and industrial employment concepts. This results in data that are of questionable utility.

The report states that 80 percent of 1982 industrial employment was in mining, service, or government. ESD records indicate 87.6 percent.

The document goes on to indicate, "As in most of the United States, the service industry is the largest employer in Nye County, but the area's character is better defined by its other large employers: mining, construction, and government" (emphasis added). According to ESD administrative data, industrial employment by order of size in Nye County during 1983 included:

1)	Service	67.4%
2)	Mining	13.1%
3)	Government	8.8%
4)	Trade	5.1%
5)	F.I.R.E.	1.7%
6)	T.C.P.U.	1.6%
7)	Construction	1.3%
8)	Manufacturing	1.0%

Note: Construction made up less than 1.5 percent of total employment.

The written communication from L. Ryan, Director, State Office of Community Services, Carson City, Nevada, 1984, mentioned in last paragraph on p. 3-63 should be cited in the reference section of the EA.

Table 3-11: This table, "Employment in selected industries in Nye County, 1978-2000," reflects questionable data.

Is it supposed to estimate the number of persons employed by industry or the number of jobs provided by employers? Usually industrial employment projections are based on establishment-based industrial employment, or the number of jobs, not people employed; these are different concepts.

Historically, Nye County industrial employment has been growing at an average annual rate of between 2 and 3 percent between 1970 and 1983. Data from the first six months of 1984 seem to indicate the 1983-1984 growth will be somewhat higher, around 4.5 percent. More importantly, however, are the 1978 baseline numbers reflected in the table. ESD records show total 1978 industrial employment at 5,390, not 7,909. This is a 46.7 percent discrepancy in employment levels between State figures and those contained in the draft EA. These employment levels, as well as individual industry levels, should be re-evaluated.

The narrative used in describing Nye County could be very confusing. The time frames of data cited jump from one year to the next in some paragraphs. For example, the 1980 total industrial employment level is cited, followed by 1982 distributions.

The second paragraph on p. 3-63 states that the baseline forecasts arrived at in Table 3-11 "are based on OBERS projections, adjusted to make them consistent with more recent University of Nevada, Reno, population growth forecast for the county." However, there is no explanation--either in the EA itself or in the reference documents--as to how these forecasts are "adjusted." The final EA should clearly describe the methodology by which such conclusions were arrived at.

3.6.1.2 Clark County

P. 3-66: The percent distribution of industrial employment for Clark County according to the State Department of Employment Security (ESD) is as follows:

	Draft EA	ESD
Mining	--	.2%
Construction	6.0%	6.4%
Manufacturing	--	3.1%
T.C.P.U.	6.0%	6.0%
Trade	21.0%	20.1%
F.I.R.E.	--	4.7%
Service	48.0%	47.2%
Hotel/Gaming/Recreation	--	31.7%
Government	12.0%	11.7%

The final EA should be revised to reflect more accurate and complete information.

3.6.2 Population Density and Distribution

Table 3-12: In reviewing the data presented in Table 3-12, significant discrepancies are apparent when compared to ESD administrative data and projections of employment levels.

As in the Nye County evaluation it would appear establishment-based industrial employment or jobs is being discussed, but the table again refers to "numbers of persons employed." Furthermore, the base year numbers vary significantly from ESD administrative data on industrial employment. The data show 1978 total Clark County industrial employment was 189,400 jobs, while the table reflects 215,758 persons employed. This is a 13.9 percent discrepancy in base year employment levels.

Current administrative data (1984) indicates that the growth rates used on the table between 1978 and 1985 will be very difficult to achieve. Total industrial employment in 1984 was 239,600 jobs. The table reflects 322,096 jobs in 1985. To achieve this level the Las Vegas total industrial job growth between 1984-1985 would have to be nearly 35 percent. ESD data indicates annual average growth in the total number of jobs between 1978 and 1984 was around 4 percent. Job growth in recent years has been somewhat higher at just over 5 percent between 1983 and 1984. ESD anticipates that job growth will increase to an annual average of around 5 to 5.5 percent through 1990. Therefore, 1990 employment levels should be around 327,000 jobs. This is significantly less than the 370,221 reflected in Table 3-12.

Because it appears that serious discrepancies exist in the information that has been presented, Clark and Nye County data should be completely re-evaluated. Input should be solicited from various agencies that are recognized to be responsible for the generation, projections, and interpretation of the kinds of data used in this report.

3.6.3 Community Services

P. 3-70: Data on community services contained in the draft EA is incomplete because it does not include information relative to Lincoln County, the City of Caliente, or the Moapa River Indian Reservation--jurisdictions that will be significantly impacted by the siting of a nuclear waste repository at Yucca Mountain. The final EA must include such data.

In addition, the document should examine services provided by the state that directly affect local governments and local communities. Such services include welfare functions performed by the state, employment and unemployment services that are the responsibility of state government, education, mental health, alcohol and drug abuse, and other such services directly provided or funded by state government.

Any attempt to describe community services at the local or county level without describing the interrelationships between state government and localities with regard to each of those services will be seriously deficient.

A general criticism that applies to all subcategories of community services discussed in the draft EA has to do with the ultimate value of presenting quantitative descriptions of services (i.e., number of schools, gallons of water used per day, numbers of police or fire personnel per capita, etc.) without attempting to put those figures in some sort of perspective. The fact that Nye County's water demand is 2,472 m^3/day (0.653 million gallons per day per 1,000 persons) is relatively useless unless we know what is the <u>capacity</u> of the county's water supply resources. Likewise, to say that there are 3.53 commissioned police officers in Nye County for every 1,000 people is not very helpful unless we know whether Nye County is above or below other parts of the country in this regard. Consequently, the final EA should not only express community service conditions quantitatively, but it should also draw substantiated conclusions as to the adequacy of those conditions as they currently exist.

Finally, no treatment of community services for Clark County can be considered adequate unless it specifically addresses the effects that massive numbers of tourists have on the type, level, adequacy, and overall status of each service subcategory.

3.6.3.1 Housing

P. 3-70: In addition to describing the number and types of housing in all three affected counties (together with vacancy rates), the draft EA should examine in detail the financial and building industry underpinnings of the housing situation in each locale. What financial institutions are involved in providing funds for both private individuals and commercial developers? What is the condition of the banking industry that serves the tri-county area, and how is that condition likely to change over the next 20-30 years? What is the status of the construction industry in each area? What demands are expected on that industry over the next 20-30 years, and what do such demands imply in terms of meeting demand for housing?

In short, housing should not be looked at simply in terms of how many dwellings there are and whether or not all are occupied. "Housing" is a complex integration of many key sectors of area activity. It is affected not only by existing supply and demand but also by extraneous variables as diverse as the behavior of interest rates and the ability of local contractors to hire workers and obtain materials at reasonable costs. The treatment of "Housing" in the draft EA is overly simplistic and one-dimensional.

3.6.3.2 Education

P. 3-70: Table 3-18 and the discussion in Section 3.6.3.2 reveal little about the adequacy of the existing school system in each county (Lincoln County and the Moapa Reservation are entirely missing). There is no indication, for example, whether certain schools in specific areas of Clark County are overcrowded or whether students from various areas of sparsely populated Nye County (or Lincoln County) must be bused for long distances. The final EA should examine the qualitative aspects of education in each county/community--at least as these relate to overcrowding, busing requirements, student-teacher ratios per school, etc. Aggregate information such as that presented in the draft document is relatively useless, except in very general applications.

Another area relative to education that will have significant bearing on the various school systems' abilities to handle repository-related enrollment increases has to do with the physical condition of existing school buildings. Are some schools likely to need replacing within 20 years? What about the maintenance or renovation needs of existing facilities to meet projected population increases? Will local government be able to finance needed replacement and/or maintenance and renovation? How are changes in educational needs in affected communities likely to affect state revenue requirements in the years ahead--since the state provides much of the money for education?

These and other such questions should be considered in the final EA section on education.

3.6.3.4 Sewage Treatment

P. 3-76: Without some evaluation as to the adequacy of existing sewage treatment capacity in each local community, the discussion of this subject in the draft EA is less than meaningful. Are existing facilities at, or close to, capacity? What impact will projected future growth in the various areas have on the adequacy of treatment systems? How do local governments finance improvements/additions to sewage facilities?

P. 3-78: Table 3-21, "Wastewater Treatment Facilities in Clark and Nye Counties" is inaccurate and incomplete. Data on capacity (MGD) for Boulder City, Clark County, and Las Vegas are inaccurate. The peak demand column does not make any sense. Lincoln County facilities have been overlooked as well as the other Clark County wastewater facilities. Communities that need to be incorporated include: Blue Diamond, Paradise Spa, Panaca, Pioche, Caliente, Alamo, Tonopah, Gabbs, Laughlin, Overton, Searchlight, and Mesquite. The listed facilities showing no data in the table are regulated by the State Division of Environmental Protection. Data can be obtained from that agency.

These and other such questions should be considered in the discussion of sewage treatment in Section 3.6.3.4.

3.6.3.7 Public Safety Services

P. 3-79: Any discussion of police and fire services within the surrounding counties must be integrated with some evaluation as to the adequacy of existing services. It is suggested that the final EA contain standards of adequacy for rural and urban police and fire operations. Such standards, which should be developed using substantiated data and a defensible methodology, could then be applied to conditions in Nye, Clark, and Lincoln County communities to determine the status of current and projected service conditions.

Simply evaluating the numbers of fire and police personnel in relation to county populations does not adequately reflect conditions in local communities. Where are fire and police stations located geographically? Which stations tend to be overstaffed or overutilized, and which tend to be understaffed/underused? What is the condition of the equipment that is essential to perform public safety services? How do citizens feel about the adequacy of existing police and fire services? These are the kinds of questions the final EA should address.

Because public safety services are being examined in relation to a nuclear repository, the final EA should discuss, in detail, the capacity of local police and fire departments to respond to emergencies involving radioactive materials. The availability of trained personnel; the availability and location of specialized equipment; the degree of cooperation among various local, county, and state entities involved in responding to any such emergency; and other relevant issues should be addressed.

Finally, the role and status of state public safety services operating within local jurisdictions should be addressed. Such state entities include: the Nevada Highway Patrol, the State Division of Emergency Management, the State Fire Marshal, the Radiological Health section of the Division of Health, the Division of Environmental Protection, and any other state agency that may be relevant.

3.6.3.8 Medical Services

P. 3-81: The draft EA accurately portrays Nye County and parts of Clark County as areas having severe shortages of doctors and other health-care personnel and facilities. Lincoln County is also a priority 1 area and should be included in the analysis.

It is not enough for the document to merely note shortages in this critical service area. There should be some attempt to project what the current medical service situation means in terms of future growth projections for the area. Is it likely that more doctors will be attracted to the area simply because there will be more people--or are there other key variables (such as the characteristics of rural living, isolation, distance from major urban amenities, etc.) that will continue to keep the numbers of doctors (and other health professionals) low? What effect will future growth in the Amargosa, Pahrump, and Beatty areas have on overall health care? Are new facilities (hospitals, partial care facilities, etc.) likely to be needed? These and other questions should be addressed in relation to medical service conditions in the area.

3.6.4 Social Conditions

P. 3-83: The draft EA states that Section 3.6.4 is intended to present a preliminary description of sociocultural characteristics of southern Nevada. However, a major area affected by the repository, Lincoln County, is nowhere addressed. No discussion of social, cultural, or economic conditions can be complete if it excludes Lincoln County communities. The Moapa Indian community is also ignored. The document goes on to explain that communities potentially affected by the transportation of radioactive waste are not included for consideration in this section because transportation routes have not yet been identified.

There are only a limited number of possible transportation routes within the state that would service a Yucca Mountain site. It is inappropriate to ignore communities along those routes. They are easily identified. All rail shipments will pass through Lincoln County, the City of Caliente, and the Moapa Reservation. Truck shipments must pass through the cities of Las Vegas and North Las Vegas as well as portions of Clark County served by I-15, U.S. 95, and U.S. 93. Henderson and Boulder City would be affected by shipments coming from the south and the east (from California and Arizona). There is no reason why each community along these routes should not be included in the analysis of social conditions (as well as all previous and future discussions relative to the socioeconomic implications of the repository).

The omission appears to seriously impair the transportation impact analysis included in Chapter 5 of the draft EA. In Chapter 5, two scenarios of transportation are evaluated. Those include 100-percent truck and 100-percent rail shipments. The draft EA must include an analysis of the effects of both rail and truck transportation in at least Lincoln, Clark (including Moapa), and Nye Counties. The range of routing alternatives is very narrow. Consequently, an impact analysis of transportation effects on social conditions should be included within the scope of the final EA.

3.6.4.1.1 Rural Social Organization and Structure

P. 3-84: The description of Nye County population as "fairly homogeneous" may be somewhat misleading. While, in the aggregate, county population figures reflect a demographic mix of people, in actuality there are significant racial divisions. A large number of Native Americans reside in the county, but they tend not to be evenly distributed throughout the area. Rather, they reside in somewhat segregated sub-communities. Likewise, as much as half of certain areas of the county are Hispanic.

A more useful approach for describing population characteristics of the county would be to describe each area/community (especially those close to the site and likely to be affected by inmigrating repository workers) in terms of its unique ethnic, age, sex, racial, and even religious composition.

P. 3-86: The draft EA states that "inmigrants would be most likely to settle in those rural communities that provide services and amenities." The text then identifies Amargosa, Pahrump, and Beatty as most likely for inmigrant settlement.

Many variables affect where workers (and their families) ultimately settle. Availability of amenities and services is certainly one such variable. However, there are others that are of equal--or greater--influence: distance from the work site; the "fit" between the inmigrating worker and the racial, ethnic, religious, and economic composition of the community; characteristics of individual inmigrants (i.e., whether he/she is used to urban or rural living); the degree of acceptance within each community of new (and possibly "different") workers, etc.

The treatment of social organization in Section 3.6.4.1.1 is weak. While population demographics are described in general terms, there is little extrapolation of that information to describe how these various population groups within the various communities function and interact. In short, there is no description of the dynamic interplay of relationships that characterize each community and make it unique. And because this type of "portrait" is missing, it is impossible to evaluate how inmigrating workers and families will affect the social and organizational mix.

3.6.4.1.2 Social Organization and Structure in Urban Clark County

P. 3-87: Comments made for Section 3.6.4.1.1 above apply equally to the treatment of Clark County in this section.

For the purpose of this analysis (indeed, throughout the EA), Clark County should not be treated as a single unit. Instead, the EA should examine the social organization and structure of each jurisdiction within the county, with special attention given to those communities--or even neighborhoods--in the Las Vegas metropolitan area where prospective repository workers are most likely to settle.

3.6.4.2 Culture and Lifestyle

P. 3-87: The text suggests that the heterogeneous nature of the culture of Nye and Clark Counties will facilitate the assimilation and acceptance of a variety of subcultures. The implication is that inmigrating repository workers will be easily absorbed into the cultural matrices of the two counties.

This conclusion is not substantiated by information in the EA or in referenced materials. At best it is an overly simplistic assumption that is based on the perception of inmigrant worker settlement behavior as driven solely by the desire for racial, ethnic, or other cultural compatibility. It is at least as likely that the nature of the repository project and the transient characteristics of workers drawn to it (during the construction phase especially) will result in settlement patterns very much at odds with the existing cultural composition of certain communities. For example, large numbers of urbanized construction workers, who are either single or without their families, might settle in Amargosa to be close to their work.

In short, it is inappropriate, given the level of data and the paucity of research, to suggest that the heterogeneity of the area (if, in fact, it is truly heterogeneous) will automatically facilitate absorption of outside workers.

3.6.4.2.1 Rural Culture

P. 3-88: The discussion of rural culture as it applies to the area surrounding the site is far from inclusive. Rural Lincoln County, Caliente, and the Moapa Reservation are not even discussed. Rural communities in Nye and Clark Counties are given barely passing mention. To be useful, an examination of the characteristics of "rural culture" should be community-specific so that the key elements of unique cultural manifestations in each community can be identified and the potential for repository impacts examined.

Since the effects of boom-and-bust economic cycles have had such major impacts on Western rural culture in general, and in Nevada's rural communities in particular, a fairly comprehensive discussion of the extensive literature on "boom-bust" communities in the West might be very appropriate in this section.

Finally, the major cultural group in the area of the repository is comprised of Native Americans--living either on reservations (such as Moapa River or Duckwater), within local communities, or in isolated groups. Yet the draft EA concludes only that the reservations are "distant from Yucca Mountain" and, presumably, not affected.

The Moapa River Reservation is adjacent to major rail and truck transportation routes for radioactive waste shipments. It is quite definitely affected.

The Shoshone people continue to claim the land on which the site is proposed to be built. An understanding of their culture and its reverence for the land will be essential if ongoing conflict between repository interests and Indian interests and culture is to be avoided.

3.6.4.2.2 Urban Culture

P. 3-88: Clark County (the Las Vegas area in particular) is a unique urban community. The draft EA correctly highlights the key role that tourism and gaming play in influencing the cultural variables of the area.

However, the suggestion that there is, in fact, a basic division between people who work in gaming and people who do other things is overly simplistic. In fact, many people who are employed in "regular" jobs also work in gaming-related capacities at the same time.

The more significant impact that is felt as a result of gaming in Las Vegas is the large influx of tourists every year. These tourists have dramatic effects on the way area residents live, work, play, worship, etc. The EA should focus on the influences of tourism--including its importance to the social, cultural, and economic fabric of the community--rather than on a less-than-substantiated division between gaming and other facets of community existence.

The urban "culture" in Clark County is rich and varied. Black, Hispanic, Asian, Indian, Mormon, and other influences are strongly felt. There is a dynamic interplay of "Old West" and southern-California-style metropolitan characteristics. Las Vegas and all of Clark County are areas of extremely rapid growth--with all the stresses, opportunities, and problems that implies.

The draft EA's attempt to describe the "urban culture" of Clark County in one short paragraph is inadequate. It is also reflective of a central flaw present throughout the document. Instead of simply stating that DOE does not have sufficient data to be able to adequately analyze the subject, the draft EA makes one or two broad characterizations or observations (often unsubstantiated) and then attempts to draw conclusions (either in conjunction with the analysis or later on in the EA).

3.6.4.4 Attitudes and Perceptions Toward the Repository

P. 3-90: Because of the lack of real research in this area, it is questionable why the section was included. The draft EA mentions a survey that contained one question asking whether Las Vegas area residents favored, opposed, or strongly opposed locating a repository "on the Test Site in southern Nevada." The draft EA then reports that "a majority of those surveyed opposed the idea; six percent were undecided."

It would be instructive to know what is meant by "a majority." Since the six percent figure is known for the undecideds, why was the figure for those opposed not expressed in terms of a percentage? Since the repository will actually be built off the Test Site on public lands, would respondents' answers be even less favorable if that fact were known?

The attitudes and concerns of citizens that were expressed during the March 1983 public hearings (as reported on p. 3-90) serve to emphasize the need for greater attention to and emphasis on the transportation and emergency preparedness aspects of the repository program. To date, DOE has relegated transportation to a secondary (or lesser) role in its analysis and decision-making. Given the extremely high profile that waste transportation commands, and given the high degree of public concern, transportation issues should have been weighted much more heavily in the EA than they are.

3.6.5 Fiscal and Government Structure

P. 3-90: The draft EA does contain some data on governmental services and revenues by source, but baseline data needed to conduct an analysis of fiscal impacts to state and local governments as a result of the repository are not provided. Simply presenting revenue statistics for local governments is insufficient. Data relative to costs associated with various services and functions of government must be presented to make revenue figures meaningful. In other words, balance sheets should be developed showing the net effect on local communities (and on the state) relative to the income and outgo of revenues needed and used by localities (and by the state under its obligations to those localities).

It should also be noted that revenues tend to lag behind population growth. People live in an area, and may demand full services upon arrival, but they have not contributed tax revenues via sales or property taxes until they have lived there for a longer period. Thus expenditures for inmigrants generally must be made before noticeable revenues are paid by them.

SPECIFIC COMMENTS ON CHAPTER 4

EXPECTED EFFECTS OF SITE-CHARACTERIZATION ACTIVITIES

Introduction

P. 4-1: This section should include a detailed discussion of DOE, State, and NRC interaction regarding the submission and review of draft site-characterization plans. This discussion should include DOE's perception of the sequencing of such interaction, the timing for receipt of comments, the conduct of public hearings, the initiation of exploratory shaft construction, and related matters.

The final EA should also acknowledge that at the time of release of the draft EAs, DOE had already begun development of site-characterization plans for the Hanford and Yucca Mountain sites without any State involvement although the NRC had been consulted. By initiating the development of site-characterization plans prior to finalizing the draft environmental assessments, DOE is prejudging the outcome of public hearings and public comment on the draft and seems to confirm the public's perception that DOE has preselected Yucca Mountain and Hanford for site characterization. It is this type of insensitivity to public involvement that is causing public confidence in this program to erode. It is also contrary to the Congressional mandate that the program be conducted in a manner that seeks to build confidence.

P. 4-2: The draft EA indicates that the data-gathering program planned for site characterization will include non-geologic information. Despite this, a detailed description of data-collection plans is only provided for obtaining geologic information. The draft EA needs to be modified to include a detailed description of the scope of the data-gathering and analysis process to be used to meet all non-geologic information needs described on p. 4-1.

Will site characterization studies and the environmental impact statement include an evaluation of possible impacts to Lincoln County and the City of Caliente? Why were not predecision impacts (i.e., negative public perception) included in the draft EA? The EA should address these questions in Chapter 4.

4.1.2 Exploratory Shaft Facility

P. 4-9: The draft EA indicates that the exploratory-shaft facility will be located in Coyote Wash on the eastern side of Yucca Mountain and refers to Figure 4-2 (p. 4-10), which shows that location. There appears to be no figure in the draft EA that depicts the location of the exploratory-shaft facility in relation to the proposed repository block. A review of various maps and figures in the draft EA suggests that the exploratory shaft is located at the eastern edge of the repository block. Given this location, will site characterization activities proposed for the exploratory shaft (Sec. 4.1.2.4) be adequate to sufficiently characterize the host rock throughout the complete block? To properly answer this question, DOE should discuss completely in the EA the decision process that led to the Coyote Wash location for the exploratory shaft. The discussion should include the criteria established for the decision, the data base applied to that criteria, identification of other locations considered but not selected, and the DOE approval process for the decision. The draft EA does not lend much confidence that the selection of Coyote Wash was based on sound, credible technical judgment or that it is the optimal exploratory-shaft location for site characterization.

Also absent in the description of the exploratory-shaft construction is a discussion of the various regulatory requirements that will have to be complied with. The document should provide a clear description of the regulations that are applicable including the Federal Mine Safety Act, the Occupational Health and Safety Act, Nevada State mining regulations, State air- and water-quality regulations, etc. This description should include the actual regulations and demonstrate how DOE will ensure compliance.

4.1.2.1 Surface Facilities

P. 4-9: Section 4.1.2.1 describes the construction of the exploratory shaft surface facilities. According to the text, approximately 2 million cubic feet of fill material will be required to construct the site pad. Construction of an engineered pad, like proposed in the draft EA, requires application of water to promote proper compaction. There is no mention of water requirements for this construction. We are concerned that the application of water for construction could compromise any data gathered relative to in-situ moisture in the exploratory shaft and tunnels.

Since the exploratory shaft is to be constructed in Coyote Wash and would, in all probability, become an integral part of the disposal facility if it is built at Yucca Mountain, the use of the 100-year storm event to design flood protection is questionable. With a 100-year return period, that event has a 1 percent probability of occurrence during any given year. If that event or a greater event did occur during the proposed characterization period, it could negate the viability of the site through introduction of large quantities of water directly into the repository block. It would seem prudent, given the significance of the proposed waste repository, to base the level of protection for the facility on the "Probable Maximum Precipitation" (PMP) concept that is widely used in hydrologic design, specifically when considering dam safety. It would appear that this potential site is at least as important as the numerous small dams throughout the country that are required to meet the "PMP" safety standard.

Pp. 4-11 to 4-13: We find the design of the sewage lagoon and the rock storage pile, and the runoff diversion discharge points unacceptable. The draft EA indicates the sewage lagoon will be an unlined containment structure for the storage of apparently raw sewage. It is proposed to add water to promote percolation into the unsaturated zone alluvium. The rock storage pile will contain rock debris from excavation of shafts and tunnels, excess drilling fluids, and any waste water not disposed in the sewage lagoon. The storage pile is designed to contain 375,000 gallons of liquid. We have two concerns with these designs: (1) percolation of fluids into the unsaturated zone may compromise in-situ measurements of natural moisture content and flow (no percolation rates are provided), and (2) percolation of sewage effluent and other waste fluids from a concentrated location could promote undue harm to the environment. (No data are presented on the environmental impacts from the design).

The State insists the design of lagoon and storage pile be re-evaluated to include lined containment structures with appropriate leak-detection facilities or the waste fluids be transported to an appropriate disposal facility.

Figure 4.3 suggests the runoff diversions around the exploratory shaft site will discharge into or adjacent to the sewage lagoon and the rock storage pile. This design raises the question whether the containment structures can accommodate the discharge of a 100-year storm event from the diversion structures. We believe not. The diversions should be redesigned to route runoff around the containment structures and down natural drainage channels.

P. 4-13: The proposed plan based on encountering perched water in the vadose zone should also include accurate chemical analyses of this water. Since saturated zone J-13 water is utilized for laboratory experiments and there is serious question concerning the validity of this methodology, all water encountered in the vadose zone should be collected and analyzed. Observations by the Desert Research Institute indicate that vadose water was encountered in UZ-4 at a depth of 81 to 86 feet below the surface. Core sections recovered were saturated and observations indicated "water running in hole." This zone of perched saturation occurred near a thin layer of clay in the non-welded base of the Tiva Canyon Formation. We suggest that the chemical analysis of this vadose water be reported in the final EA.

P. 4-13: The description of ventilation fans includes the statement: "The ventilation system would meet all the requirements of the Tunnel and Mine Safety Orders of the State of California" (emphasis added).

DOE should explain the inclusion and applicability of California State regulations in this section, especially since there is no discussion of Nevada or federal regulations.

4.1.2.2 Exploratory Shaft and Underground Workings and
4.1.2.3 Secondary Egress Shaft

Pp. 4-14 and 4-15: The draft EA indicates that water will be utilized in the excavation of the exploratory shaft and underground workings, and when used will be tagged with a suitable tracer. We oppose the use of water during any excavations or drillings of the unsaturated zone. The tagging of excavation water can differentiate from in-situ water in identification only, not quantity. The presence of tagged water prevents the measurement of volume or chemical analysis of in-situ water. Is sodium bromide a suitable tracer, given the potential sorption characteristics of the host rock?

4.1.2.3 Secondary Egress Shaft

P. 4-16: The draft EA states "the fifth test, unsaturated zone water sampling, would only occur if perched water were found during shaft sinking, which is not considered likely." No evidence is found in the draft EA to support the statement that perched water is considered unlikely in the unsaturated zone. Rush and others (1983) observed evidence of perched water in drill hole USW H-1. Free-standing water has also been observed in drill hole UZ-1 and UZ-4. While there could be alternative explanations for the observations, perched water zones are plausible.

4.1.2.5 Final Disposition

P. 4-17: The discussion of the use of radioactive materials during site characterization should include the actual requirements of the Nuclear Waste Policy Act even though DOE indicates that it does not, at this time, plan to use such materials at Yucca Mountain. The requirements from the Act that such use of any radioactive materials requires NRC approval and that all such radioactive materials must be fully recoverable should be clearly stated.

4.2.1.1.2 Hydrology

P. 4-23: In the second paragraph the following statement is made: "The actual injection of the tracer material into ground water or rock poses less of a hazard than handling the material. Handling of radioactive material would be in strict accordance with accepted procedures."

This statement is in direct conflict with the previous one made at p. 4-17 that current plans for site characterization at Yucca Mountain do not include the use of radioactive materials.

The use of any radioactive materials during site characterization has to be approved by the NRC and such materials must be fully retrievable. (See Nuclear Waste Policy Act, Section 113(c)(2)--Restrictions.)

The use of any radioactive materials at any time in the state of Nevada must be in accordance with State law. If DOE is currently using radioactive materials or plans to do so in the future, compliance with State law must be ensured.

P. 4-23: The draft EA states "Site-characterization activities are expected to use substantially less than 494,000 m^3 (400 acre-feet) per year." The draft EA presents no data by which to judge how much water will actually be utilized during site characterization. Impacts on water quantity and quality cannot be assessed given the lack of information in the draft EA.

4.2.1.1.3 Land Use

P. 4-24: The draft EA states that the Yucca Mountain site is located entirely on "federally controlled lands" that are not being actively used. While that statement is essentially true, the wording may give the impression that being "controlled" means, in essence, being within the boundaries of the test site or the Nellis Bombing Range. In fact, much of the site is located on public lands that are administered by the federal government (BLM). Whenever discussing the subjects of land use, land withdrawal, etc., DOE should clearly indicate that the land in question is not restricted or controlled as part of NTS or the Nellis Range but is currently open land in the public domain.

4.2.1.6 Archaeological, Cultural, and Historical Resources

P. 4-29 and 4-30: Although DOE minimizes the amount of construction and the number of workers necessary to complete characterization studies, the effect on cultural resources will be great due to the large number of individuals (690) working in a limited area. Archeological sites will not be threatened merely by construction but also by vandalism and illegal collection. We question DOE's method of prohibiting excavation or collection (p. 4-30) when efforts to date with the existing work force at NTS have not been successful.

4.2.2 Socioeconomic and Transportation Conditions

P. 4-30: Site characterization impacts will be small in comparison to later phases and, hence, problems with the analysis of these impacts are of a lower order of magnitude in this sense. However, the analysis, assumptions, methods, etc. in Section 4.2.2 establish a pattern for later chapters. As a result, the adequacy of information and the manner by which the information was obtained are extremely important to socioeconomic and transportation analyses later on.

The draft EA states that the area for socioeconomic analysis is defined as "the bicounty area of Nye and Clark counties." Characterization impacts can be expected to accrue to Lincoln County and to the state as well. These impacts should be assessed in detail in the EA.

For example, property values along the Union Pacific rail line in Lincoln County and the City of Caliente are already being affected by the mere speculation that a repository may be built and waste may be shipped through the area. If Yucca Mountain is characterized, the publicity surrounding that decision and the increased likelihood that the site will be chosen as the repository location can be expected to have further impacts. These must be identified and, subsequently, mitigated.

Likewise the state's tourism industry and its economic diversification program may be affected by a characterization decision for Yucca Mountain. The EA should assess the potential for such impacts and lay the groundwork for continuing research to quantify such impacts as they are occurring.

The statement that "The social and economic impacts of site characterization are expected to be small and insignificant" is totally unsubstantiated anywhere in the document. The Nuclear Waste Policy Act clearly intended that DOE look closely and comprehensively at the effects of site characterization on all segments of the affected state's population and economy. DOE has not only failed to do this, but has instead made sweeping and unsubstantiated statements attesting to the insignificance of site-characterization activities in relation to social and economic impacts.

4.2.2.1.1 Employment

P. 4-31: A "bicounty" or even "tricounty" comparison is not generally desirable in assessing impacts of site characterization or later phases of the project. Admittedly, the comparison may be reasonable for some assessments (e.g., impacts on the local banking industry). However, on the general grounds that the "bicounty" or "tricounty" comparison averages two or three counties with vastly different characteristics and capacities to absorb the impacts of site characterization and later phases, such comparisons in the draft EA appear to be inappropriate in at least some, and perhaps most, cases.

DOE gives no reference to support its work-force estimates for characterization. There is also no substantiation for DOE's conclusion that 60 percent of the work force would be individuals currently employed by the Department and 40 percent would be new workers. It is impossible to assess the validity of these estimates unless DOE clearly spells out how those estimates were derived.

Likewise, use of a multiplier of 1.54 secondary workers for every worker employed directly on the project is without foundation. There is no reference that substantiates the appropriateness of the multiplier. DOE cannot merely assume that for each worker it employs, another 1.54 jobs will be created in the area.

Previous studies (see Dobra, Atkinson, and Barone, "An Analysis of the Economic Impact of the Mining Industry on Nevada's Economy," Nevada Mineral Industry, 1982, Nevada Bureau of Mines and Geology, UNR. Also see Dobra and Harris, "The Commercial Structure of Nevada's Economy and Prospects for Development," Nevada Review of Business and Economics, vol. VII, no. 3, Fall 1983, indicate that multipliers used to estimate indirect impacts vary across counties. Clark County's multiplier is higher than Nye's because Clark has a much more well developed infrastructure of businesses supplying goods and services. In addition, there is a significant sales leakage out of southern Nye County into Clark County.

Also note that the studies cited above find a significantly lower multiplier for Nye and Clark Counties than used in Section 4.2.2.1.1. The multipliers estimated for Nye and Clark were 0.55 and 1.27, respectively.

As an area grows, particularly as it grows rapidly, demands are placed on the supporting infrastructure that can, at least temporarily, alter the simple multiplier. Heavy demands on one industry may alter costs and wage rates, and affect other sectors of the economy. If a severe bottleneck is created, the impacts may be totally altered. These changes can lower the value of the multiplier. There may also be lags; as the initial growth in local employment for Yucca Mountain takes off, the support sector may expand more slowly.

An alternative assumption can also be made. This is that news of the impending major construction project will lure significant numbers of workers here in advance of the project beginning. This would markedly impact local unemployment, social and governmental systems, and social services, and have negative effects on local crime rates. When the project began, there might be no visible increase in support employment because the influx had already largely occurred.

It is obvious that some additional considerations need to be made before the model becomes acceptable. First, a more reasonable multiplier should be employed. Second, the possibility of spillover support employment in Clark from Nye base employment should be considered. Third, the possibility of lags between the beginning of construction and support growth (with resulting congestion) should be considered. Fourth, the possibility of an influx of workers before construction should be examined.

It should be noted that the last two are somewhat opposite in nature. Other large construction projects done in isolated areas (such as the Alaskan pipeline) should be examined to determine which of these is the likely case.

The following labor-market-related observation is contained in this section (on p. 4-31): "The peak total site-characterization employment is estimated to be about 690 jobs. This represents about 0.2 percent of projected 1985 Nye and Clark County employment."

One problem with this statement and similar ones in later sections of the draft EA is the "bicounty" comparison employed, as noted above. However, another, more serious problem is the comparison of the demand for mining and construction workers induced by project activities against the entire labor force of both, or either, counties.

The problem with this comparison is that it implicitly assumes that all workers, including secretaries and casino change-persons, are potential Yucca Mountain workers. Some workers currently employed in other sectors may enter NNWSI jobs, but a more appropriate measure of comparison is the existing baseline supply of mining and construction workers. The table below provides an alternative view of the impacts of site-characterization activities.

In examining the table, first note that the 1985 Nye County mining and construction work force includes 1,419 workers (see Table 3-11 of the draft EA). Second, assuming that, as indicated in Section 4.2.2.1.1, third paragraph, only 40 percent of the estimated peak total direct employment of 273 (109) workers (or 109) are new NNWSI employees, the table below shows the relative impacts on Nye County labor markets assuming different levels of hiring from Nye County.

POSSIBLE IMPACTS OF SITE CHARACTERIZATION ACTIVITIES
ON NYE COUNTY MINING AND CONSTRUCTION WORK FORCES
NEW JOBS: 109

% Hired From Nye County	% of Nye County Mining and Construction Work Force
100	7.7
80	6.1
60	4.6
40	3.1
20	1.5
13	1.0

Note that without bringing in indirect employment effects, the potential impacts of relatively limited site-characterization activities have a significantly greater potential than indicated by the "0.2 percent" of the total "bicounty" labor force.

Even under the most restrictive assumption presented on the table above, where the 83 percent Clark to 13 percent Nye assumption is used, the impact in Nye County will be around 5 times greater than the draft EA indicates using a "bicounty" total employment basis of comparison. Under the least restrictive assumption, where all of the new mining and construction workers are hired from Nye County, the draft EA's figure of 0.2 percent understates the impact in Nye County by a factor of 38.5.

This last comment is not intended to imply that the effects of site-characterization activities will be greater than indicated by the draft EA. Rather, it is intended for future reference as an indicator of the degree of bias in estimates based on the methodology employed throughout the draft EA. As such, the substance of these comments is equally relevant to the socioeconomic analysis for the repository as a whole contained in Chapter 5.

4.2.2.2 Population Density and Distribution

P. 4-32: DOE contends that between 800 and 2,000 people will be brought into southern Nevada as a result of site-characterization activities It further contends that either figure represents an "insignificant" impact to the area.

That is not a supportable conclusion, given the data--or lack of data--presented in the draft EA. DOE fails completely to discuss the impact of alternative settlement scenarios and how these may affect specific communities. If, for example, 2,000 new people locate in Clark County and are distributed evenly throughout the County, then DOE's assumption would be accurate. The impact to the county would be insignificant. However, if 2,000 people settled in Nye County, the impacts would be substantial (this would mean a 10 percent population increase almost overnight!). Even if only half of the lower estimate work force of 830 people settled in Nye County, there would be a 2 percent jump in population. Similar impacts could accrue in Clark County and in the cities of Las Vegas, North Las Vegas, and even

Henderson should repository workers settle in unevenly distributed groups in an area, or in one or two neighborhoods.

The EA should clearly evaluate potential impacts of various settlement scenarios to all potentially affected jurisdictions.

4.2.2.3 Community Services

P. 4-32: The draft EA states that because significant population increases are not expected as a result of site-characterization activities, community-service impacts (except for the already present Beatty water-supply problem) will be non-existent. As discussed above with regard to population changes and settlement patterns, population increases may be locally significant depending on how many workers reside in a single area--especially if that area is part of a rural county or unincorporated town. Simply stating that community-service impacts will be insignificant is inadequate. DOE should examine various settlement scenarios and then assess service impacts based on each scenario.

4.2.2.4 Social Conditions

P. 4-33: The draft EA concludes that impacts on social conditions will be insignificant because there will be no significant changes in population as a result of characterization. As with the assessment of population and community-service impacts, DOE fails to examine potential worker-settlement patterns and their effect on social conditions of the area. A large number of workers (200-500) moving into an area of low population such as Amargosa or Beatty will have significant impacts on social conditions of these communities. DOE needs to examine the effects of various worker-settlement scenarios on area social conditions.

4.2.2.5 Fiscal and Governmental Structure

P. 4-34: DOE makes the same argument here as it does for other socioeconomic effects of characterization: there is no significant population change; therefore, there are no effects on regional or local employment, population, community services, or social conditions; therefore, there will be no fiscal impacts. Because DOE did not address possible settlement alternatives, the entire line of reasoning breaks down. Even a relatively small number of new workers settling in Amargosa could have major fiscal implications for the community.

In this section, the draft EA recognizes State participation in the process. The Nuclear Waste Policy Act provides financial assistance for the State to review DOE activities undertaken to assess public health and safety, social, and environmental impacts, and to engage in any monitoring, testing, or evaluation activities. The current DOE policy, as applied to the State of Nevada, has been to withhold State-requested funds for the development of independent data on selected technical issues. The draft EA statement recognizing the State's right to financial assistance (adopted from the Nuclear

Waste Policy Act of 1982) is inconsistent with DOE actions. In practice, the DOE has been "characterizing" the Yucca Mountain site since before 1982. The draft-EA-referenced documents are strong evidence for this when viewed from the perspectives of topic, required funding, and depth of research. The EA should be modified to reflect practiced DOE policy. Or better, the DOE policy should be made to conform to both the spirit and letter of the Nuclear Waste Policy Act of 1982. By facilitating full state participation, the scientific tests of replicability of data and multiple investigative approaches to very complex technical questions would be served. There is pending litigation on the currently practiced DOE policy. If the State of Nevada prevails in this litigation, the final EA should be modified to reflect the intent of the Nuclear Waste Policy Act. If the DOE prevails, the EA should reflect and explain currently practiced DOE policy.

4.2.2.6 Transportation

P. 4-34: During site characterization, DOE suggests that it may use some unspecified quantities of radioactive materials for testing purposes (see p. 4-17). If that is the case, the EA should discuss how DOE plans to transport these materials to the site. Will they be shipped by commercial carrier or by DOE-owned-and-operated equipment? What precautions will be taken during transportation? Will trucks (or rail cars) be clearly marked? Will the State and local communities be informed of each shipment in advance? Will the transport of such radioactive materials be carried out in compliance with State law? These and other questions regarding the transportation of radioactive materials for characterization purposes must be addressed in the EA.

This section fails to address shipments of construction materials to southern Nevada by rail during site characterization. Without an assessment of added rail shipments, it is not possible to evaluate potential noise, traffic, and other effects to the Lincoln County/Clark County area. In the same way that rail transportation impacts during repository construction and operation are assessed (Chapter 5), it is suggested that rail transportation impacts during site characterization be evaluated.

SPECIFIC COMMENTS ON CHAPTER 5

REGIONAL AND LOCAL EFFECTS OF LOCATING A REPOSITORY AT THE SITE

Introduction

P. 5-1: The first paragraph of Chapter 5 indicates that the evaluation of the regional and local effects of locating a repository at Yucca Mountain "is based on limited information about the environment of Yucca Mountain and its vicinity, about the social and economic conditions in the area that might be affected by a repository, about the design and operation of the repository, and about the transportation system and routes that would be used to ship waste to the repository."

To some degree this evaluation must be based on relatively limited information. However, in certain areas, DOE appears to have chosen to use data that is more limited than it needs to be. Throughout the socioeconomic and transportation sections of Chapter 5 (as well as in Chapters 3 and 4), there is no mention of Lincoln County, the City of Caliente, or the Moapa River Indian Reservation--even though these jurisdictions stand to be directly and significantly affected by a repository. Repeatedly, the draft EA cites the lack of knowledge about actual transportation routes into and through the state as the rationale for not examining social, economic, cultural, and other impacts to communities and areas along potential shipping corridors. Given the extremely limited number of possible routes within Nevada, it is a relatively simple process to identify which roads and rail lines are most likely to see significant numbers of waste shipments. Communities and conditions along these routes should have been identified and included in the various analyses.

In other areas, where information is actually limited and speculative, the draft EA seems to reverse course and proceed at "full steam" to draw conclusions and conduct evaluations that simply are not justified by the data base. The draft document's treatment of labor-force estimates is one such area. Employment figures (direct and indirect) are based on extremely speculative data. The lack of a defined methodology for calculating baseline construction and operating labor needs; the use of large contingency numbers and other manipulation of data (which are discussed in more detail in comments relative to Sections 5.1.1.5 and 5.4.1) in arriving at direct worker requirements; and the use of unsubstantiated multipliers for figuring indirect labor effects all tend to make these extremely critical labor-force numbers very unreliable. Yet the draft EA proceeds to use the high range of these questionable figures in driving other key socioeconomic impact analyses.

5.1.1.5 Schedule and Labor Force

P. 5-13: Estimates as to the numbers of workers needed for each phase of the repository project are critical. These calculations form the basis by which many of the major socioeconomic impacts must be calculated. The draft EA does not describe the methodology by which DOE arrived at the estimates for workers needed to build, operate, and decommission the repository. Without a clearly laid-out explanation of this methodology, there is no way to determine the appropriateness of the numbers DOE has put forth.

Because so much of the environmental assessment depends on these workforce estimates, DOE should describe in detail exactly how it arrived at the figures. The McBrien-Jones (1984) report cited as the reference for workforce estimates does not provide the background needed. That document merely refers to "unpublished data" from Leo Scully (1984) of Sandia National Laboratories as documentation for its conclusions. We have been unable to obtain that reference and cannot evaluate the appropriateness of the labor-force estimates in the draft EA.

Since these calculations are so critical to all of the other social and economic conclusions reached in other sections of the draft EA, DOE should not bury its labor-force calculations under two layers (at least) of reports that are speculative and derive from unknown foundations. The methodology by which labor-force calculations were arrived at should be clearly and explicitly spelled out in the body of the EA itself. To do anything less suggests that DOE may be seeking to hide its underlying assumptions from scrutiny.

Another problem with labor-force estimates is that they do not appear to include labor required to construct the rail spur from Dike's Siding to the site or the access road from U.S. 95. The final EA should clearly identify labor-force requirements for these elements of the project.

(See also comments made relative to labor-force and employment estimates relative to Section 5.4.1 of this chapter).

5.1.1.3 The Subsurface Facilities

P. 5-8: Section 5.1.1.3 indicates underground openings may encounter scattered pockets of perched water. This statement contradicts the statement on p. 4-16 that indicates perched water is unlikely. Figure 5.5 (p. 5-10), which is discussed in this section, indicates the waste emplacement ramp will cross numerous faults, at least one with major dip-slip displacement. The draft EA provides no discussion of engineering measures that may be required across these planes of weakness to insure integrity of the openings.

5.1.1.6 Material and Resource Requirements

As with labor-force estimates, DOE nowhere discusses the methodology by which it arrived at the figures used for the material and resources needed to construct, operate, and decommission the repository. The reference cited for this information, the McBrien-Jones report (1984), contains no more substantiation than does the draft EA. There is an obscure reference in the McBrien-Jones report to something (it does not say what) from a Thomas Eglinton (July 24, 1983). We have not been able to obtain this information.

Because material and resource calculations--like labor-force estimates--are so critical and actually drive many of the social and economic effects to be experienced by local communities, DOE should clearly describe the methodology by which these calculations were carried out and the estimates arrived at. Without such a detailed explanation, the numbers contained in the draft EA are unsubstantiated and essentially meaningless.

It is also unclear whether or not material and resource requirements for the proposed rail and road construction aspects of the project are included in the overall estimates.

To the extent possible, raw and manufactured materials required for repository, road, and railroad construction should be derived from Nevada sources. For example, limestone could be obtained from the Caselton area of Lincoln County and shipped by rail to the construction area. The EA should discuss possible sources of construction materials and the impacts, both positive and negative, of obtaining materials from alternate sources.

5.1.2.1 Waste Receipt

P. 5-21: The draft EA estimates that eight truck and four rail shipments of waste will be received by the repository each operating day. These estimates assume that shipping schedules will conform to average estimates. What impact on repository design and generation will there be in order to handle peak shipping estimates? For example, weather delays or scheduling foul-ups can be expected to occur numerous times during the 30-year emplacement phase. If the facility is required to handle twice, three times, or even four times the "average" number of shipments for a significant number of operating days each year, will that alter design criteria, operation requirements, safety requirements, etc., for the repository? DOE should address this issue in detail in the EA since peak shipments and consequent peak handling requirements are certain to occur in real-world operating conditions.

5.1.5 Alternative Repository Concepts

P. 5-25: Section 5.1.5 discusses a two-stage repository concept first proposed in the DOE draft Mission Plan for Geologic Disposal for High-Level Radioactive Waste Disposal. We have concern with this concept from a number of perspectives.

(1) Staged construction is a deliberate attempt to circumvent NRC's statutory requirement to review and approve complete site construction prior to the site accepting any waste for disposal. NRC concurrence in this concept should be solicited before the Mission Plan and Environmental Assessment are final.

(2) The draft EA and support documents do not consider health and safety impacts of a two-staged repository approach. The simultaneous emplacement of

waste in combination with adjacent blast- and muck-mining operations presents potential health risks and raises questions as to the safe handling and emplacement of waste. All implicit health and safety risks must be discussed in the EA.

(3) The assumption that defense waste, if comingled, would be included in the 70,000 MTU capacity of the first repository is false. The DOE draft Mission Plan states that defense waste, if comingled, would be in addition to the 70,000 MTU of commercial waste. The EA should be revised to be consistent with other DOE documents.

(4) On p. 5-27 the draft EA states that all evaluations, experiments, conceptual models, and preliminary designs assume ten-year-old spent fuel. However, in the next paragraph, the text indicates that the two-staged repository concept will accept five-year-old spent fuel. Why will the standard repository concept accept ten-year-old fuel while the two-staged concept will accept five-year-old fuel? There are health, safety, and thermal-loading implications attendant upon emplacing five-year-old fuel in a repository designed for ten-year-old fuel. These implications should be discussed.

5.2.1 Geologic Impacts

P. 5-34: There is concern for the integrity of repository openings due to stress release post-excavation. The draft EA statement that excavation of the repository represents an insignificant disturbance to the overall competence of the rock unit at Yucca Mountain is an inappropriate conclusion given the evidence available. This concern is supported by several sources, including: (1) Healy and others (1982), which indicate some faults may be near failure; (2) Carr (1984), which suggests that north-trending faults should be considered active; and (3) statements in the draft EA (p. 6-227), which indicate that faults on NTS are tectonically stressed near the failure point. The repository block is acknowledged to contain faults, some of significant size. The evidence suggests a potential for stress release along these faults during construction and possibly operation. The EA should address this potential hazard in depth.

5.2.2 Hydrologic Impacts

P. 5-35: The draft EA states the water requirements for the repository at Yucca Mountain would average 220,000 m^3 (180 acre-feet) per year, and this withdrawal would not lower the regional water table. The cited reference, McBrien and Jones (1984), does not contain any estimates of on-site water use. Also, the draft EA statements do not consider other repository water uses. To assess the impact on available water supplies, the maximum usage rate per year and a complete accounting of all uses are critical. Without complete knowledge of maximum pumpage rates over identifiable time periods, the effect on the regional water table cannot be assessed.

P. 5-35: The statement that natural barriers would limit exposure to accessible ground water and to the public is unsupported. The nature and behavior of potential natural barriers to radionuclide transport at Yucca

Mountain are unknown; therefore, the degree of limitation of exposure during any period of time is unknown. The baseline data package is insufficiently developed for Yucca Mountain. Behavior of the hydrologic system in the vadose zone is essentially undocumented. Nor are the sorption characteristics of oxyhydroxides, smectites, and other minerals well known. In light of these deficiencies, a preliminary assessment of either long- or short-term performance of a repository at Yucca Mountain is without foundation.

P. 5-35: The last sentence states "The evidence compiled to date suggests that climatic changes during the Quaternary Period, the last 1.8 million years, probably had a negligible effect on the hydrologic system at Yucca Mountain." This statement conflicts with the finding on the favorable condition guideline for climatic change. Page 6-200 concludes this favorable condition is not present at Yucca Mountain.

P. 5-36: The text indicates that parts of the surface facilities could be inundated by the 500-year and regional maximum floods. Why is there a different level of protection from flooding (i.e., 500-year and regional maximum flood) during repository construction and operation than during characterization? This higher level of protection would also seem appropriate for the characterization phase and the exploratory shaft.

In the next paragraph the text states that runoff will be channeled into evaporation ponds. Has there been any quantification of the expected amount of runoff that would be channeled into evaporation ponds? What provision will be taken to prevent the evaporation ponds from becoming point recharge sources? The high ET rate is not effective during the winter months. The ponds should be lined or sealed, just as sewage effluent lagoons and rock storage piles should be lined. The discussion does not give confidence that the repository will be a zero-discharge facility.

5.2.3 Land Uses

P. 5-36: DOE indicates that "In addition to use of Nevada Test Site land, about 21,000 ha (50,000 acres) of public land administered by the Bureau of Land Management (BLM), U.S. Department of Interior, would be withdrawn from public use. Because Yucca Mountain is not a prime location for other uses, withdrawing this land should have essentially no effect on land use in the area." There is no justification or rationale for the need for such a large land withdrawal. Previous estimates of additional land required for a repository at Yucca Mountain were in the 5,000-acre to 10,000-acre range. Why is DOE now finding that it will need five to ten times the amount of new land than was originally considered adequate?

The fact that the Yucca Mountain site is not located on the NTS is, in itself, a source of considerable concern given DOE's initial mandate for examining sites in Nevada (see discussion of this issue in comments on Chapter 2). The additional 50,000 acres of public lands will mean that the repository boundaries will extend at least to and probably across highway U.S. 95 and into the unincorporated town of Amargosa. Without extensive justification, DOE's proposal for such a large land withdrawal appears unwarranted.

DOE must clearly explain the rationale for its land requirements in the EA. The EA should justify the withdrawal of 50,000 acres of BLM land considering that only approximately 2,000 acres are actually required for repository and surface facilities. That rationale should include a discussion of all the issues involved. It should also include detailed maps showing precisely what land is needed and where that land is located. The effects of the proposed repository land acquisition cannot be assessed without such graphic portrayals of the withdrawal and its relationship to the geography of the area and to the surrounding local communities.

A withdrawal of this magnitude will conflict with mining activities, agricultural uses, and recreation. Such issues should be comprehensively addressed in the final EA.

5.2.4 Ecosystems

P. 5-38: The text states that heat generated by wastes is expected to increase the temperature of the ground at the surface of the site by approximately 1°C (2°F). It goes on to say that the available information is insufficient to enable the quantification of ecological consequences resulting from the temperature increase. The very next statement, however, concludes that "significant ecological consequences would not be expected to occur."

The conclusion is inconsistent with the information contained in the text. If the information is insufficient for drawing conclusions, on what basis does the draft EA predict that effects will not be significant?

The final EA should contain either an expanded analysis of this issue using information that is adequate for drawing conclusions, or it should simply state that the consequences of the projected temperature increase on area ecosystems are unknown at this time.

The EA addresses potential impacts to wildlife species and habitat in the area of the waste repository site. As pointed out by the draft EA, wildlife values at the site are relatively low, except for desert tortoise and fishhook cactus, both of which have recently been made candidates for federal listing as threatened species. The EA should address potential impacts to the tortoise and cactus with the possibility in mind that both species will be afforded threatened species status. The primary mitigations for potential impact to tortoises presented in the draft EA on pp. 5-37 through 5-38 were avoidance and/or translocating individuals away from the disturbance area. However, the supporting studies (EGG 1183-2438, Medica et al., 1981) for the draft EA do not recommend translocating as a viable mitigation measure. It appears that the writers of the draft EA did not pay attention to their expert consultants. Mitigation plans for the desert tortoise in the draft EA should be re-evaluated with regard to the data and suggestions supplied by EGG.

The EA briefly discussed possible development of a railroad spur from near Las Vegas to the Yucca Mountain site. There was no discussion of the potential impacts of such a rail spur on wildlife values. If the proposed development might include a rail spur, the EA should address the potential impacts of same. We are concerned with potential impacts of a rail spur in the vicinity of the Desert National Wildlife Refuge (DNWR) and through the Spotted Range. Portions of the DNWR are proposed to be declared a wilderness area. The EA should address the potential conflicts associated with placement of a rail spur near the potential wilderness area. The Nevada Department of Wildlife has identified the Spotted Range as an area of high potential for a bighorn sheep transplant. The development of a rail spur through potential bighorn habitat could compromise the plans that are being developed by the State and the U.S. Fish and Wildlife Service for establishment of bighorn sheep in the Spotted Range.

5.2.5 Air Quality

P. 5-39: The report should address the emission of radionuclides in relation to the standards associated with 40 CFR Part 61.

The zeolitic rock, when mined and disposed of, will have to have stringent controls and an impact analysis conducted to insure protection of the general public and the workers. There also seems to be a discrepancy in the number of acres that will be of disturbed land associated with the project.

The proposed 60-meter tower for measurement of meteorological conditions should be at least 100 meters as required for most power-plant siting towers in Nevada. The data would be gathered at 10 meters, 50 meters, and 100 meters. The extra 40 meters would still be below the ridge line. This would provide a better data base for the local wind-flow patterns. This site would also enable a better projection should there be an accidental release during operation.

There is some reference to the Air Quality Regulations (article #3) that have been amended and codified to NAC 445. These references should be correct.

5.2.9 Radiological Effects

P. 5-55: Since the Yucca Mountain site was appurtenant to the Test Site during above-ground testing, an evaluation is needed to assess whether dust emitted during construction will be of a contaminated nature. Re-entrainment of radioisotopes during waste retention needs to be explored and defined.

5.2.9.2 Radiological Effects During Operation

P. 5-57: According to the Mission Plan, DOE intends to simultaneously emplace waste in the completed portion of the repository at the same time that construction of remaining sections is ongoing. However, there is no discussion of the effects such a concurrent emplacement-construction plan will have on worker-exposure rates--both during normal operations and in the event of an accident at the repository. Since the presence of a large construction force on-site at the same time that waste-handling and storage operations are ongoing would appear to increase significantly the number of workers potentially exposed; and since these workers would be in relatively close proximity to large quantities of waste for long periods of time, it would seem essential that DOE conduct an analysis of the potential for radiological exposure to these personnel. The EA is incomplete without such an assessment.

5.3 Effects of Transportation Activities

P. 5-62: The draft EA states that "Because transportation during the retrievability phase would have the smallest effects, its effects are not discussed here." Assuming that a decision to retrieve and reprocess spent fuel stored in the repository is made at some time during the retrievability phase, it would seem logical to assume that the amount of shipments needed to extract waste from the repository would be comparable to those required to place waste in it. If that is the case, a significant number of radioactive waste shipments would traverse the state--most likely through the Las Vegas area (by truck) or through Lincoln County (by rail). Radiological and non-radiological impacts could be comparable to those experienced during emplacement.

Given the location of the Yucca Mountain site (in the far western part of the country) and the likelihood that any reprocessing would be done farther east, the need to reship waste back across almost two-thirds of the country in the event retrieval becomes necessary could be a variable in determining whether Yucca Mountain is more or less suitable, overall, than the other sites being considered.

The draft EA fails to assess any transportation effects arising out of possible retrieval of waste from the repository. Likewise, it fails to examine differential impacts of such transportation from each of the nine potentially acceptable sites.

5.3.1 Highway Impacts

P. 5-62: The draft EA indicates that "no roads are planned to be improved [or constructed--except for an access road] for the sole purpose of transporting people and material [including waste] to the repository site."

Given the level of concern over the prospect of high-level nuclear waste shipments traversing populous areas of Clark County, DOE should evaluate the possibility of constructing an access road--perhaps parallel to the proposed rail spur--that would bypass major population centers in the state.

5.3.1.1.1 Construction

P. 5-62: During construction, massive amounts of material will be shipped from and/or through the Las Vegas area to the site. Many of those shipments will consist of raw materials (concrete, steel, sand, etc.). In any project involving such construction-type transport, the probability that subcontractors and shippers will use overweight trucks as a means to increase profitability is high. Routine, ongoing overweight shipments can have significant deleterious effects on roadways. The EA should examine the probabilities associated with the use of overweight shipments during repository construction and identify potential impacts to the state's roads. Such impact analysis should include U.S. 95, I-15, and all state roads that could possibly be used for such transportation.

In addition, impacts resulting from construction shipments should not be limited to those occurring only along U.S. 95 from Las Vegas to the site. Such impacts should be assessed according to each local jurisdiction (i.e., City of Las Vegas, North Las Vegas, Henderson, Boulder City, Clark County, Nye County, Lincoln County, and the City of Caliente, as well as the Moapa River Indian Reservation). The analysis contained in the draft EA is far too limited and general in nature to adequately project transportation effects.

The draft EA assumes that construction shipments will occur according to a regularized, routine schedule of five trucks per hour. It does not consider the effects of "peak" shipments during construction (i.e., shipments that result from breakdowns in scheduling, poor coordination, changes in material requirements, etc.). Under such conditions, it is very likely that more (perhaps many more) than five trucks per hour will transit the Las Vegas area and U.S. 95 to the site at any given time. What impacts will accrue as a result of heavy shipping periods--say, 10, 15, or even 50 trucks per hour? How will consideration of such "peak" conditions affect the outcome of the transportation analysis contained in the EA?

In identifying construction-related transportation effects, DOE cannot assume idealized, theoretical conditions. It must employ a real-world focus if its analysis is to have validity.

5.3.1.1.2 Operation

P. 5-68: The draft EA assumes that in 1998, approximately 1 truck carrying construction material and up to 33 trucks carrying waste could enter and leave the repository daily. Given DOE's own plans for simultaneous emplacement and repository construction (see Mission Plan), that estimate seems significantly understated. If construction work at the site is ongoing, it is highly unlikely that only one truckload of materials daily would suffice to sustain the level of activity needed for a project of this magnitude. DOE should revise its estimate of the number of shipments required to and from the site once emplacement begins.

The draft EA reasons that "As repository-related traffic remains constant over the 30-year generational period . . . , the regional traffic along the segment [of U.S. 95] would grow. Therefore, the incremental impacts due to repository operational traffic would diminish over time, which would make the first year a worst-case for the operations period." This reasoning leaves much to be desired. If routine, regional traffic along already overburdened sections of U.S. 95 grows steadily over a 30-year time span, it would seem that the ongoing (albeit relatively constant) construction-related traffic would have an ever increasing effect upon road conditions. Rather than these effects being incrementally smaller, it would seem that they would be increased geometrically by the ever-growing demands placed on the roads being used.

As with the analysis of transportation effects during construction, the draft EA fails to consider the impact of "peak" conditions during operation. What are the effects when weather conditions or scheduling mix-ups cause conditions where 20, 30, even 50 trucks per hour pass through the Las Vegas area and along U.S. 95 to the site?

Also, like the construction-related transportation analysis, only U.S. 95 is examined for possible effects. The EA needs to assess all potential transportation-related impacts within each potentially affected jurisdiction in the state, including the Moapa River Indian Reservation.

The draft EA and support documents discuss a number of routines for truck transportation. The draft EA (p. 5-76) considers two routine scenarios. Scenario I assumes entry points at I-15 North, I-15 South, U.S. 93, and I-80 East. Scenario II has entry points at I-15 North and South. Truck-routing maps used to calculate the percent of travel in population zones (RADTRAN II Population Zone Maps) also show entry points of I-80 West, U.S. 95 North, SR 160 South, and I-15 North and South. The Traffic Density Map, which shows the estimated number of shipments per year, identifies entry points at I-15 North and South and U.S. 93 from the south.

The potential traffic problems and safety risks along these routes are identical to those along U.S. 95 between the Yucca Site Access Road and North Las Vegas. However, the draft EA fails to evaluate each segment of roadway in order to identify specific problems. This should have been done before the draft was prepared.

5.3.1.2 Railroad Impacts

P. 5-71: Even though the main Union Pacific rail line to be used for transporting waste bisects Lincoln County and passes through the center of the City of Caliente, the draft EA fails completely to consider the effects of transporting thousands of carloads of highly radioactive materials through these jurisdictions. Without an in-depth assessment of all impacts to Lincoln County, the City of Caliente, and any other communities along the rail line, the EA is incomplete and inadequate.

This section states that during the first two years rail use would be zero during construction of the rail spur. This section fails to address added rail traffic resulting from shipments of construction materials needed for the rail spur, road, and repository construction programs. Table 5-7 suggests that 90 to 100 trains annually (at 60 cars each) would be required to ship highway and rail construction materials. What effect will this added traffic have on rail condition, rail traffic, accident rates, noise, and air quality within those Nevada counties and communities through which the rail line passes?

The first part of this section deals with the proposed rail spur. The analysis, however, discusses impacts to mainline Union Pacific. If one considers an increase of one 60-car train every 2.5 days (based upon 90 to 100 trains required to move construction materials during year one and two and 250 operating days per year), this represents a significantly greater increase in traffic than 0.2 percent. Rail-traffic impacts on rail-line capacity during the first two years should be estimated and presented in the final EA.

The draft EA states that "Projections of future Union Pacific rail use without the repository are unavailable." It is difficult to imagine that major rail companies such as Union Pacific do not keep records and make projections relative to future usage. Given the crucial importance of the UP rail segment through southern Nevada in DOE's overall plan for transporting waste to the Yucca Mountain site, it is not inappropriate to expect that DOE would have conducted an in-depth analysis of rail usage and capacity as part of its site-comparative work. Using 1981 conditions (as DOE does) to represent rail traffic in 1998 (and for 30 years after that) renders any analysis meaningless.

As rail traffic increases proportionately, so does the length of required sidings needed for storage capacity of passing trains. The associated maintenance costs, increased detection devices, and inspections also increase. A reciprocal effect is caused by delays at existing crossings and increased exposure and possible risk of accidents. Transportation analyses in the draft EA fail to adequately consider such issues.

The proposed 85-mile rail access spur (Figs. 3-20 and 5-2) from Dike's Siding to the site may pose problems to the State Public Service Commission Rail Safety Inspector who is responsible for inspecting all railroad tracks in the state. The additional budgetary requirements for track inspection may be totally state-funded if the current FRA State Assistance Program is eliminated by Congress. The spur line itself should be constructed to mainline standards (using CWR, continuous welded rail) for maximum safety and longevity. Additional design and environmental information concerning the structure over Fortymile Wash is needed to evaluate potential downstream damage in the event of a major derailment.

Alternate rail system routes for nuclear waste shipment across Nevada are not addressed in the draft EA. If the Paradox, Utah, site is selected, the Southern Pacific Railroad might be chosen as the prime rail carrier, as shown on some DOE RADTRAN maps. The SP line is not currently maintained to the same high standards as the UPRR mainline; moreover, it bisects the cities of Reno, Lovelock, Winnemucca, Battle Mountain, Elko, and several other smaller communities. The accident-risk factor is also higher since the SP corridor crosses approximately 167 at-grade (public and private) crossings.

The draft EA states that the UP rail line through southern Nevada operated "substantially below capacity in 1981" and, therefore, no impacts are expected as a result of increased traffic related to a repository. That analysis may be inaccurate for several reasons:

(1) Such calculations (as to capacity) rely heavily on average speeds expected for trains along various segments of routes. The faster the average, published speed, the larger the volume the line can carry. In the case of the Nevada UP line in question, there is significant evidence that the speeds projected for the line are considerably higher than what the rail bed can actually accommodate because of the poor condition of track along many portions of the line. The State Department of Transportation estimates that the rail line in question is <u>already</u> at capacity given the <u>actual</u> allowable speeds and the number of rail cars per day currently using the line.

(2) As with its analysis of truck transportation, the draft EA fails to assess rail transport--and rail line usage--in terms of "peak" conditions. What happens when weather conditions (rail-bed washouts, heavy snows to the east, etc.) and/or scheduling foul-ups or miscalculations result in 20 or 30 rail cars per day on the line--instead of the "average" of 5 to 7? Such conditions will occur and will have major impacts not only on rail-line capacity but also on communities located along the rail corridor. Any transportation analysis that fails to consider "peak" conditions (especially as these relate to risks of accidents, exposure, etc.) will be seriously deficient.

5.3.2 Transportation of Nuclear Waste

P. 5-71: The draft EA assumes that the controlling factor in reducing risks associated with radiological materials transport is the amount of time the material is in transit. Consequently, interstate highways, in general, are considered to be the preferred routes for truck transportation. However, the draft EA and the transportation analysis contained in Appendix A fail to differentiate between interstates or between portions of various interstates. The assumption is made that an interstate route through mountainous, hazardous-weather-prone terrain is just as safe and as appropriate as one that traverses flat desert country. Likewise, the draft EA considers an interstate that passes through a congested urban area as being equal to one that runs through a sparsely populated rural area in terms of transportation safety and possible transportation effects. Such an approach casts considerable doubt on the appropriateness and utility of the entire transportation analysis contained in the draft EA.

This section also fails to describe existing local, state, or federal regulations concerning the transport of nuclear waste by rail. What regulations concerning rail transport of nuclear waste will apply to the project? Is there a lack of appropriate regulations currently?

5.3.2.1 Radiological Effects of Nuclear Waste Transportation

P. 5-72: The draft EA states that defense wastes generated at West Valley (New York) and at Savannah River (South Carolina) are included in the transportation analysis. Nowhere in the document are defense wastes currently stored at the Hanford (Washington) or Idaho Falls reservations mentioned. Shipment of these wastes to a southern Nevada repository could have substantial impacts on transportation routes (and communities that would otherwise be unaffected by waste shipment). Wastes coming from the north might pass through Washoe County (the state's second-largest population center) and transit all U.S. 95 communities between Fallon and the site. Such shipments would also travel along segments of I-80 (perhaps across the Sierra Nevada) and effect portions of California along I-80 and I-5. In assessing transportation impacts, the EA must consider all potential defense wastes that may be comingled in a commercial repository. The omission of the Hanford and Idaho Falls wastes further reduces the credibility of DOE's entire transportation analysis.

The draft EA states that "Transportation accidents severe enough to release radioactive materials from a shipping container are extremely unlikely." That statement is unsupported by statistical or other evidence and is not documented by any reference to studies or other data. Table 5-31 (p. 5-67) indicates that there will be approximately one accident per million vehicle miles. This would lead one to suspect that there will be a total of about nine traffic accidents involving waste-carrying trucks on the roads between Las Vegas and Yucca Mountain. In fact, as congestion develops because of normal and repository-related traffic increases, accident rates are likely to be much higher. Inclement weather is also likely to contribute to higher-than-projected accident statistics.

By assuming that radiological risks resulting from accidents are virtually non-existent, the draft EA understates the importance of variables such as accident rates, road/rail conditions, meteorological conditions, etc. in the transportation analysis. A more appropriate and conservative approach would have been to look at "worst-case" scenarios with regard to transportation variables associated with each site (i.e., transportation of wastes from reactors and defense waste facilities to each potential repository location) and then compare those "worst-case" conditions to determine which site(s) is more favorable with regard to transportation.

Another variable not addressed in analyzing possible transportation risks involves the potential for sabotage or terrorist attacks on waste shipments. Of all the accident scenarios in which a release of radiation might occur, sabotage would appear to be the most potentially harmful. DOE should include an analysis of the potential for sabotage--and the "worst-case" effects of such acts--in its comparative analysis of transportation variables among the nine sites under consideration.

Risk of radiation exposure from rail transportation is of particular concern to the City of Caliente. Because of penetrating radiation, which the text indicates is emitted from casks, exposure to persons within 100 feet of train shipments through the City of Caliente could be very frequent. This is particularly true since trains move very slow and/or often stop in the downtown area. The final EA should address various alternatives that may exist for minimizing radiological exposure associated with rail shipments through Caliente. The final EA should consider minimizing stops through operational guidelines and track upgrading, as well as relocating tracks out of the populous areas.

The analysis of radiological risk to the state (as well as for the nationwide transportation system done as part of Appendix A) is inadequate for a number of reasons. The RADTRAN II program does not consider the effects of "peak" shipping conditions on risks to potentially-exposed individuals and communities. What happens, for example, when several trains carrying high-level waste are stopped for days in the center of the City of Caliente due to a rail washout (something that happens frequently in that area)? What radiological effects are there when rail cars are delayed for days or weeks in switching yards in urban areas? What are the effects of trucks carrying waste being delayed for hours or days at truck stops because of weather?

The RADTRAN model relies on aggregate, national data rather than on route-specific information and variables in assessing risk. As such, it cannot discriminate (in terms of risk) between a repository located in an area that must be accessed by traversing mountains--where weather conditions are severe, where road and rail conditions are poor, and where highways/rail lines are congested and accident rates excessive--and a repository located in a more easily accessible area.

Because RADTRAN relies on aggregate national data, its applicability to conditions in Nevada is extremely questionable without modifications in input data and assumptions. RADTRAN II assumes that the release possibility of radioactivity as a result of an accident (even sabotage) is infinitesimal. As such, the risks due to accidents are limited to routine exposure to emissions from intact casks. That assumption is overly optimistic and should not have been used in analyzing transportation risks. DOE should have used a more conservative approach and assumed radioactive material releases under certain accident (or sabotage) conditions. These conditions could then be evaluated with regard to the probability of such accidents occurring in areas of varying populations along potential routes to each potential repository site. There are simply too many uncontrollable variables (such as cask design flaws, workmanship, quality control, human error, etc.) to be able to assume, as a basis for risk calculation, that releases of radioactive materials during certain types of accidents simply cannot occur.

P. 5-75: The text indicates that assessments were performed to characterize radiological impacts that may be incurred within the state of Nevada. This level of analysis is referred to as regional characterization of impacts. Yet on p. 5-76 the text indicates that the RADTRAN II risk analysis method is not well suited for region-specific analyses. The reason for this appears to be that the RADTRAN II model is based upon nationally aggregated data, not representative of southern Nevada.

Despite this, DOE uses the mis-specified RADTRAN II model to perform region-specific analyses depicted in Tables 5-38, 5-39, and 5-40. Why was region-specific data not utilized in conducting the region-specific analyses?

The draft EA goes on to indicate that results of such "regional" impact assessments (which actually involve several very specific routes within southern Nevada) indicate the following: "(1) the differences in assumed routing do not substantially affect the resultant doses and (2) the magnitude of the total population dose (1500 to 5500 man-rem) for each scenario is low compared with the dose that would be received from natural background sources."

With regard to DOE's finding that the differences in assumed routing do not substantially affect the resultant doses, is it not possible that the reason no significant difference is found is because the only variable in the model was distance shipped with all other variables being held constant in accordance with the nationally-aggregated specifications of population zones, vehicle/train speed, stop times, and accident rates? What would happen if each of these factors were specified to reflect route-specific conditions, and the model rerun?

In DOE's analysis, the magnitude of the total population dose for each routing scenario is low compared with the dose that would be received from natural background sources. However, the issue is not absolute exposure rates (i.e., 1500 to 5,500 man-rem) but the fact that one route may result in 1,500-man-rem exposure versus an alternate at 5,500 man-rem, which represents a 350-percent-or-greater increase in relative exposure risk. Alternate routes present very significant differences in terms of the relative magnitude of risk. An evaluation of these differences in relative risk should be included in the final EA. This is extremely important since, in DOE's analysis (and by DOE's own admission), it is the relative, rather than numerical, values of the results that are significant--given the stated limitations of the analytic tools employed.

This section of the draft EA also states that the "HLW mixture for which the impacts are assessed consist, in part, of spent fuel that has been out of the reactor for a 10-year decay period" (used in RADTRAN II). However, the Transportation Appendix indicates that the spent fuel shipped to a repository will have been out of the reactor at least five years. If the ten-year-old fuel was used as a basis for the calculations in RADTRAN II (as it appears), and if the proposed regulations specify "at least 5 years," one would expect the assumptions in the RADTRAN II model to be erroneous. What is the impact of reducing the holding time from ten to five years? What are the effects of five-year-old fuel that is placed in the newer, less heavily shielded casks proposed for use in shipping spent fuel to a repository?

The risk analysis in the final EA should be done using assumptions that most closely approximate real-world conditions at the time when waste is to be shipped. As contained in the draft, this analysis is seriously flawed by the use of outdated, erroneous, incomplete, and conflicting data and assumptions.

In addition, the entire discussion is impaired by the lack of a reasonable comparative analysis among sites that considers transportation comprehensively and in a route-specific manner from reactors and other waste-storage locations to each proposed repository site.

5.3.2.3 Costs of Radioactive Waste Transportation

P. 5-80: Cost calculations in the draft EA fail to consider the costs associated with shipping defense waste from Hanford (Washington) and Idaho Falls (Idaho) to each repository site.

Other significant costs that should be included in estimates for transporting high-level waste and spent fuel were not part of the draft EA cost analysis. These include: costs for road and rail upgrading/road improvements needed as a result of waste shipments; cost of emergency preparedness for communities within Nevada and along the major transportation corridors from reactor and waste sites to the repository; and costs for training drivers, rail personnel, and others in the safe handling and transporting of these materials. Such costs are legitimately part of the total for waste shipment since they reflect expenses that will have to be made if a sound, publicly acceptable transportation system is to be established.

Cost comparisons among all nine sites should include these additional cost items. Such items should not be limited solely to costs needed to bring conditions within the state up to appropriate levels of safety. Rather, these costs should be calculated based on an analysis of each potential route from reactors/HLW facilities to each different repository location.

5.3.2.4 Emergency Preparedness

The discussion on emergency preparedness contained in the draft EA is inadequate. DOE merely observes that it has traditionally been the responsibility of state and local governments to respond to transportation accidents and that DOE radiological response teams may be available to assist. The concept of a national nuclear waste repository as the focal point for thousands of shipments of highly radioactive materials from almost every section of the country is not a "business-as-usual" situation. Potential repository states such as Nevada and potential "corridor" states along transportation routes cannot be expected to cope with the potential for accidents inherent in a major, sustained undertaking of this kind. By merely assuming that states will be able to handle emergency response responsibilities without major upgrading of state and local capabilities is extremely naive at best. DOE should formally evaluate, as part of the EA, the emergency response capabilities of the states and localities along each major transportation route and estimate what it will cost to adequately prepare each state/locality for the level of responsibility it will face when large-scale shipping begins.

Such an analysis should also be done in a comparative manner so that the current status of emergency preparedness within states along major transportation corridors and the costs associated with appropriate and necessary upgrading can be used in determining what differences exist between potential repository sites vis-a-vis emergency preparedness. The results of this analysis should be used in comparing sites based on overall transportation favorability.

5.4 Expected Effects on Socioeconomic Conditions

P. 5-84: In the introduction to this section, DOE notes that the socioeconomic analysis contained in the draft EA is based on the assumption that "safety questions about waste transportation and disposal would be resolved before the repository would be constructed." This is an unfounded, even naive, assumption. It is likely that concerns over safety and the public's perception of the risks associated with radioactive materials disposal will continue to be major issues and subjects for debate before, during, and long after construction. To dismiss such issues out of hand--as DOE has done--eliminates major potential influences on socioeconomic conditions that should be addressed in the EA. For example, a significant level of public concern about health and safety issues can have a variety of economic effects, ranging from impacts on property values for land near the repository or along transportation corridors to impacts on the state's ability to attract tourists and encourage new industry to come to the state. Such items bear directly on the effect a waste repository will have on the social and economic fabric of the state and local communities and should be addressed in detail in the EA.

5.4.1 Economic Conditions

P. 5-85: The draft EA states that the various operations end-points associated with the repository would lead to slower periods of economic growth not unlike the state has experienced before. DOE seems to be admitting that it plans to cause three recessions within the time period defined for the project.

Almost all of the economic effects of a repository are driven by the estimates of the numbers of workers needed to build,. operate, and decommission the facility. Impacts on state and local population, employment, infrastructure, services, etc. all depend upon the numbers used in estimating the repository work force. If those figures are in question or are erroneous, projections as to economic (as well as social) impacts all along the line are affected.

The figures used by DOE in the draft EA relative to projecting the repository-related work force are highly speculative at best; unsubstantiated, misleading, and inaccurate at worst. Direct labor requirements for all phases of the repository are contained in the referenced study entitled "Nevada Nuclear Waste Storage Investigations, Socioeconomic Impacts of Constructing a High-Level Waste Repository at Yucca Mountain" by Stephen McBrien and Laura Jones (1984). That report is flawed in numerous ways, among them:

- The methodology by which the authors arrived at the numbers of workers needed in each area of endeavor (miners, mechanics, etc.) is nowhere explained. There is no way to examine these calculations to determine if they are reasonable.

- Numbers for direct workers required during each phase of the project include "contingency" factors of up to 40 percent, something that is excessive and wholly inappropriate.

- Allowances for vacation time, sick leave, and other benefits are expressed in terms of additional jobs/people, adding 15 to 17 percent to the direct work-force estimates.

- In attempting to compute secondary employment figures (i.e., the number of jobs created as a result of the increase in employment resulting from direct repository employment), the authors used a multiplier used by the Air Force for estimating secondary employment resulting from Nellis Air Force Base. That multiplier (1.54) is not explained anywhere in the document (or in the draft EA). The reference containing the Nellis study (if there is such a study) that postulated the 1.54 multiplier figure has not been available for review. The citation in the McBrien-Jones report refers to a publication done by the Las Vegas Review-Journal in 1982, which merely states that "using an economic multiplier of 1.54, the number of off-base civilian jobs created by the presence of Nellis Air Force Base is 20,250." That is the only mention of the multiplier. There is no indication as to how it was arrived at. However, assuming that that figure derives from the overall character and make-up of the Nellis work force and the demographics and socioeconomic conditions of the surrounding communities, it would appear questionable to use the same multiplier in relation to a highly specialized repository work force and the substantially rural communities that surround the site. The multiplier used for the Nevada site is also 2-1/2 to 5 times larger than multipliers employed for any of the other eight sites under consideration.

Additional comments concerning the appropriateness of the indirect employment multiplier are found in our comments on Section 4.2.2.1.1.

P. 5-85: The draft EA indicates that only the "bicounty region" encompassing Nye and Clark Counties is considered in terms of the socioeconomic effects of locating a repository at Yucca Mountain. Lincoln County, which borders the Nevada Test Site on the east and which contains the major rail corridor by which waste will be shipped into the state, is not even mentioned in the document. Likewise, the Cities of Las Vegas, North Las Vegas, Henderson, and Boulder City are lumped together under the umbrella of Clark County with regard to the draft EA's analysis of socioeconomic impacts. The Moapa River Indian Reservation, which contains major transportation routes, is completely ignored.

In order to adequately identify the social and economic effects of a repository and to be able to use that information effectively in comparing sites, the EA should, at the minimum, assess impacts to all the local jurisdictions that are potentially affected. Because socioeconomic considerations are intended by the Nuclear Waste Policy Act to be included in the information used to differentiate among sites and select three for characterization, it is not appropriate to postpone a more complete and adequate socioeconomic assessment until an environmental impact statement is completed following characterization. The scope of the socioeconomic information contained in the draft EA is simply too limited and incomplete to be used in drawing any defensible conclusions about the effects of a repository on the state's economic, social, cultural, or fiscal fabric.

5.4.1.1 Labor

P. 5-85: All employment figures used in this section of the draft EA are suspect for the reasons noted above. The draft EA does not describe the methodology by which estimates of the numbers and types of direct workers are arrived at. There is no justification for using the multiplier of 1.54 for calculating the secondary or indirect employment numbers contained in the document.

There is reason to believe that the labor force numbers contained in the draft EA have been substantially overestimated. Until the document was published, direct-worker estimates being promoted by the DOE Nevada Operations Office ranged from 1,000-2,000 at peak employment. Figures in the draft EA represent an increase of between 60 percent and 200 percent depending upon which earlier figure is used for comparison.

The McBrien-Jones report (referred to above), which contains the rationale for the employment numbers presented in the draft EA, postulates contingency factors of up to 40 percent in arriving at direct worker estimates. The report also presents benefits such as sick leave and vacation time in terms of additional employees--adding another 15 to 17 percent to the overall employment numbers. No justification is given anywhere for the high contingency figures or for expressing fringe benefits in terms of extra workers.

Labor-force estimates (both direct and indirect workers) are 3-1/2 to almost 4-1/2 times greater for the Yucca Mountain site than they are for any of the other sites under consideration. The following comparison seems to suggest that worker estimates for the Nevada site are considerably out of line with the other eight sites identified as possible candidates for the first repository.

COMPARISON OF LABOR-FORCE ESTIMATES AMONG POTENTIAL SITES

Site	Construction Phase Peak Employment			Operations Phase Peak Employment		
	Direct	Total	Multiplier	Direct	Total	Multiplier
Yucca Mountain (NV)	3,350	8,500	1.54	2,131	5,875	1.54
Hanford (WA)	1,100	2,400	n.s.[a]	900	1,800	n.s.[a]
Deaf Smith (TX)	1,370	2,055	.5	1,500	3,000	1.0
Richton (MS)	1,370	1,918	.4	1,500	2,849	.9
Davis Creek (UT)	1,750	2,280	.3	1,390	2,490	.8
Cypress Creek (MS)	1,370	1,908	.4	1,500	2,840	.9
Lavender (UT)	1,750	2,280	.3	1,390	2,490	.8
Swisher (TX)	1,370	2,055	.5	1,500	3,000	1.0
Vacherie (LA)	1,370	2,188	.6	1,500	3,149	1.1

[a]Not specified.

The multiplier used to calculate indirect employment is 2-1/2 to over 5 times greater for Yucca Mountain than for any other site in relation to construction phase employment. During operations, the Nevada multiplier is between 1-2/5 and about 2 times larger.

Another area where significant discrepancies exist between Nevada and the other sites under consideration has to do with estimates of inmigrating workers. The draft EAs for both Utah sites, both Texas sites, both Mississippi sites, and the Louisiana site all employ complex models to calculate the percentage of repository-related workers expected to be inmigrants. This methodology is extremely useful in accurately predicting employment-related socioeconomic impacts to the area of each site. If such calculations can be done for seven of the sites, why was not a similar effort made with regard to Nevada? Assuming, as the Yucca Mountain draft EA does, that all workers will be inmigrants not only serves to overstate impacts but also understates employment potential for local workers. Some attempt should have been made to predict realistic inmigration percentages for the site.

The only comparable project of the type envisioned in the draft EA is the Waste Isolation Pilot Plant (WIPP) project currently underway in New Mexico. In its employment estimates for WIPP, DOE projected that twice as many workers would be employed than were actually needed once construction began. There is reason to believe that if DOE's methodology for calculating labor force requirements at WIPP was erroneous, its methodology for projecting employment at the Yucca Mountain site may be equally flawed--and equally overstated.

The EA should clearly describe the methodology DOE used to arrive at its repository-related employment projections. If a defensible and replicable methodology cannot be demonstrated, the entire socioeconomic analysis must be questioned since labor force numbers are the foundation upon which subsequent analyses must rest. The final EA should also explain any major differences in employment projections among the various sites.

The use of settlement patterns of workers at the Nevada Test Site as the basis for projecting likely settlement patterns for repository-related workers is also highly speculative. The current NTS work force is much more complex and diverse than the labor force constructing and operating a repository is likely to be. The draft EA fails to develop any rationale at all for projecting that repository workers will settle in the same areas--and in the same percentages--that regular NTS workers do. A more detailed, sector-by-sector analysis of settlement practices must be done before any conclusions can be drawn as to what percentage of workers is likely to settle in what areas. Such an analysis might examine experience with worker settlement in other large-scale projects in the western part of the country and should especially review the WIPP experience in this regard.

As with the estimates of the numbers of workers needed for a repository, an accurate and defensible projection of likely worker-settlement preferences is critical to all other aspects of the socioeconomic analysis. Unless the EA can predict--in a credible way--how many new workers can be expected to be drawn into the various Nye, Clark, and Lincoln County communities, it is impossible to project what impacts will accrue to those communities as a result of the project.

Using NTS settlement data, the draft EA projects that approximately 83 percent of repository workers will reside in Clark County and 13 percent will live in Nye County. There are many factors that undercut the assumed 83-13 percent split of workers between Clark and Nye Counties and, thereby, undermine the meaningfulness of "bicounty" comparisons. Two of these include:

1. Yucca Mountain workers will have to commute an additional 40 miles beyond Mercury for a daily (two-way) increase in commuting time of 1.45 hours at 55 miles per hour.

2. Given the additional commuting time, there is considerably more potential for residential and commercial development in communities conveniently located near Yucca Mountain than in communities between Mercury and Las Vegas that could serve NTS workers. That is, the communities of Amargosa Valley, Pahrump, and Beatty might provide housing and commercial opportunities for Yucca Mountain workers that are not as attractive to NTS workers.

In short, there are reasons to doubt the 83-13 percent geographic distribution of workers.

P. 5-86: In the third paragraph, there is some discussion of potential labor-market implications of the project. However, there is no analysis of the effects that changes in labor can be expected to have on local inflation rates. Not only are wages likely to increase in certain sectors, but the influx of new workers in a small community will increase demand for goods and services, thereby driving costs upward. The EA should examine the effect of potential labor-force changes on the marketplace for each community that is potentially affected.

The draft EA consistently discusses the employment and income gains that will occur as the site is developed. It just as consistently ignores the declines in employment that occur as the operation moves from one phase to another. As noted previously, the project may cause three recessions over its lifetime.

The majority of employment during the construction phase will be in construction and mining activities. Using DOE's figures, mining employment is expected to remain roughly constant throughout. However, construction employment peaks at 1,929 (or 1,913, depending on which figure is used) and declines two years later to zero. After construction is complete, more than 1,000 workers with skills different from those required during construction will be needed to operate the repository. This means that there will be a boom-and-bust cycle. First, a large influx of construction workers is required. After a period of five years, the need for construction personnel will vanish. These workers will either leave the Las Vegas area, taking their income with them and leaving a vacant house behind, or will stay in place and attempt to find other employment.

It would take a number of years to find such workers new construction jobs, given their number. During the transition, the State would be responsible for unemployment compensation, welfare, and various social services. There would be distortions in local housing markets and possible increases in local crime rates. It is also possible that many support-sector workers would follow the construction workers into unemployment, worsening the total negative impact. However, at the same time the construction workers were being laid off, up to 1,400 new workers would be hired. These workers also need to be housed, fed, etc., and will, therefore, require additional support-sector services.

So we have a boom-bust cycle for construction workers. The boom begins in year 1 and runs through year 3, when the decline begins. By the end of year 5, the construction workers are entirely unemployed, while the operations workers are beginning their boom phase, which runs until year 35.

The entire treatment of labor-force impacts in the draft EA points up an underlying assumption that is seriously flawed (but is nonetheless operative throughout the document), namely, that all markets work with perfect efficiency. In this case, the draft EA assumes that if 1,900 workers are needed, 1,900 workers will appear--no more or no less--and they will appear at just the proper time. If too few appear, wage rates will rise, and this will draw more workers. If too many workers appear (a far more likely consequence), there will be significant unemployment, social, and fiscal impacts--even during the so-called boom phase of the project.

5.4.1.2 Materials and Resources

P. 5-87: As noted previously, the draft EA does not describe the methodology by which DOE arrived at its estimates for the materials required for the project. Without some defensible basis for projecting material and resource needs, the numbers contained in the draft EA are highly speculative.

The document assumes that all materials except concrete, steel, fuel, and power will be purchased outside the area and suggests that approximately $390 million will be spent over the life of the repository project. Two elements of this figure are questionable. It seems unlikely that materials costs during each year of operation will be almost equal to those during the initial construction phase ($10 million/year vs. $13.5 million/year). It also seems unlikely that the retrievability phase will require almost $.5 million per year when the repository is simply under surveillance.

The discussion of socioeconomic effects that result from procurement of materials is far too limited and brief. There should be a detailed analysis of the impacts of a project the size of a repository upon the price and availability of "local" materials, especially cement and aggregate. What inflationary impact can be expected, and how can these be mitigated? Are there other materials or resources that will be adversely affected by repository demand? The EA should examine the effects of projected material and resource usage on the marketplace--within local communities, regionally, and for the state as a whole.

5.4.1.4 Income

P. 5-87: The draft EA concludes that "Increases in Department of Energy spending on labor and materials during the construction and operation of a repository at Yucca Mountain would contribute to growth in the region." However, the brief discussion that follows is incomplete since it addresses only one side of the equation--increased spending and increased income. In order to identify the real effects on communities, the EA should examine the impacts that increased income and increased DOE spending (with its attendant increase in demand for goods and services) will have on prices and availability of these things locally. In other words, the EA should analyze both sides of the equation before attempting to conclude that increased DOE spending will promote growth. The discussion in this section is misleading unless an attempt is made to examine other key variables that will affect the way repository spending impacts local communities and the state. If, for example, increased spending results in shortages of key commodities and rampant inflation the overall effect may be to stifle growth in sectors of local economies not directly related to the repository.

The data presented in Tables 5-47 and 5-48 concerning the potential annual wage expenditures associated with a repository at Yucca Mountain and the discussion on p. 5-88 are seriously flawed. Because of the highly questionable nature of direct and indirect labor-force estimates discussed earlier (the data on wages derives directly from those earlier employment numbers), the projection arrived at in this section can be considered as no more than pure speculation.

There is also no discussion of how these wage impacts might affect local communities and the state as a whole. The impression one obtains reading Section 5.4.1.4 is that there will be an annual "economic stimulus" to Clark and Nye Counties of between $131.5 million and $157.2 million, depending on which emplacement scenario is chosen. However, there is no discussion of what portion of the total wage figure would actually go to workers and contractors outside the "bicounty region." How much will be paid to out-of-state consultants, subcontractors, etc.? What will be the real wage amounts for repository-related workers actually living in surrounding Nye, Clark, and Lincoln County communities?

5.4.1.5 Land Use

P. 5-88: As discussed in comments pertaining to Section 5.2.3, the draft EA does not discuss the rationale for the extremely large (50,000 acres) land withdrawal proposed for the repository.

The land-use impact discussion in this section is wholly inadequate. It addresses only two issues--range land and mineral resources--and it does so in two very brief paragraphs. Several areas require further discussion or analysis with regard to repository land use and its effects on state and local socioeconomic conditions.

First, there is evidence that the mineral-resource potential of the site and surrounding area may be significantly more substantial than described in the draft EA (see our comments on this matter in relation to Sec. 3.2.4).

Second, the withdrawal of 50,000 acres (or even 10,000 or 25,000 acres) will have impacts on the communities adjacent to the site other than reduced range land for cattle grazing. A 50,000-acre withdrawal could seriously impact the development potential of the unincorporated town of Amargosa. Over the next 50, 100, 500, or more years, the Amargosa Valley area can be expected to grow substantially. The EA should examine the growth potential of this area over the next 500 years (at least) and then discuss the implications of permanently withdrawing 50,000 acres of land from any use by the State or by local communities. In addition, the EA should contain detailed maps showing exactly what land is targeted for withdrawal and the relation to present and projected settlement patterns, and agricultural, industrial, commercial, and other activities (existing or possible) within the area.

Third, there are significant jurisdictional and legal/constitutional questions involving the proposed land withdrawal that must be addressed in the final EA. (See comments on land and water issues contained in the Major Comments section.)

5.4.1.6 Tourism

P. 5-91: Given the critical importance of tourism to the southern Nevada economy--and to the economy of the entire state--the discussion of potential tourism impacts contained in the draft EA is inadequate. Nevada is unique among all other states in the nation--and certainly among the six states being considered for the first repository--in that its economy is built around revenues generated by tourism (especially gaming). The socio-economic impacts associated with a repository in southern Nevada cannot be adequately analyzed unless the effects of such a project on the state's tourism industry are examined in detail. Likewise, it is impossible to compare Nevada with other potential-site states vis-a-vis socioeconomic factors unless a comprehensive assessment of tourism impacts has been conducted.

The entire tourism discussion in the draft EA consists of four short paragraphs, which oversimplify the issues that need to be addressed. DOE begins by noting that research concerning the potential effects of a repository on Nevada's tourism is "inconclusive." The discussion then goes on to subtly imply that tourism impacts are likely to be small given the fact that the existence of the Nevada Test Site "does not appear to have had a significant effect on tourism, and this suggests that the repository would not change the total aesthetic appeal of the Las Vegas area." There is no discussion about what tourism or other economic-growth opportunities might have been lost to Nevada because of the activities at the Test Site.

The only research on tourism impacts cited in the draft EA is a 1983 study done by Science Applications International Corporation. That study is a very general report that does not attempt to conduct or utilize any Nevada-specific research. Instead, it provides statistics on the numbers of people currently visiting the Las Vegas area annually (ostensibly to demonstrate the numbers of tourists involved) and summarizes the results of a "study" of selected "cases" that each contain mention of some form of tourism/recreation impacts associated with such things as nuclear power-plant projects, the Three Mile Island incident, offshore oil spills, earthquakes, hotel fires, the Love Canal situation, and the Legionnaire's Disease outbreak in Philadelphia. There does not appear to have been any attempt to develop a justifiable methodology for selecting "cases" for inclusion in the report or for determining the relevance of studies/cases selected to the situation in Nevada.

Any conclusions drawn about potential repository-related tourism impacts from this study must be treated with considerable skepticism. Nevada is vastly different economically, socially, and culturally from Harrisburg, Pennsylvania, upstate New York, Mammoth Lakes, Philadelphia, or other places mentioned in the report. The role and importance of tourism in Nevada's economy--and in the state's entire social, cultural, and political fabric--is unique. It is inappropriate at best to attempt to extrapolate the tourism effects felt at Harrisburg to those that will potentially accrue to Las Vegas as a result of a nuclear-waste repository at Yucca Mountain.

Likewise, a nuclear waste repository with its unique siting and operational characteristics (including massive transport of highly toxic materials and the 10,000-year project life-span) presents a drastically different set of circumstances from the short-lived, relatively limited projects and incidents examined in the SAIC report.

The EA must be revised to include a more comprehensive assessment of tourism impacts on local Nevada communities and on the state as a whole. The information contained in the draft EA is inadequate for either identifying possible effects on the state's largest industry or comparing Nevada with the other five potential host states in terms of overall socioeconomic impacts attendant upon the siting of a nuclear waste repository.

A related area that should be examined in the EA, but is not mentioned anywhere, involves the effects a repository at Yucca Mountain might have on the economic development potential of the state. How will a repository impact local communities' and the state's ability to attract new industry and diversify the industrial base (both locally and statewide)?

The final EA should expand the analysis of tourism effects to include an examination of the impacts on potential economic development. Section 5.4.1.6 might be re-titled, "Tourism and Economic Development."

One final comment involves potential tourism and recreation impacts unique to Lincoln County. Because Lincoln County has the greatest concentration of state parks of any county in Nevada and because Lincoln County is, in many respects, a playground for residents of Clark County, it is probable that state parks within Lincoln County will experience repository-work-force-related increased usage. To what extent may these increases occur?

Also, what effect, if any, will shipments of nuclear waste by rail have on tourism in the City of Caliente and at Kershaw Ryan State Park and the Rainbow Canyon Resort, all located south of Caliente in the vicinity of the mainline Union Pacific?

5.4.2 Population Density and Distribution

P. 5-92: Population density and distribution impacts derive directly from earlier labor-force and settlement-pattern estimates. As discussed earlier, those estimates as they are presented in the draft EA are speculative and unsubstantiated. There is evidence that the labor force (both direct and indirect employment) has been overstated (perhaps by as much as 40 to 60 percent). (See comments relative to Sec. 5.4.1). In addition, population impacts to Lincoln County communities are ignored completely in the draft EA.

Estimating population density and distribution effects is a critical part of any socioeconomic analysis. The final EA should contain a detailed assessment--using revised and justifiable labor-force estimates--of population changes in each local community, including Amargosa, Beatty, Pahrump, Tonopah, Las Vegas, North Las Vegas, Henderson, Boulder City, Caliente, and the remaining areas of Clark, Nye, and Lincoln Counties.

5.4.3 Community Services

P. 5-92: Impacts on community services relate directly to repository-related employment estimates and worker-settlement patterns. As noted previously, those projections in the draft EA are suspect. Consequently, any analysis of community services will likewise be flawed.

P. 5-92: DOE notes that analyses of community-service impacts were performed only for Nye and Clark Counties. Only whole-county impacts were reviewed. No attempt was made to analyze impacts to local jurisdictions within those counties. In addition, Lincoln County, the City of Caliente, and the Moapa River Indian Reservation are ignored completely--as they are throughout the document. Likewise, no mention is made of possible statewide community-service-related impacts (for example, the effect on state unemployment levels and benefit/costs resulting from the ebb and flow of employment at the site).

P. 5-95: The document states that it was assumed that existing service ratios would be valid in future years and that no assumptions were made as to the timing of needed service expansion, only that the necessary numbers of facilities (and services) would be available during each phase of the repository.

The assumption that existing service-to-population ratios will be an appropriate yardstick for predicting future service needs is only valid if existing service levels are adequate. If services are already overburdened, such an assumption leads to significant understatement of future requirements. Conversely, if service levels today are far short of capacity, future needs will be overstated. The final EA needs to discuss the adequacy of services currently available in each of the categories mentioned. Based on that analysis, it can then go on to predict future requirements, given various growth scenarios.

P. 5-95: The draft EA states that while probable settlement patterns of inmigrating workers are uncertain, inmigration could become a burden to small communities while larger communities would be more likely to absorb new workers with fewer impacts on existing services. It is essential that the EA focus not on "bicounty" impacts but on potential effects to each locality. In the case of urban Clark County, significant impacts may be expected if a large percentage of workers (and families) should settle collectively in one area of the county. There could be--and probably will be--disproportionate impacts on schools, housing, and other services in certain sections of Clark County.

Another comment relative to community services in general (although it applies equally to the entire socioeconomic analysis contained in the draft EA) is that the document assumes that inmigrating workers will be demographically similar to existing populations in the various communities that are potentially affected. This is not likely to be the case. The impact on service needs resulting from an influx of repository-related workers and families who are in the aggregate dissimilar in age, race, sex, income, etc. from residents already in the area should be discussed in the final EA. For example, mining and construction workers in other "boomtown"situations have shown a tendency to place greater demands on law enforcement facilities, lower demands for library books, etc.

Another general assumption reflected in the draft document's discussion of all service impacts is that there will be just enough workers moving into an area at just the right time to fill just the right number of jobs. In actuality, there are likely to be severe problems of timing. Initially, many more workers than are needed may be drawn to the area by the prospect of jobs and high wages. These workers may begin moving into local communities well in advance of the time they can expect to be hired. Such eventualities can be expected to have far greater impacts on all local services than would be the case if labor-supply-and-demand forces worked perfectly (as assumed in the draft EA).

Note: Several important areas of community-service impacts are missing entirely from the draft EA. There is no discussion of social-service impacts that can be expected as a result of a repository at Yucca Mountain. Current and future availability of mental health, alcohol and drug abuse, rehabilitation, and unemployment services are not assessed. The entire State/county welfare system and its ability to handle potential impacts associated with the ebb and flow of repository employment and with the family disruption that is often associated with rapid growth or major population changes are likewise not examined.

Because the changes attendant upon a large-scale project of this type will affect the ability of people (residents and inmigrants alike) to control their lives and cope with new conditions and conflicts, it is important that the final EA carefully examine the current and future capabilities of local, county, and state social and welfare services to meet expanding needs and adapt to changing conditions.

5.4.3.1 Housing

P. 5-99: The general comments noted above apply to the draft EA's discussion of housing impacts.

The assessment of a Yucca Mountain repository's effects on housing in local communities is generally inadequate. It fails to examine the real-world conditions in each potentially affected locality and assess impacts based on that examination. To simply imply, as the draft EA does, that housing impacts are easily mitigated by supplying temporary housing during the construction phase is misleading. For example, the UNLV Center for Business and Economic Research points out that the housing market functions less than perfectly. In a typical year, about 6,000 new housing units are created in Clark County. If, at the end of year 5, the 1,900 construction workers and their 3,000 support workers (hypothetical numbers) were all to pull up stakes and leave town, one year's total housing supply would be vacant. This would mean that no building would be required for a year.

Here again, the markets work with less than total efficiency. Builders respond to market conditions and do not have perfect knowledge of total demand. If they build based on the market demand during the first three years of construction or the first year of operation, Clark County will have significant overbuilding. Add the overbuilding to the large vacant stock caused by layoff of construction workers at the end of the construction phase, and the housing industry in Clark County could face severe financial hardship. This hardship could also spill over into the banking industry, which would find it difficult to operate in the home-finance market.

If the scenario mentioned above seems farfetched, it is not. The University of Nevada-Las Vegas Center for Business and Economic Research points out that this is exactly the situation that occurred in Clark County following the Test Site expansion in the early 1960s. Severe overbuilding caused a collapse in the housing market lasting until the late 1960s, and caused noticeable concern in the financial markets. Several financial institutions were reported close to insolvency at various times. Similar impacts can be postulated for Nye and Lincoln County communities.

The final EA should examine in detail real-world housing conditions and potential impacts (including those to the banking and construction industries) within all potentially affected communities. (See also comments relative to housing in Chapter 3, Sec. 3.6.3.1).

5.4.3.2 Education

P. 5-99: The draft EA again assumes that there will be a homogeneous distribution of inmigrants throughout the "bicounty region." Impacts on Clark County schools could be significant if large numbers of people settle, en masse, in a few areas or neighborhoods. There could be substantial increases in population for certain schools.

The same is true for Nye County (as well as Lincoln County, which is not even considered). However, such uneven settlement patterns within rural Nye or Lincoln Counties could have a drastic effect upon these counties' ability to provide adequate educational services. The draft EA postulates a 20 percent increase in the Nye County school population overall as a result of repository activity by the year 2000. If that population increase were to occur primarily in Amargosa, for example, the implication for the County's school system would be dramatic. Does the County proceed to build the equivalent of three new schools in the Amargosa area--even though demand will drastically subside once construction of the repository is complete? What other options are available to the County?

The final EA should examine repository-related education impacts in more detail and in a manner that reflects real-world conditions.

(See also our comments relative to education in Section 3.6.3.2.)

5.4.3.3 Water Supply

P. 5-101: The discussion in the EA on water supply appears somewhat contradictory. In the first paragraph under 5.4.3.3, the document states that, "At present, the size of municipal and private utility systems in most communities near Yucca Mountain appears adequate for current and future population levels, although some water systems need to be expanded." In the next paragraph, however, it is pointed out that, "if present rates of water use continue, then there is both legal and technical uncertainty as to the ability of existing sources [of water] to provide additional capacity to meet increased water demands in the Las Vegas valley beyond the year 2020. . . ." This apparent inconsistency should be clarified in the final EA.

Beyond the need for water to meet demands of population increases brought about by the repository-related work force, a major impact on water supplies would be the potential for aquifer contamination in the event of a repository failure some time in the future. The area surrounding Yucca Mountain is likely to be very different, population-wise, 100 years or 500 years or 1,000 years from now. The EA should attempt to project population and settlement changes for at least the time periods referred to and assess the impact of a worst-case repository failure (i.e., one that results in rapid contamination of ground water immediately below and adjacent to the site).

What effects would there be on people in the area at the time? Is it conceivable that the Las Vegas area may need to draw water from the aquifer beneath Yucca Mountain in 500 or 1,000 years?

The Nevada Department of Conservation and Natural Resources points out that the Yucca Mountain site lies over the deep carbonate aquifer that may be a significant source of water for the future needs of Nevada. Due to the fact that Nevada is the driest state in the nation, while at the same time experiencing the fastest growth rate, water demand is fast outpacing the available supply. In order for Nevada to meet future needs, alternate sources of water must be investigated and assessed. One alternative that is currently under investigation is determining the feasibility of tapping the deep carbonate aquifer for a future supply of water.

The quality of water beneath the Yucca Mountain site in the shallow aquifer appears to meet the Safe Drinking Water Standards for Human Consumption. Any contamination of this aquifer and, subsequently, the deep carbonate aquifer could be extremely detrimental to the future growth of Nevada. The interconnection between the deep carbonate aquifer in the hydrologic basin beneath Yucca Mountain and other areas in Nevada where the deep carbonate aquifer may be tapped in the future is unknown at this time. However, it is known that the ground-water aquifers that have been investigated flow from the Yucca Mountain site to an adjacent hydrologic basin, and that such waters become interspersed with water originating in other ground-water basins. (See also our comments relative to water supply in Section 3.6.3.3.)

5.4.3.5 Public Safety Services

P. 5-102: General comments made in relation to overall community services (Sec. 5.4.3) apply to public-safety service impacts. Specifically, the need for additional police and fire services cannot be expected to be spread evenly throughout Clark or Nye Counties. There will be differential needs in various areas depending upon projected settlement patterns of inmigrants. The final EA should examine the impacts on local governments and on communities in general of increased and uneven demands placed on different parts of each county by repository-related population increases.

Demographic characteristics of the projected work force, together with an analysis of impacts that have occurred with regard to other large-scale construction projects as a result of inmigrating workers, should be examined in the final EA.

It should be pointed out again that public-safety service impacts for Lincoln County and the City of Caliente are not included in the EA despite the fact that the County and City will contain major rail transportation routes and facilities for high-level waste shipped to the site. Since County police and fire services are already extremely limited and overtaxed due to the large land areas that must be covered, any additional duties, responsibilities, etc. will substantially impact the county both financially and from a public-safety standpoint.

Another area missing from analysis in the draft EA has to do with potential public-safety impacts to the State. What effects will a repository at

Yucca Mountain--with its attendant shipments of waste into the state, and the population and traffic increases associated with the project--have on the Nevada Highway Patrol? What impacts will there be to the State with regard to emergency-preparedness requirements necessitated by the large numbers of rail and truck shipments coming into the state? These and other public-safety impacts to the State should be comprehensively addressed in the final EA. (Such an assessment should examine the interrelationships of the State and local governments in responding to hazardous-materials accidents and the financial implications to the State of providing local jurisdictions with the equipment, training, and support necessary to respond effectively to radiological emergencies.)

(See also our comments relative to public safety services in Section 3.6.3.7.)

5.4.3.6 Medical Services

P. 5-102: As with other types of community services, impacts of a repository upon medical services in affected communities will be directly related to labor-force estimates and settlement patterns of workers. If these projections are questionable, any inferences drawn from them--including impacts of population changes on medical services--will be unreliable. The final EA must base all such impact analyses on defensible labor-force calculations. (See comments relative to Sec. 5.4.1 above.)

Nye, Lincoln, and other rural counties surrounding the proposed site are considered areas with severe shortages of medical personnel and facilities. Repository-related population changes in those counties will have a disproportionately serious impact on the level and availability of health care. The final EA should examine in detail the medical-service impacts that might be expected to occur in the various rural communities of Lincoln, Nye, and even Clark Counties. Such an analysis should include, but not be limited to, inflationary effects, service availability, costs to local governments to provide additional services, potential changes in morbidity and mortality rates, potential impacts on existing acute-care facilities (in Clark as well as Nye and Lincoln Counties) as a result of heavier usage caused by decreased health care availability in local communities, etc.

(See also our comments relative to medical services in Section 3.6.3.8.)

5.4.3.7 Transportation

P. 5-102: Repository-related socioeconomic impacts associated with transportation will not be limited to potential changes in traffic volumes along state roads and rail lines. Transportation impacts to Nevada communities along truck and rail routes used for shipping high-level radioactive waste will be greatly disproportionate to the overall increase in road or track usage. Such transportation-related impacts involve, among other things, the risks associated with waste shipment and the perception of those risks (and attendant consequences of such perceptions) by citizens residing in the various affected communities. Impacts on property values, on industrial and commercial migration into or out of areas associated with risks (or perceived risks), and on state and local entities responsible for emergency-preparedness planning are examples of the types of effects that should be examined in relation to transportation factors. (See also comments on transportation in Sec. 5.3, which apply equally to this section).

In terms of transportation infrastructure impacts and needs, the draft EA understates the potential effects of a repository at Yucca Mountain. While the projected increase in the number of jobs (directly related to construction and maintenance of the facility) is not great in terms of the entire labor picture in Las Vegas, secondary impacts are underestimated by DOE. The Yucca Mountain project could mean that Pahrump Valley and the corridor along U.S. 95 north of Las Vegas will expand. DOE assumes that settlement patterns of the new employees will be typical of Nevada Test Site employees of the past. Because of distances, difficulties in the commute, and the need for cost-effective housing, areas projected to grow by small degrees could actually boom. In one respect, growth in these outlying communities will behave much like mining towns in Nevada's past. The perception of growth may draw in a variety of people all eager for new opportunities and with a desire to make money. In the long run the proposed project could make areas like Pahrump Valley into detached suburbs of the Las Vegas metropolitan area.

Growth in these outlying areas will strain the existing transportation network, and there will be a need for new roads. A cycle will be started where better transportation increases growth, which strains transportation facilities and creates a need for a better transportation network. The State will be in the position of having to obtain funds to plan, build, and maintain the transportation network this project will ultimately call for.

The final EA should discuss the range of possible impacts to Nevada's transportation infrastructure together with the costs potentially associated with such impacts.

5.4 Sociocultural Conditions

P. 5-105: The draft EA correctly points out that sociocultural factors associated with a nuclear waste repository include a whole series of "special" conditions or effects that stem from public concerns about radioactive materials and things nuclear. The draft EA indicates that such special effects include: "(1) the effects on health and safety; (2) the fairness of the site selection process; (3) the institutional issues related to security, handling, and transportation; and (4) public participation and monitoring." Another effect that should be added is that of the public's <u>perception</u> of the risks associated with a repository and with shipping highly radioactive materials through the state.

5.4.4.1.1 Standard Effects on Social Structure and Social Organization

P. 5-105: The draft EA indicates that "In light of the small size of the increment relative to the projected baseline population and the complex nature of the existing social structure in urban Clark County, the effects [of a repository on social structure and social organization] would not be significant." Such a statement is <u>not</u> substantiated by any evidence or analysis contained in the document. In fact, standard effects on social structure and social organization may be extremely significant if large groups of repository workers settle in relatively small Clark County communities or are concentrated in a few specific areas or neighborhoods. The final EA should clearly examine potential impacts from such uneven settlement patterns since, in the real world, it is very likely that workers will tend to congregate in the areas of Clark County closest to the site or to the prime commuter corridors between Las Vegas and Yucca Mountain.

P. 5-106: The statement in the draft EA that the compatibility between inmigrating workers and communities of Nye County will preclude significant standard effects on the county's social structure and organization is based on a substantially incomplete and even simplistic appraisal of conditions affecting the degree of compatibility between existing and inmigrating populations. While there may be areas of commonality between new repository workers and existing residents of surrounding communities, those areas of common ground are likely to be limited to similarities in things related to occupation (i.e., inmigrants, like many existing residents, will be miners, construction workers, laborers, etc.). However, there is no basis to assume that workers attracted to the area by the project will mirror residents in terms of their demographic composition. Given the fact that Nye County is an extremely rural area, and given the nature of the project and the likelihood that it will attract construction personnel from large urban areas throughout the country, there is strong reason to assume that a significant number of inmigrating workers may be accustomed to living in more urbanized environments and may be dissimilar, in the aggregate, to existing residents in terms of age distribution, racial composition, and certain lifestyle variables (urban orientation, expectations, attitudes toward rural people and rural living, etc.).

The draft EA postulates that the long lead time of the project (and the lengthy span for planning that implies) may reduce eventual social disruption to a minimum. It does not, however, consider the converse possibility--that the long lead time may exacerbate the problem by causing workers, motivated by rumors of lucrative employment, to flow into the area well in advance of the actual construction phase. Such a situation would tend to strain existing local institutions dealing with large numbers of transient, unemployed people and would compound whatever "natural" conflicts there might be between residents and newcomers.

Admittedly, either scenario (the one presented in the draft EA or the one suggested above) is speculative at this point. However, a document that purports to objectively assess social and cultural impacts on local communities cannot assume one hypothetical set of conditions without examining other, equally likely scenarios. This selective assumption trend runs throughout the draft EA and is one of the document's major flaws--especially in the socioeconomic, transportation, and sociocultural areas.

5.4.4.1.2 Special Effects on Social Structure and Social Organization

P. 5-106: The discussion in the draft EA of the special effects of a repository at Yucca Mountain is almost wholly inadequate. It highlights only the potential for social conflict arising out of the formation of groups that either oppose or support the project and makes no attempt to examine such potential in relation to expected effects on local communities or on the state as a whole.

Many other important "special" effects are entirely absent from the document. For example, how will the presence of a repository containing massive quantities of highly radioactive materials affect the evolution of social structures and social organizations in surrounding communities over long periods of time (i.e., hundreds and even thousands of years)? What are the effects of perceived risks associated with a repository upon long-term stability of social institutions? What are the positive and negative implications of likely public perceptions (from a local, regional, and national perspective) of the site and surrounding area as dangerous or radioactively contaminated?

Admittedly, such special impacts are extremely difficult to identify and measure. The Environmental Assessment cannot be expected to address every such effect in detail. However, the EA should begin to lay the groundwork for a more comprehensive treatment of the subject in subsequent socioeconomic impact analyses. The extremely limited treatment of special social, economic, and cultural effects of repository siting, construction, operation, and long-term existence in the draft EA would seem to suggest that DOE does not intend to pursue the matter in much detail. At the least, the final document should describe a framework by which further investigation of special impacts will be undertaken.

Note: The whole issue of "special" effects is relevant to the entire spectrum of socioeconomic analyses and should be addressed in relation to each section in Chapter 5. "Special" impacts associated with the nuclear nature of the repository project can be expected to occur with regard to almost all economic conditions (labor, project cost and income effects, land use, tourism, community services, transportation, and others). The final EA should begin to identify major special effects with regard to each socioeconomic and transportation subcategory discussed in Sections 5.3 and 5.4, respectively.

5.4.4.2 Culture and Lifestyle

P. 5-107: The discussion of repository effects on culture and lifestyle contained in the draft EA consists entirely of one short paragraph. The conclusion that "Because of the diversity of the existing cultural environment, inmigrating workers would be able to select a compatible cultural environment and are likely to be readily assimilated into the community" is unsupported by any sort of documentation or evidence. This statement is characteristic of the types of overly optimistic, unreferenced, and unsubstantiated conclusions that are made throughout the draft EA.

Apart from the fact that such a statement is probably nothing more than someone's personal opinion, there is evidence to suggest that worker-settlement patterns are influenced far less by the desire for cultural homogeneity than they are by the hard-and-fast realities of convenience and the old cost/benefit equation. This may be even more true for the type of work force required during construction (i.e., relatively transient workers from diverse backgrounds, drawn from urban as well as rural areas). To assume that such workers, who will be employed only for a period of four to five years, will seek out the most culturally compatible locale within which to settle is naive at best. It would be more appropriate to assume that repository employees will gravitate to those areas where they can maximize earnings and minimize the inconvenience of working in (and having to commute to) a very isolated construction site.

In concluding the excessively brief treatment of culture and lifestyle impacts, the draft EA states that "Further assessment may be required following identification of specific routes within the state" (emphasis added). First, further assessment must be done if the final document is to have any credibility in this important area. Second, the implication that investigation of cultural and lifestyle (or any other) impacts must await the selection of actual transportation routes is greatly misleading. There are only a limited number of potentially usable truck routes into the state leading to the Yucca Mountain area. Potential rail routes are even more limited. DOE essentially knows where waste will be shipped within Nevada. The final EA should examine the culture and lifestyle effects of such shipments on communities located along all routes that may be considered prime candidates for shipping high-level radioactive materials to the repository.

Finally, the Environmental Assessment should describe clearly what constitutes culture and lifestyle effects and variables for analysis. The final document should not only provide a preliminary analysis of the major potential impacts on each community, but it should also establish a comprehensive framework by which additional investigation will be carried out in the event Yucca Mountain is selected for characterization.

5.4.4.3 Attitudes and Perceptions

P. 5-107: The impacts of citizens' attitudes and perceptions about a nuclear waste repository and about the risks associated with such a project (especially the transportation of radioactive materials) are much more complex than is implied in the draft EA. The document summarizes (briefly) some of the major elements likely to influence public opinion (pro or con) relative to a repository. However, there is much more to such an analysis than an examination of public opinion.

Attitudes and perceptions are the foundations upon which behavior is based and, ultimately, decisions are made. How people think about a nuclear waste repository in Nevada and how they perceive the risks associated with such an undertaking will have direct economic, social, and even political implications for local communities and for the state as a whole. For example, if people believe that the risk associated with waste transportation is high (whether is is or not), they will be less likely to buy property near shipping routes or move businesses into areas where large numbers of waste shipments must pass. Likewise, if people outside Nevada perceive the existence of a repository located approximately one hour from Las Vegas in a negative manner, that perception may influence their willingness to visit the area as tourists or even to locate businesses in the state.

While such impacts are by no means certain, the final EA should begin to develop the methodology and framework by which the entire spectrum of impacts related to public attitudes and perceptions about the repository project can be identified and examined.

5.4.5 Fiscal Conditions and Government Structure

P. 5-108: The discussion on repository-related effects on fiscal conditions and government structure in the draft EA is wholly inadequate. The discussion on pp. 5-108 and 5-109 contains one brief paragraph that summarizes, in the shortest and most general manner, certain broad areas of fiscal impacts expected during the planning, construction, and operational phases of the project. The document then goes on to describe the mitigation provisions of the Nuclear Waste Policy Act in general terms--without any attempt to relate such provisions to specifics of the Nevada situation.

The assessment of repository-related impacts on state and local governments' structure and finances should have been a major focus of the draft EA. How can the social, economic, cultural, transportation, and other effects of a repository be compared among the various candidate sites unless some effort has been made to quantify those impacts in fiscal terms? And how can DOE justify any site-comparative evaluation unless it has identified the major implications a repository is likely to have on the structure--and stability--of affected governments (especially local governments)?

The current version of the EA cites three areas of fiscal impact: (1) expenditures required for local, county, and state planning; (2) costs associated with community service impacts during construction; and (3) funds needed for road maintenance, traffic escort and control, and emergency preparedness during operation. There is no elaboration of exactly what these impacts are comprised of nor is there any discussion as to how these impacts will affect specific governments and levels of government.

The same paragraph goes on to state that such costs will be offset, at least partially, by a variety of state revenue-generating mechanisms (taxes, user fees, etc.). Nowhere is such a statement supported by evidence of statistical (or any other) research.

The final EA should establish a comprehensive framework by which the costs and benefits of a repository to state, county, and local governments can be identified and estimated--in terms of dollars and cents, not generalized assumptions. To do this, the EA might be organized so that each socioeconomic and transportation section contains an analysis of the potential costs (using justifiable ranges based on supportable assumptions for worst-case and best-case conditions) projected for each level of government. Similar analyses should be done for the income (or benefit) side of the equation. Such evaluations should be structured so that fiscal impacts are identified according to each phase of the repository project (including characterization, which is not mentioned in Sec. 5.4.5 in the draft document).

A similar analysis should be done in relation to possible impacts on government structure. What happens to local government in a small rural community when inmigrating workers and their families descend upon the area in large numbers? What impacts can be expected to accrue to the Nye County governmental structure, for example, in the event that the Amargosa Valley population increases to the point where it becomes a "major" population center within the county? Could repository workers influence the makeup of county government (in Nye County) to such an extent as to alienate long-time residents or increase pressures for changing current in-county jurisdictional alignments? These are the type of questions that need to be addressed if the final EA is to present any meaningful evaluation of repository impacts on government structure.

The lengthy discussion of the provision for mitigation contained in the Nuclear Waste Policy Act is probably inappropriate and unnecessary, unless the discussion relates specific mitigation proposals to specific fiscal (or other) impacts identified directly within the EA itself. Otherwise, a wordy summarization of the NWPA serves only to fill space and divert attention away from the real issues involved.

5.5 Summary of Environmental Effects

P. 5-110: Table 5-57 paints an overly optimistic picture of what the draft EA considers "environmental effects" of the repository. This table should be revised to incorporate all of the areas contained in these comments. In addition, any portrayal of impacts in table form should be structured so that the negative as well as positive aspects of each impact are clearly described and quantified (if possible).

SPECIFIC COMMENTS ON CHAPTER 6

SUITABILITY OF THE YUCCA MOUNTAIN SITE FOR SITE CHARACTERIZATION AND FOR DEVELOPMENT AS A REPOSITORY

6.2.1.1 Postclosure Site Ownership and Control

P. 6-7: Section 6.2.1.1 implies high confidence that DOE can obtain permanent control of the land in a timely manner. Nowhere in the draft EA is there a delineation of the site or the controlled area. The BLM portion of the site will require withdrawal through the Federal Land Policy and Management Act of 1976 (described briefly in Richards and Vieth, 1984). Given that renewal of the Nellis Air Force Range under the 1976 Act has been before Congress since 1977 with no action, what confidence does DOE have that timely action can be accomplished for the repository land withdrawal? See also our comments concerning land use relative to Section 5.2.3.

This section also notes that "superior water rights" may control DOE's ability to own water rights at the site. Since significant quantities of water will be utilized during site characterization, it is imperative that the question of superior water rights be resolved as soon as possible, at least prior to characterization.

6.2.1.1.4 Postclosure Site Ownership Potentially Adverse Condition

P. 6-11: The draft EA concludes that while this potentially adverse condition does exist relative to Yucca Mountain, "in view of the absence of conflicts over land use for this [BLM] portion [of the site], no impediments to the obtaining of control by the DOE are projected." This conclusion is totally unsubstantiated by any information contained in the draft EA or by an even superficial examination of the issues involved. There are numerous conflicts regarding land use/ownership that could impede DOE in obtaining control of a large segment (50,000 acres) of public lands. First, there is an ongoing dispute between the federal government and the Western Shoshone Indian Tribe over ownership. Second, local interests in the Amargosa Valley and Nye County are not likely to passively allow DOE to usurp 50,000 acres of land that may be needed for expansion, agriculture, etc.

The DOE should state clearly that this potentially adverse condition is definitely present with regard to the Yucca Mountain site. There is no basis for modifying that conclusion with inaccurate and overly optimistic phraseology.

6.2.1.1.5 Postclosure Site Ownership Qualifying Condition

P. 6-11: The draft EA concludes that "no impediments to eventual complete ownership and control [of the land required for the repository] by the DOE have been identified." That is not an accurate statement. There will be significant impediments to the withdrawal of over 50,000 additional acres of public land--as proposed by DOE. A withdrawal of that size will require Congressional action and will be challenged by the State and local governments as well as by numerous local and national interest groups. A level 3 finding is not justified for this qualifying condition.

6.2.1.2.5 Population Density and Distribution Disqualifying Condition 3

P. 6-19: The text states that "Preparation of an emergency preparedness plan for Yucca Mountain should present no problems. . . ." This statement may or may not be accurate. However, it is not substantiated anywhere in the draft EA. Without adequate substantiation, it is difficult to see how DOE can conclude that the site is not disqualified under condition 3.

6.2.1.3 Preclosure Site Ownership and Control

P. 6-22: See our comments relative to Section 5.2.3. Comments made relative to postclosure site ownership and control (Secs. 6.2.1.1, 6.2.1.1.4, and 6.2.1.1.5) also apply to this section.

6.2.1.3.3 Preclosure Site Ownership and Control
Favorable Condition

P. 6-23: DOE qualifies its finding that the site does not meet this favorable condition by stating that "because the remaining portions of the proposed site are owned by the Federal Government, it is expected that the DOE can acquire jurisdiction and control over the land, including all surface and subsurface rights."

That statement is wholly unsubstantiated, for reasons noted in comments applicable to Sections 6.2.1.1.4 and 6.2.1.1.5.

6.2.1.3.4 Preclosure Site Ownership and Control
Potentially Adverse Condition

P. 6-23: While acknowledging that this potentially adverse condition is present, DOE concludes that "in view of the absence of conflicts over land use for this portion, no impediments to the obtaining of control by DOE are projected."

There is no basis for such a statement given the size of the withdrawal, the need for Congressional action, the existence of competing claims (the Western Shoshone land issue), and the potential for competing uses by the Town of Amargosa and Nye County. (See comments relative to Sec. 6.2.1.1.4).

Richards and Vieth (1984) indicates DOE will not initiate a FLPMA land withdrawal request until a license application is sent to NRC. Is this the application to construct a repository? There is no discussion in the draft EA or Richards and Vieth of measures that will be taken during site characterization to restrict public access to BLM land and the proposed site. Such measures should be described in the EA.

6.2.1.3.5 Preclosure Site Ownership and Control Qualifying Condition

P. 6-24: There is no basis in the draft EA for a level 3 finding with regard to this qualifying condition. As noted with regard to Section 6.2.1.1.5, there are potentially major impediments to DOE's obtaining control over the 50,000 acres of public land required for the repository. The treatment of this qualifying condition with regard to the Nevada site is wholly inadequate. The conclusion contained in the document is unsubstantiated and subjective.

6.2.1.5 Offsite Installations and Operations

P. 6-34: Figure 6-1 locates past, current, or potential future weapons-testing areas on the Nevada Test Site. No references document the future weapons-testing areas. Documentation of potential future weapons-testing areas on NTS should be cited and provided.

6.2.1.5.4 Offsite Installations and Operations Potentially Adverse Conditions

P. 6-37: Section 6.2.1.5.4 evaluates the presence or absence of nearby potentially hazardous installations or operations that could adversely affect repository operation or closure. The mere presence of the active Nellis Air Force Bombing Range bounding the repository on the north and west suggests a potentially hazardous condition. While Yucca Mountain is presently not in the normal flight patterns, future changes in flight patterns cannot be discounted. Aircraft crashes and stray ordnance releases over the surface facilities cannot be dismissed. Present analysis of the problem in the draft EA is inadequate and unsupported. The EA should acknowledge that a complete evaluation of the aircraft-hazard problem and any resulting design recommendations will be performed during site characterization.

6.2.1.5.5 Offsite Installations and Operations Disqualifying Condition

P. 6-41: The draft EA states that no damage to off-site mines due to underground weapons tests has been reported through 1977. The time period of the surveillance by the U.S. Bureau of Mines is not identified. Weapons testing has been underway since the early 1950s; it is unknown if any mines have been in continuous operation since then. Repository construction, operation, and closure could take 90 years to accomplish; therefore, the surveillance data proves no evidence of long-term stability. The data do not support a level 1 finding with regard to this disqualifying condition.

P. 6-42: The draft EA states "No detectable levels of radioactivity from the underground testing program were observed outside the Nevada Test Site boundaries during 4 of the past 5 one-year reporting periods for which data have been compiled (see Table 6-7)." This statement is a distortion of the facts contained in Table 6-7. A complete review of Table 6-7 indicates detectable levels of radioactivity were observed in 5 of the last 9 one-year reporting periods. A different conclusion is thus drawn by utilizing all the data, not just a portion. A history of detectable releases of radioactivity off-site could present significant problems for future repository-release monitoring. The EA should describe the complete data base relative to off-site releases and should discuss in detail potential future problems with accurate monitoring of repository releases at the site.

6.2.1.6 Environmental Quality

Pp. 6-44 to 6-73: The evaluation included in this section relative to possible environmental consequences of a repository at Yucca Mountain does not address the possibility of ground-water contamination as a result of repository failure during the first 500 years. The single most significant cause of environmental impacts would be some sort of water contamination. That possibility should be examined and consequences thoroughly evaluated with regard to each environmental quality guideline.

6.2.1.6.4 Environmental Quality Potentially Adverse Condition #6

P. 6-69: The draft EA concludes that "repository siting, construction, operation, and closure at Yucca Mountain should not affect the outflow of the springs in Ash Meadows. Water supplies for the repository will not be drawn from the ground-water basin that feeds the springs." There are, however, conflicting reports as to whether or not the waters in the Yucca Mountain area flow to the Devil's Hole area in Amargosa Desert. This issue should be resolved since Devil's Hole contains federally protected endangered species, and excessive pumping at the Yucca Mountain site could adversely affect the springs if they are hydrologically connected.

6.2.1.7 Socioeconomics

P. 6-74: The conclusions reached with regard to every socioeconomic condition are unsubstantiated by information contained in the relevant sections of the draft EA (Chapters 3 and 5). As pointed out in our comments relative to Sections 3.6, 5.1, and 5.4, the document's analysis of socioeconomic conditions and impacts is based on incomplete, inadequate, and erroneous data; questionable data-analysis methodologies; unsubstantiated assumptions; and seriously incomplete assessments. The information presented in the documents simply does not support any of the conclusions reached in Section 6.2.1.7. Our comments relative to Sections 5.3.6, 4.2.2, 5.1, and 5.4 should be considered to apply to the draft EA's treatment of the socioeconomic guidelines throughout Section 6.2.1.7.

6.2.1.7.2 Data Relevant to the Evaluation for the Socioeconomic Qualifying Condition

P. 6-74: The text states that "preliminary studies" indicate that the socioeconomic effects predicted for two counties (Nye and Clark) are indicative of the nature and extent of the total social and economic impact (referring to an undefined "larger geographic area"). What preliminary studies were conducted in Lincoln County and the City of Caliente? Where are the references to these? The City of Caliente is the only community in the area whose downtown is split by the Union Pacific mainline. How do impacts unique to Lincoln County and Caliente compare to Nye and Clark County? DOE is basing a conclusion on an admittedly incomplete analysis. How can the draft EA state that all impacts can be mitigated or compensated when DOE admits that it does not know what the impacts are?

The document goes on to imply that the McBrien and Jones report (1984) and the SAI tourism report (1983) are examples of such "preliminary studies." Neither of those reports contains any information regarding Lincoln County or the City of Caliente. Nor do they evaluate socioeconomic or tourism impacts in anything other than general terms using aggregate county and bicounty data. There is no attempt to expand the scope of the socioeconomic assessment or to incorporate areas outside Clark and Nye Counties (or to specify conditions and impacts within various Clark and Nye County local jurisdictions). To imply that such studies somehow provide the basis for generalizing the inadequate data contained in the draft EA to a wider area of the state or for claiming that such data are "indicative of the nature and extent of the total social and economic impact" of a repository is blatantly misleading.

6.2.1.7.3 Favorable Conditions

(1) Ability to absorb project-related population changes.

P. 6-78: The text concludes that "given these previous growth rates, the affected area is expected to be able to absorb the repository-related population changes without significant disruptions in community services or significant impacts on housing supply and demand."

This conclusion is not supported by the data presented in the draft EA. As indicated previously, the "affected area" defined by DOE in its analysis is overly restrictive (including Nye and Clark Counties only) and ignores Lincoln County entirely (as well as jurisdictional distinctions within Nye and Clark).

The University of Nevada-Reno's Bureau of Business and Economic Research points out that the validity of using comparisons between projected repository-related growth and historical growth rates as the basis for determining the significance of possible impacts and the ability of communities to absorb those impacts is questionable.

The conclusion that the "affected area" can absorb repository-related population changes without significant impacts is not justified. Evidence does not indicate that this favorable condition is present at Yucca Mountain (although evidence does not indicate that it is not present either--there simply is not enough data to be able to conclude anything one way or the other).

(2) Availability of adequate labor supply.

P. 6-79: While the text concludes that this favorable condition is not present at Yucca Mountain, it does not acknowledge the inadequacy of the data and analysis contained in the draft EA and supporting documents. In short, there is no basis for concluding that "an adequate total work force may be available for a repository at Yucca Mountain" even though enough mining and construction workers would be lacking. The level of analyses in Chapters 3 and 5 of the draft EA and in the McBrien and Jones (1984) report is simply inadequate to support such a statement.

(3) Projected net increases in employment, business sales, improved community services, and increased government revenues.

P. 6-80: Any conclusions drawn relative to the costs/benefits to affected communities derive directly from employment estimates (direct and indirect). As pointed out in comments on Sections 3.6 and 5.4, the figures arrived at by DOE for numbers of new jobs created as a result of the repository are unsupportable. Therefore, any extrapolation as to the effects of net employment increases based on those figures are necessarily unreliable. The same can be said for estimates of material and resource needs. Likewise, the text refers to increased tax revenues that were not estimated in Chapter 5 and were generally ignored in the discussion of baseline conditions in Chapter 3. The conclusion that tax revenues will rise cannot be deduced from the information available in the draft EA or any supporting documents.

The state tax base is extremely narrow so that the fiscal impact of higher wage earnings in Nye County, in particular, is likely to be small on the revenue side. Assumptions concerning project-induced community-service impacts are also problematic (see comments relative to Secs. 3.6 and 5.4). Hence, such assumptions are unsubstantiated by the reported data and analysis.

In the evaluation relative to favorable condition 3, DOE, by its own reasoning, seems to imply that there will not be net project-induced changes in terms of improved community services and increased government revenues. In order to support a finding that net increases will occur, DOE is forced to include possible mitigation in terms of additional revenue to offset revenue loses and additional costs for community services to State and local governments. The amount, timing, and conditions relevant to any potential federal mitigation for repository-related impacts is a significant unknown at this time. As such, mitigation should not be included in the equation by which net effects on employment, sales, community services, and government revenues are calculated.

The finding that this favorable condition (net employment, sales, service, and revenue increases) is present at Yucca Mountain is not supported by data in the draft EA or in reference documents. In fact, the wording used in the concluding paragraph substantiates this fact. DOE states: "Though studies performed to date are insufficient for a firm conclusion, community services could be improved, and net government revenues could increase. Therefore, the evidence indicates that this favorable condition is present at Yucca Mountain" (emphasis added). If studies to date do not provide sufficient information for a conclusion to be drawn, it is extremely inappropriate for DOE to hypothesize that certain effects could happen and these effects could be beneficial. They could just as easily be detrimental to local community services and governmental revenues.

The appropriate conclusion would have been, simply, that there is insufficient data available to determine whether this favorable condition exists or not.

(4) No projected substantial disruption of primary sectors of the economy.

P. 6-81: The conclusion that this favorable condition is present relative to Yucca Mountain is not supported by data contained in the draft EA or in reference documents. All of the indicators--even those presented by DOE (i.e., the SAI report cited in the EA)--point to potentially negative effects on tourism in southern Nevada as a result of the repository. To assume, as the SAI report does, that such effects will be short-lived as they were for disasters such as Three Mile Island, hotel fires, and other time-limited occurrences fails to take into account the extremely long-term nature of a repository and the uniqueness of Nevada (especially southern Nevada) in its reliance on tourism as the major economic sector.

The conclusion contained in the draft EA on p. 6-81 that "Information available to date suggests that the repository is not likely to significantly effect tourism . . . " is blatantly untrue and even contradicts the information DOE itself included in earlier chapters and that SAI developed as part of its extremely inadequate study on tourism.

The conclusion that mining, the other sector of the Nevada economy identified as "prime" by DOE, would only be favorably affected by the repository is likewise unsubstantiated. As noted in comments made on Sections 3.6 and 5.4, the assumption that only favorable employment trends will accrue to various sectors of the economy works only if one assumes that all markets function with perfect efficiency. In the case of the state's mining industry, extremely negative impacts could occur if fewer workers from outside the state than are needed appear to work on the repository. Such a scenario would cause wages to escalate. It could cause a drain of workers from other (i.e., productive) mining activities in the state toward the better-paying repository project (which is non-productive in terms of extracting minerals for sale). In short, the draft EA ignores potential negative effects on mining within the state. It then makes a leap of faith to conclude that there will be only positive impacts on this primary sector of the economy.

Here again, as for the other three favorable conditions, the appropriate conclusion would have been that the information available is not adequate to support a finding one way or the other.

6.2.1.7.4 Potentially Adverse Conditions

(1) Potential for significant repository-related impacts on services, housing, and State/local government finances.

P. 6-82: The finding expressed that "Negative impacts on community services and housing supply and demand are not expected to be significant" is suspect for a variety of reasons noted in relation to the discussion on favorable conditions. In any event, the conclusion is unsubstantiated by the data and analysis in the draft EA. If anything, evidence that is available points to the possibility of significant negative effects on government finances as well as on community services and housing. To rationalize away these negative impacts, as the draft EA does, by assuming that mitigation (of questionable form and timing) will avert unfavorable consequences (and result in a net gain) is stretching the thread of logic considerably.

The appropriate finding is that there is insufficient data to determine if this potentially adverse condition exists or not.

(3) Need for repository-related purchase or acquisition of water rights, if such rights could adversely impact present or future development of the area.

See comments relative to Section 6.2.1.3.2.

(4) Potential for major disruptions of primary sectors of the economy.

The evaluation associated with the draft EA's treatment of this potentially adverse condition simply refers to the absence of any projected substantial disruption as discussed under favorable condition 4. Our comments relative to favorable condition 4 (under Section 6.2.1.7.3 above) demonstrate that there is, at best, insufficient information contained in the draft EA or in supporting documents to conclude that there will be no disruption of the mining and tourism sectors of the Nevada economy. There is evidence that both sectors could be adversely affected in a significant way.

The proper finding for this condition should have been one that reflects the fact that there is not enough information to determine whether adverse impacts will occur or not.

6.2.1.7.5 Socioeconomic Disqualifying Condition

P. 6-84: The draft EA states that "Because the climate is arid and the water table is deep . . ., it is extremely unlikely that repository activities could degrade the quality of ground water in the Yucca Mountain region." The information contained in the draft EA and in referenced materials does not justify making this statement. See our comments relative to this disqualifying condition in Chapter 2 (Sec. 2.3, p. 2-50).

The draft EA reference (Young, 1972) does not support the conclusion that regional effects of withdrawing ground water for repository use are negligible. Young's data indicate a historical decline of ground-water levels in Jackass Flats from pumpage (Young, 1972, p. 13, Table 3), which if projected into the future could impact regional water quantities and qualities. Young's data also indicate significant drawdowns at high pumping rates in several pump tests. DOE has not indicated the pumping rates proposed during repository construction and operation. Drawdown could be significant if pumpage continues for a long period. The EA should be revised to realistically evaluate the implications of repository water use on regional water supplies.

6.2.1.7.6 Evaluation and Conclusion for the Qualifying Condition on the Socioeconomic Guidelines

P. 6-85: As indicated throughout our comments on the socioeconomic guidelines (Secs. 6.2.1.7 through 6.2.1.7.5 above), the data presented in the draft EA and the information contained in supporting documents are not sufficient to justify the conclusions reached. What DOE appears to have done is to take admittedly limited and extremely incomplete data, extrapolated portions of that information that tend to support favorable findings relative to socioeconomic conditions, and formulated conclusions that are wholly inappropriate to the level of research and information available to date. The conclusion for the qualifying condition contained on p. 6-86 carries this faulty reasoning even further. Not only does DOE restate the assertion that a repository at Yucca Mountain is "not expected to generate any significant adverse socioeconomic effects on the surrounding region that cannot be offset by reasonable mitigation or compensation, through a process of planning and analysis"--a conclusion the draft EA does not support--but the Department goes on to attach a level 3 confidence assessment to this conclusion!

Given the paucity of information in all areas of socioeconomic assessment, the finding that the conclusion relative to the qualifying condition merits a relatively high degree of confidence is unwarranted. The only appropriate conclusion regarding the socioeconomic qualifier, based on the existing data, is one that acknowledges that a determination as to the social and economic impacts of a repository at Yucca Mountain cannot be made until additional research is conducted and more complete information is available.

6.2.1.8 Transportation

P. 6-86: The qualifying condition relative to transportation in the preclosure guidelines relates principally to conditions in the vicinity of the site. The qualifier does not adequately provide for an analysis of transportation variables from specific reactor and other waste sites to each potential repository location. As such, it fails to meet the requirements of the Nuclear Waste Policy Act, which stipulates (1) that "the proximity to sites where high-level radioactive waste and spent nuclear fuel is generated or temporarily stored and the transportation and safety factors involved in moving such waste to the repository" be considered and (2) that DOE "consider the cost and impact of transporting to the repository site the [HLW/spent fuel] to be disposed of in the repository and the advantages of regional distribution in the siting of repositories."

(See also our comments relative to Appendix A.)

6.2.1.8.2 Data Relevant to the Evaluation of the Transportation Qualifying Condition

Data contained in the draft EA and in supporting documentation relative to this qualifying condition are seriously deficient for a number of reasons:

1. There is inadequate consideration of variables associated with the proximity of waste generation or temporary storage locations to the various repository sites;

2. The available information does not provide the basis for a meaningful comparative evaluation of transportation variables among the candidate sites, especially the characteristics of transportation "corridors" leading to each site from waste/spent fuel sources;

3. No consideration has been given to variables associated with the use of a Monitored Retrievable Storage (MRS) facility within the transportation system;

4. Information on defense high-level waste fails to include volume and transportation analyses for waste stored currently at Idaho Falls and Hanford;

5. Information relative to risks associated with waste transportation is based on analyses that are overly generic, that rely on aggregate national data exclusively, and that fail to consider key elements associated with risk; and

6. There is no assessment of the effect a second repository will have on transportation variables for the first repository.

A detailed discussion of deficiencies found in the evaluation of transportation variables is contained in our comments relative to Appendix A.

6.2.1.8.3 Favorable Conditions

(1) (ii) Federal condemnation is not required to acquire rights-of-way for the access routes.

P. 6-92: While condemnation may not be required to obtain land for new road and rail construction to the Yucca Mountain site, DOE may have to seek Congressional approval for such withdrawal of land--either as part of the overall site withdrawal application or as a separate action. In the case of the lengthy rail spur between the site and Dike's Siding, there may be significant opposition from conservation and other groups because of the proximity of the proposed spur to the Desert National Wildlife Refuge. Simply using need for federal condemnation as the criteria for this condition is inadequate in terms of assessing the degree of difficulty to be encountered in obtaining necessary land rights.

(2) Proximity to local highways and railroads that provide access to regional highways and railroads and are adequate to serve the repository without significant upgrading or reconstruction.

P. 6-95: The repository site at Yucca Mountain will require 85 miles of new rail construction in order to connect it with the nearest main rail line. All discussions and plans for the repository contained in the EA refer to the new rail spur that will have to be built from Yucca Mountain to Dike's Siding. DOE simply ignores this fact in determining whether or not this favorable condition exists. Instead, the draft EA concludes that "The proposed transportation system will not be superimposed on the local transportation network" (emphasis added). It would appear that the condition has nothing whatever to do with the need to superimpose repository-related transportation needs on existing infrastructure. Rather, the condition has two components: (1) is the site located in proximity to local connecting highways and railroads, and (2) are these local highways and railroads adequate to meet repository needs without significant upgrading or reconstruction? Obviously, Yucca Mountain is not located in close proximity to the nearest local rail line that provides access to regional railroads. By assuming that a rail spur already exists, DOE appears to be deliberately attempting to distort the significance of Yucca Mountain's location vis-a-vis major rail service access. Not only will 137 km of rail line be needed, but at least one bridge will have to be constructed--at considerable expense.

The draft EA fails completely to address the issue of whether or not local highways and railroads are adequate to meet repository traffic needs. Can existing local roads and rail lines be used without significant upgrading or reconstruction costs? In New Mexico, the only other state where a nuclear waste repository is being built, DOE plans to spend $50 million upgrading components of the state's highway system that will be used as part of the WIPP project.

Nowhere in the EA are potential flooding and rock-slide problems along the Union Pacific line in Lincoln County addressed. What about needs for additional sidings and "safe harbors"?

This favorable condition most definitely does not exist with regard to Yucca Mountain.

(3) Proximity to regional highways, mainline railroads, or inland waterways that provide access to the national transportation systems.

P. 6-94: The draft EA again assumes that a rail spur connecting the site with the UP line at Dike's Siding already exists. The fact that DOE plans to build such a rail connection as part of the repository project does not compensate for the fact that the site--as it exists--is located a long way from a regional railroad and there is, at present, no rail access from that railroad to the site.

This condition is not present with regard to Yucca Mountain.

(4) Availability of a regional railroad system with a minimum number of interchange points at which train crew and equipment changes would be required.

What constitutes a "minimum number of interchange points"--one, five, twenty, one hundred? Unless DOE defines what it means by "minimum number"--and includes the rationale supporting that definition--it is impossible for anyone, DOE included, to conclude that Yucca Mountain meets this condition.

(5) Total projected life-cycle cost and risk for transportation of all wastes designated for the repository site which are significantly lower than those for comparable siting options, considering locations of present and potential sources, interim storage facilities, and other repositories.

P. 6-95: As stated earlier (and detailed in our comments on Appendix A), the treatment of transportation costs and risks in the draft EA is inadequate and does not allow for a meaningful comparison among sites.

(6) Availability of regional and local carriers--truck, rail, and water--which have the capability and are willing to handle waste shipments to the repository.

P. 6-95: The documentation in the draft EA and in supporting materials does not substantiate the conclusion that this condition is present with regard to Yucca Mountain. It may very well be, but there is nothing in the document that justifies the finding. Speculation and assumptions should not be substituted for hard evidence.

If it is "reasonable to expect that local and regional businesses will be developed and the necessary arrangements will be made for equipment and services," DOE should have little difficulty demonstrating that assertion.

(8) Plans, procedures, and capabilities for response to radioactive waste transportation accidents in the affected State that are completed or being developed.

P. 6-96: Since local governments (not the State or DOE) bear primary responsibility for responding to such emergencies within their jurisdictions, plans and capabilities of each local government entity throughout the state (and especially those along major transportation routes) should have been reviewed and evaluated as part of the discussion relative to this condition.

The conclusions that the U.S. Department of Energy Nevada Operations is capable of responding to accidents during the transportation of radioactive materials, and the assumption that this is a favorable condition at Yucca Mountain are highly questionable. Given the extremely remote areas in the state and great distances involved, plus the rugged terrain, it is doubtful if an emergency crew could respond with the necessary equipment in the event of a major catastrophe for several hours to either a train or truck accident.

(9) <u>A regional meteorological history indicating that significant disruptions would not be routine seasonal occurrences</u>.

P. 6-97: The finding in the draft EA that there is no <u>regional</u> meteorological history indicating potential for significant seasonal transportation disruptions entirely ignores the intent and scope of the condition itself. The text discusses meteorological conditions only as they relate to Nevada (and these primarily as they pertain to the southern part of the state). That is fundamentally erroneous. This favorable condition exists at none of the sites in the western United States to which waste must be transported from the Midwest and East. Shipments to these sites will experience significant transportation disruptions because of snow and blizzard conditions on the Plains and in the Rocky, Cascade, and Sierra Nevada mountain ranges. To ignore that fact and find that the favorable condition is present only in the immediate area surrounding the Yucca Mountain site is simply to ignore the significance of transportation conditions from a regional perspective.

The draft EA's discussion of meteorological history is primarily directed toward the repository site, although some mention is given to the Winnemucca and Ely areas. However, almost no attention is given to the routes leading to the site area. Specific mention should be given to the flood-prone area of Meadow Valley Wash and Rainbow Canyon. These locations have historically been noted for major flash flooding. The Moapa area was the scene of two recent floods causing a UP mainline derailment approximately one year ago. There are also mountain passes on virtually every northern highway in the state, many of which are subject to closure.

The information contained in the draft EA and in supporting documents is insufficient to conclude whether this favorable condition is present for Yucca Mountain or not.

<u>6.2.1.8.4 Potentially Adverse Conditions</u>

(3) <u>Existing local highways and railroads that could require significant reconstruction or upgrading to provide adequate routes to the regional and national transportation system</u>.

P. 6-99: As with the discussion of favorable conditions 2 and 3, the draft EA completely ignores the fact that, at present, there is <u>no</u> rail access to the regional and national railroad system. In order to make the Yucca Mountain site viable, a local rail line 85 miles long will not merely have to be upgraded, <u>it will have to be built from scratch</u>.

There is also no discussion of potential waste transportation impacts on existing road or rail infrastructure or on the need for upgrading areas of State and local roads/rail lines to insure safety.

This adverse condition is definitely present relative to the Yucca Mountain site. To imply otherwise requires considerable sleight-of-hand in assuming conditions that do not exist at present.

(4) Any local condition that could cause the transportation-related costs, environmental impacts, or risk to public health and safety . . . greater than those projected for other comparable siting options.

P. 6-99: The analysis of transportation costs, risks, and environmental impacts contained in the draft EA is inadequate to enable DOE to conclude that this condition is not present at the Nevada site.

(See our comments relative to Secs. 3.5 and 5.3, and Appendix A.)

6.2.1.8.5 Evaluation and Conclusions for the Qualifying Condition on the Transportation Guideline

P. 6-100: The comments relative to the various favorable and potentially adverse conditions made above cast considerable doubt as to DOE's ability to conclude that the Yucca Mountain site is likely to meet the qualifying condition for transportation. Given the complete lack of rail access and the considerable distance (85 miles) between Yucca Mountain and the UP rail line at Dike's Siding, two of the favorable conditions DOE found to exist are actually not present. In addition, one of the potentially adverse conditions related to this issue (condition 3) that DOE found not present may, in fact, exist. DOE findings relative to other conditions are based on incomplete or questionable data.

Taken together, the evaluations of the Yucca Mountain site against the favorable and potentially adverse conditions do not, given the information in the draft EA, support a level 1 confidence rating, much less the level 3 score assigned to the qualifying condition by DOE.

6.2.2.1.3 Evaluation of the Yucca Mountain Site Against the Preclosure System Guideline for Radiological Safety

P. 6-104: The draft EA states that "At the Yucca Mountain site, surface-water transport mechanisms are not considered likely because of the aridity of the climate and the absence of surface water." However, Bowen and Egami (1983) state that "Severe weather in the form of high winds, heavy precipitation, lightning, and high temperatures will affect the construction and operation of the repository." In light of high potential for overland runoff during heavy storms, surface-water transport mechanisms may be significant if radionuclides reach the ground surface.

P. 6-104: The draft EA states that "The arid conditions allow very limited infiltration and recharge (Quiring, 1965; Winograd and Thordarson, 1975; personal communication from P. Montazer, 1984, USGS; data expected to be published in a USGS report by P. Montazer and Wilson and entitled

Conceptual Models for Flow through the Unsaturated Zone at Yucca Mountain, Nevada)." While the statement may well be true, each of the above-cited references directly or by reference use "indirect methods to obtain" estimates of infiltration and recharge which may have considerable error associated with them. No such statement of infiltration and recharge is found in Quiring (1965) and Winograd and Thordarson (1975). These references are inappropriately cited here.

P. 6-104: We believe, contrary to the draft EA, that ground-water transport is a reasonable release mechanism because the nature and flux of water in the vadose zone has not been characterized, and the potential for retardation is unknown. Montazer and Wilson (1984) have assumed the net infiltration rate for Yucca Mountain is 4.5 mm/yr. On the basis of this assumption combined with a conceptual hydrologic model of flow in the vadose zone they conclude that probably 1 mm/yr flux is transmitted through the Topopah Spring unit. The statement in the draft EA treats the Montazer and Wilson (1984) data as known certainty. This problem plagues the entire draft EA, except for sections in Chapter 7:

> P. 7-14: "For the Yucca Mountain site, there are uncertainties about the effective porosity, moisture content, as well as ground-water recharge and flux in the unsaturated zone, and the mechanism of water movement in the unsaturated zone."
>
> P. 7-14: "For Yucca Mountain, there are uncertainties about the moisture content, ground-water recharge, and ground-water flux in the unsaturated zone."

Consequently, it is unknown what the significance is of recharge rates and volumes via fracture flow and what the rates and volumes are via fracture/matrix or matrix flow.

P. 6-104: The draft EA states that "The air pathway may therefore represent the most likely pathway of radionuclide travel during the period when gaseous radionuclides are present in the radioactive wastes." Given this hypothesis, the EA should devote more discussion to the significance of fractures as transport pathways.

P. 6-104: Table 6-45 in Section 6.4.1 does not consider maximum releases for krypton-85 as stated on this page. The table only considers maximum releases for tritium, carbon-14, and iodine-129 but fails to define 10 CFR Part 20 allowable limits for these radionuclides. The text or table should be revised to be consistent and complete.

6.2.2.2 Preclosure System Guideline: Environment, Socioeconomics, and Transportation

P. 6-106: The qualifying condition for this guideline requires that "During repository siting, construction, operation, closure, and decommissioning the public and the environment shall be adequately protected from the hazards posed by the disposal of radioactive waste."

As noted in our comments relative to Sections 3.6, 4.2.2, 5.3, and 5.4, the information contained in the draft EA and in supporting documents is insufficient to justify any finding, much less a level 3 one, relative to this guideline. It may be that DOE can adequately protect the public and the environment as required by the guideline. Our comments simply point out that the information and level of research contained in the draft document do not, at this point, support such a finding.

6.3.1.1 Geohydrology

P. 6-114: Table 6-15 summarizes the analysis for the Section 6.3.1.1 geohydrology guideline. The findings are overly simplistic and in some cases misrepresent the evidence. Although conditions for disposal in the saturated zone are not applicable for Yucca Mountain, the document indicates that the conditions are met to some degree. Condition (4)(i) states that the host rock (Topopah Springs) is low in hydraulic conductivity (< 1.0 mm/yr). This is not correct. Core matrix samples show a geometric mean of perhaps 1 mm/ yr. However, the range of conductivities is over three to four orders of magnitude. In addition, bulk conductivity may be high, based on saturated-zone testing of the Topopah Springs at Wells J-12 and J-13. Condition (4)(ii) indicates that the gradient is downward in Topopah Springs, but these data are not reported in any supporting references. Condition (4)(iv) indicates that the hydraulic gradient is low in the Calico Hills; however, no data are present in the draft EA on the gradient. Data are presented in the references stating that the effective porosity, or portion of pore space contributing to flow under saturated conditions, may be as low as 1.6 percent by volume. This contradicts the value of 20 percent reported in the draft EA.

P. 6-116: Condition (5)(iv) in Table 6-15 considers "free draining host rock." The DOE finding states that the host rock (Topopah Springs Member) is "expected to be freely draining." This point needs some clarification. Core analysis by Weeks and Wilson (1984) indicates that the Topopah Springs Member rock matrix does not drain significantly even at high matric potentials (Figs. 17-22, Weeks and Wilson, 1984). The free drainage concept may apply, however, to the fracture network in the Topopah Springs Member.

P. 6-117: Condition (1) under Potentially Adverse Conditions in Table 6-15 considers hydrologic changes that could influence radionuclide transport to the accessible environment. DOE finds that pluvial changes are not expected to cause significant increases in transport of radionuclides. The available evidence does not necessarily indicate that increases in precipitation will decrease the travel time. The understanding of fluid movement in fractured rock is still in its infancy and is not at a stage where the cross-over point between matrix and fracture flow can be predicted in a heterogeneous fractured medium.

6.3.1.1.3 Geohydrology Favorable Conditions

(1) Site conditions such that the pre-waste-emplacement ground-water travel time along any path of likely radionuclide travel from the disturbed zone to the accessible environment would be more than 10,000 years

P. 6-121: The draft EA states that "for the likely flux through the repository of less than 1 mm/yr (0.04 in./yr), the estimated ground-water travel time to the base of the host rock is 5,000 years or more." This conclusion is based upon assumptions that may or may not be valid. Montazer and Wilson (1984, p. 4) state: "The current lack of knowledge is the result of: (1) Lack of data, because of the newness of the focus on the unsaturated zone; (2) inadequacy of the general state of understanding of the physics of flow in thick, fractured-rock unsaturated zones in arid environment; and (3) lack of well established techniques for testing and evaluating the hydrology of such unsaturated zones."

P. 6-121: An inappropriate conclusion is drawn from the report of Weeks and Wilson (1984). Weeks and Wilson report hydraulic conductivity measurements of core from the Topopah Spring Member and conclude that the average matrix flux may be as low as 0.003 mm/yr. Based upon these values, DOE concludes that "conservative ground-water travel times could be longer than 20,000 years." This conclusion does not give adequate consideration to uncertainty inherent in data collection, analyses, and interpretation. Weeks and Wilson (1984) flatly state that their study is preliminary and should be used only as a guide for future studies, not for conclusions.

(2) 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.

P. 6-121: A shift in water-table elevation due to climatic change is based on work by Czarnecki (1984). In this document, the recharge estimates are based on Rush (1970) using a technique developed by Eakin et al. in 1951. This technique as stated by Czarnecki (1984) has been evaluated by others and has been found to be only a very approximate estimate of recharge. This technique, although used extensively in Nevada reconnaissance studies whose purpose is quite general, was never intended to be an accurate site-specific recharge estimating method.

(3) Sites that have stratigraphic, structural, and hydrologic features such that the geohydrologic system can be readily characterized and modeled with reasonable certainty.

P. 6-122: This discussion is confusing in the way in which it is written. The conclusion that current data do not allow the geohydrologic system at Yucca Mountain to be characterized and understood with reasonable certainty is appropriate. Whether or not future characterizations will provide this information with certainty remains a key question. We believe that it may not be possible to do so within the current time-frame for site characterization.

(5) For disposal in the unsaturated zone, at least one of the [listed in EA] pre-waste-emplacement conditions exists.

P. 6-126: According to the draft EA, "The zone of continuous fully saturated voids is not expected to extend more than about 30 m (100 ft) above the water table." Yet, core samples taken from the Calico Hills units report saturation values of approximately 90 percent (Montazer and Wilson, 1984). Weeks and Wilson (1984) also report saturations in the bottom 10 meters of the Topopah Spring of approximately 90 percent. In the vadose zone, one would consider these samples to be essentially saturated at zero pressure, with the remaining 10 percent of the void space filled with trapped air. Therefore, it does not seem unreasonable to say that the Calico Hills and portions of the Topopah Spring are at or near total saturation under wetting conditions.

P. 6-129: The section on free drainage fails to consider the observations of Rush et al. (1983) in drill hole USW H-1 (moisture seeping from fractures) and observations of others in drill hole UZ-1 and UZ-4 (free-standing water). These observations suggest perched-water conditions in some areas, which admittedly could be localized. This evidence argues that a favorable condition for free drainage may not be present everywhere at the site.

P. 6-130: The draft EA states that "Potential evapotranspiration was estimated by an empirical method reviewed in Rosenberg (1974) that uses a yearly heat index and mean monthly temperatures. Potential evapotranspiration for Yucca Mountain, corrected for actual sunshine hours, is about 630 mm/yr (24.8 in./yr). Therefore, the average annual precipitation, about 150 mm (5 to 6 in.), is about 20 percent of the annual potential evapotranspiration." The statement is factual but misleading. Citing average annual evapotranspiration values gives the incorrect impression that no infiltration occurs after evaporation. The statement obscures the fact that short-term, high-intensity summer storms, and winter precipitation as snow at Yucca Mountain clearly do produce infiltration, an unknown part of which is not later evapotranspired. This distinction is even more critical considering that the proportion of winter precipitation was probably greater during the full-glacial period, while in the latest Pleistocene, torrential summer rains may have been more important than today.

6.3.1.1.4 Geohydrology Potentially Adverse Conditions

(1) Expected changes in geohydrologic conditions--such as changes in the hydraulic gradient, the hydraulic conductivity, the effective porosity, and the ground-water flux through the host rock and the surrounding geohydrologic units--sufficient to significantly increase the transport of radionuclides to the accessible environment as compared with pre-waste-emplacement conditions.

P. 6-130: In Section 6.3.1.1.4 the draft EA deals with the expected changes in the fluid flow regime as a result of waste emplacement. Missing from this discussion is the effect of heat loading on the hydraulic gradient, conductivity, and water contents. The processes involved with non-isothermal fluid movement are poorly understood at best and may provide for nuclide pathways not discussed in the draft EA such as vapor transport, aerosol transport, dewatering of zeolite minerals adjacent to the repository, and the resultant volume changes. These questions are important to the feasibility of an unsaturated-zone repository. At present, there is insufficient evidence to conclude that no adverse conditions exist.

P. 6-131: In the discussion of changes in recharge rates, the draft EA states that "The geochemical barrier provided by the Calico Hills nonwelded unit would still retard the transport of radionuclides, although their movement could be more rapid than during periods of less recharge." The draft EA has not demonstrated that a geochemical barrier exists in the Calico Hills nonwelded unit. Sorption is a function of mineral stability, heat flow, and ground-water chemistry. The chemical composition of vadose water has not been measured. Therefore, the extent to which nuclide species may be retarded is unknown.

P. 6-132: The draft EA states that "No evidence of modern or Quaternary springs or seeps at Yucca Mountain has been found." Field observations indicate that the Bow Ridge fault exhibits evidence of spring activity. Carbonate deposits in the fault zone of Trench 14 (Swadley et al., 1984) are attributable to spring activity.

<u>6.3.1.1.5 Geohydrology Disqualifying Condition</u>

P. 6-136: This section, which addresses infiltration-percolation-recharge, is plagued by unverified assumptions and weakly grounded models. Montazer and Wilson (1984, pp. 40-41) indicate that ". . . a discrepancy exists between the <u>in situ</u> potential measurements in borehole USW UZ-1 and the matric potentials reported for borehole USW H-1. . . . Preliminary analysis of data from borehole USW UZ-1 indicates both upward and downward water fluxes occurs in the Paintbrush nonwelded unit. Estimates of flux range from 10 to 30 mm/yr, both in upward and downward directions when only vertical flow is considered." There seems to be some question concerning the flux in the vadose zone as reported in this section. If matrix saturation is reached with a low matrix flux it appears feasible that fracture flow will dominate. If fracture flow dominates, the flux would presumably be significantly greater. The actual travel time could be much reduced and could potentially not be within the 1,000-year expectations.

The scenario just described is possible and would fit with data presented. Montazer and Wilson (1984, p. 1) state: "In this model, flow through fractures can occur at almost all stages of saturation. . . . The authors recognize, and the reader should be aware, that the proposed model probably is not the only reasonable description that would be made at this point, and it certainly is subject to revision and quantification as more data becomes available."

Pp. 6-137 to 6-140: The travel-time calculations discussed in this section are based on assumptions of matrix flux and estimations concerning average saturated hydraulic conductivities. The assumptions and estimates are not conservative, and bounding estimates on hydraulic saturation are not offered. The section states, "In the absence of data on tuffs from Yucca Mountain, pumping tests were used to estimate . . . effective porosity." Because effective porosity could reasonably range over several orders of magnitude in the fractured terrain of the assumed travel path, this part of the travel-time calculation is also not conservative. There does not seem to be reliable field data available. Consequently, travel-time estimates are inconclusive and not conservative in derivation.

6.3.1.1.6 Evaluation and Conclusion for the Qualifying Condition on the Postclosure Geohydrology Guideline

Pp. 6-140 to 6-142: The evaluation for this qualifying condition is unsupported and misleading. It should be rewritten to indicate that there is no information present that shows the site would qualify. The absence of raw data does not indicate that Yucca Mountain would meet appropriate conditions. Yucca Mountain's status vis-a-vis the qualifying condition is still unknown. The fact that the site is located in a desert environment does not assure that very little water will contact the radioactive waste. Paleoclimate data available do not specifically predict how much more infiltration will occur in the future. There is no enhancement of isolation potential provided by the information available. The retardation capacities in the expected flow paths are unknown and unmeasured, and the statement with respect to them is unwarranted.

The conclusions drawn in this section have not been documented. There is serious question concerning the reference to Section 6.3.1.2. It does not document conditions as reported in Section 6.3.1.1.6. Analysis of ground-water flow time, ground-water flux, and radionuclide retardation point only toward insufficient data to draw any meaningful conclusions.

6.3.1.2.2 Data Relevant to the Evaluation of Geochemistry (10 CFR 960.4-2-2)

P. 6-143: In Section 6.3.1.2.2 the draft EA states "The minerals in Yucca Mountain that contribute significantly to radionuclide sorption have been identified (Heiken, 1982)." This statement is incorrect. Stratigraphic diagrams showing mineralogy and separate stratigraphic diagrams showing limited species of radionuclides have not defined which minerals are responsible for sorption (Heiken, 1982, pp. 84-95).

P. 6-147: In paragraph 3 the water discussed is inappropriately identified as "Yucca Mountain groundwater." Knauss et al. (1984) reports the water as J-13 water. Well J-13 is not located on Yucca Mountain.

6.3.1.2.3 Geochemistry Favorable Conditions

(1) The nature and rates of the geochemical 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.

P. 6-149: Petrofabric studies (Bryant and Vaniman, 1984) do not consider zeolites in fractures and in perched-water zones above the water table. Zeolites above the Topopah Spring Member were not investigated, nor were the zeolites below the Bullfrog Member of the Crater Flat tuff. Therefore, no conclusions can be drawn relative to the time of zeolitization in these horizons.

(2) Geochemical conditions that promote the precipitation, diffusion into the rock matrix, or sorption of radionuclides; inhibit the formation of particulates, colloids, inorganic complexes, or organic complexes that increase the mobility of radionuclides, or inhibit the transport of radionuclides by particulates, colloids, or complexes.

P. 6-151: Precipitation of radionuclides in a natural environment is a complex problem. The research to date is inadequate to answer if radionuclides will or will not be precipitated in any form. The discussion on p. 6-151 only mentions pH and the actinides. While this is interesting, it has limited bearing on the question of radionuclide precipitation. A complete evaluation is needed with both Eh-pH, dissolved ions, temperature, etc. Precipitation will only take place if the activities of the appropriate cations and anions are present in supersaturation amounts. It is further proposed that this precipitation will take place in the vadose zone, from which there is no water chemistry. Therefore, the possible precipitation of radionuclides in the vadose zone is clearly only a hypothesis.

Radionuclide diffusion into Yucca Mountain tuffs is also an untested hypothesis. Certain analogies are made with studies in granitic terrain where general characteristics, such as porosity, are compared. The major question still remains as to how much diffusion will take place under conditions of fracture flow with velocities of several meters per day. Rainier Mesa tuffs are interpreted as having flow velocities of several meters per day with minimal changes in water chemistry from the soil zone to the tunnels (Henne, 1982).

The study of sorption of radionuclides by Yucca Mountain tuffs appears to show misplaced emphasis. An underlying research assumption for radionuclide sorption has been that matrix, not fracture flow, is dominant. Fracture flow is ignored even though varying data support fracture flow in Yucca Mountain tuffs. The apparent lack of a multiple working hypothesis, which is basic to any scientific investigation, leads to ignoring many possibilities. The one clear omission is an examination of the sorption capacity of minerals coating the fractures. If fracture flow is dominant, then the tremendous effort put into both sorption studies on crushed tuff will be of limited value.

The formation of particulates, colloids, and inorganic complexes, which increase both the solubility and mobility of radionuclides, is highly probable. Data on particulates and colloids are lacking, but recent observations by Lawrence Livermore National Laboratory presented in their latest annual report suggest that colloids are common in ground-water systems.

P. 6-151: The text describes geochemical conditions that promote the precipitation of radionuclides. This is an interesting discussion concerning ground water; however, its relevance to the vadose zone of Yucca Mountain is questioned. Considering that the repository is situated in the vadose zone, it is surprising that no vadose water has been collected, even though it has been encountered in drilling. What are the oxidation states of the vadose waters, and how does this affect radionuclide solubilities?

P. 6-151: The discussion on geochemical conditions that promote diffusion indicates an agreement between data obtained from granitic rocks (Neretnieks, 1980) and data obtained from tuffs from Yucca Mountain (Johnstone and Wolfsberg, 1980). If the conclusions of this discussion are correct, an important question is raised as to the true age of Yucca Mountain ground water. If there is 14-C diffusion into the matrix, then 14-C age data for Yucca Mountain ground water may appear too old. If a similar analysis is applied to the 14-C diffusion calculations as completed by Neretnieks (1980), it is expected that the ground-water ages will appear considerably older (up to two orders of magnitude) than their actual transport time from recharge to well-sampling point. Although the diffusion of 14-C effects is not expected to be as great as reported by Neretnieks (1980) for granite due to the apparent greater permeability of the tuffs and thus a greater flux rate, it is believed that <u>if</u> the discussion offered in the draft EA is valid, the resulting transport times of water will have to be considerably elevated.

<u>6.3.1.2.4 Geochemistry Potentially Adverse Conditions</u>

(1) <u>Ground-water conditions in the host rock that could affect the solubility or the chemical reactivity of the engineered-barrier systems to the extent that the expected repository performance could be compromised.</u>

P. 6-165: In Section 6.3.1.2.4 the draft EA states "The pre-waste-emplacement water chemistry in the host rock is not known, because water samples from the unsaturated zone of the Topopah Spring Member have not yet been obtained. However, it is assumed to be similar to the composition of samples obtained from below the water table in drill holes at Yucca Mountain (Heiken, 1982), because water in the saturated zone includes water that was formerly in the unsaturated zone. The ground-water samples have similar chemical compositions and, when taken as a group, are similar to water taken from well J-13 (approximately 6.5 km (4 miles) southeast of Yucca Mountain). At well J-13, the Topopah Spring Member lies below the water table and is the producing horizon for the well." Contrary to this discussion, there is no documented evidence to assume vadose water is similar to J-13 water. This assumption is made because the program did <u>not</u> collect vadose water, but instead used the nearest well water available, that of J-13. This could prove to be a serious flaw in the research program. Eh of the vadose water, a critical chemical parameter in radionuclide behavior, could be distinctly different from J-13 water. J-13 water does not appear similar chemically to other ground water obtained from Yucca Mountain. There are significant differences in cation composition that could affect authigenic mineral stability reactions. Also, as noted in Thordarson (1983), there are significant variations in J-13 water chemistry with time. These variations apparently have not been considered in the research with J-13 water.

Separately, Henne (1982), reporting on geochemical work in Rainier Mesa tuffs, indicates the chemistry of ground water is controlled by soil chemistry, not equilibrium with the host rock.

6.3.1.3 Rock Characteristics (10 CFR 960.4-2-3)

P. 6-175: The qualifying condition for rock characteristics suggests that knowledge of thermal and pressure effects are important for determination of site compliance with radioactive releases to the accessible environment and releases from the engineered barrier system. Yet the draft EA states that the effect of temperature and pressure on the host rock has to date not been investigated. An evaluation of the site's ability to meet this qualifying condition cannot be performed when important factors have yet to be studied. The text indicates qualitative and semi-quantitative analyses were used to predict mineralogical response to heat and pressure. Review of the reference material indicates that these analyses contain significant uncertainties both in the assumptions and the conclusions. The draft EA acknowledges these uncertainties (p. 6-176): "The uncertainty introduced by the computer models is poorly known at present." The draft EA proposes to reduce the uncertainty by model comparison; collection of reliable in-situ data is equally important. Data on heat and pressure are known to be absent. A finding that the site meets this qualifying condition is suspect given the lack of important information and the large uncertainty.

6.3.1.3.3 Rock Characteristics Favorable Conditions

(1) A host rock that is sufficiently thick and laterally extensive to allow significant flexibility in selecting the depth, configuration, and location of the underground facility to ensure isolation.

P. 6-176: Figure 6-5 shows the primary area for locating the underground facility. The text states that the primary area contains few faults and rare fault breccias. The report of Scott and Bonk (1984) does not support the statement of low fault density. Scott and Bonk acknowledge that because of the poor rock exposure in some locations, some faults may not be mapped. All information on faults is based on surface observations only; no subsurface data are available. Figure 6-5 shows only major mapped faults. Two conclusions are clear from the available evidence: (1) more faults are present than currently observed in the field, and (2) the density of faults in the subsurface is unknown. These conclusions question the stability and integrity of the host rock at the repository level and the ability of DOE to predict repository conditions.

P. 6-176: In Section 6.3.1.3.3 the percentage of lithophysae in the host rock is cited as one of the selection criteria for repository location. The text states "At low percentages, lithophysae have little effect. For high percentages (probably near 30 percent), lithophysae could change the thermomechanical properties to the point that mineability and ground support requirements are affected. At what percentage the lithophysae become a concern will be determined during site characterization. For planning purposes, the underground facility has been placed in the relatively lithophysae-free section (less than 15 to 20 percent) (Mansure and Ortiz, 1984)." The literature does not support statements that low percentages of lithophysae have little effect. There are no data to substantiate that lithophysae-free sections have sufficient lateral extent for placement of the repository. A review of Mansure and Ortiz (1984) indicates the data defining the lateral and vertical distribution of lithophysae are contained in Ortiz, Williams, and Nimick, "A Three-Dimensional Model of Thermal-Mechanical Units at Yucca Mountain," Sandia Report SAND 84-1076, a document not cited in the draft EA. This report might help substantiate the statements on lateral and vertical flexibility presented in the draft EA.

P. 6-177 and 6-178: Figure 6-5 and the text identify contingency areas for possible repository expansion. Outside of discussing the size of these other areas, there is no discussion of the attributes of these areas. Some immediate questions come to mind:

1. Is the water table higher or lower than the primary area? Robison (1984) indicates a higher water table in area 4 west of the primary area;

2. Do the contingency areas have sufficient overburden (greater than the required 200 m)? Data on Figure 6-6 places areas 4, 5, and 6 in question of meeting the overburden requirement;

3. Are the contingency areas more or less complex geologically than the primary area? Review of draft EA Figures 6-5 and 6-7, and Scott and Bonk (1984) indicates contingency areas have higher density of faults. An increase in fault density adds to the complexity of the site and lessens confidence in predicting conditions; and

4. Does the proposed host rock in the contingency areas have similar thermal-mechanical properties? Mansure and Ortiz (1984) suggests a greater percentage of lithophysae is found west of area 1.

If serious consideration is given to these expansions, then the EA should describe their attributes and the potential impacts from characterization of these areas.

(2) <u>A host rock with a high thermal conductivity, a low coefficient of thermal expansion, or sufficient ductility to seal fractures induced by repository construction, operation, or closure or by interactions among the waste, host rock, ground water, and engineered components.</u>

P. 6-181: Favorable condition 2 states a host rock should be sufficiently ductile to seal fractures induced by repository construction, operation, or closure or by interactions among the waste, host rock, ground water, and engineered components. However, the conclusion on p. 6-182 states that "The host rock is not sufficiently ductile to seal fractures." The draft EA argues that fracture sealing is undesirable for a repository in the unsaturated zone. While this may be true, the guideline does not discriminate between unsaturated- and saturated-zone sites; therefore, the only reasonable conclusion that can be reached is that this favorable condition is not present at Yucca Mountain. The EA should be revised to reflect this conclusion.

P. 6-184: We question the applicability of the Johnstone et al.(1984) model for evaluating thermomechanical response of the host rock in the near and far fields for short and long time periods. The model is at best conceptual since it does not account for complex fault and fracture conditions and a significant percentage of lithophysae present in the matrix. The potential for thermally induced fractures cannot be assessed based upon this model exercise.

P. 6-184: It has been stated elsewhere in the draft EA that there are very few authigenic minerals in the near-field stratigraphy. Yet, in this section the draft EA states "In spite of the possible decrease in thermal conductivity, such fracturing may be desirable because of the increased surface area available for radionuclide retardation." DOE should elucidate on this statement with respect to actual field data.

P. 6-185: Smyth (1982) does not support the conclusion that the host rock is chemically stable. Smyth concludes:

> Non-welded and partially welded tuffs may contain major amounts (>50%) of the zeolite minerals: clinoptilolite, mordenite, and analcime. The cation exchange properties of these zeolite minerals allow them to pose a natural barrier to the migration of cationic species of various radionuclides in aqueous solutions. However, these minerals are unstable at elevated temperatures and at low water vapor pressures, and they may break down either by reversible dehydration or by irreversible mineralogical reactions. All of the breakdown reactions occurring with increased temperature involve a net volume reduction and evolution of fluids. Thus, they may provide both a pathway (shrinkage fractures) and a driving force (fluid pressure) for release of radionuclides to the biosphere.

The text should be revised to consider that zeolites and thus the host rock may not be stable at elevated temperatures.

6.3.1.3.5 Evaluation and Conclusion for the Qualifying Condition on the Postclosure Rock Characteristics Guideline

P. 6-189: Satisfaction of the postclosure rock characteristic guideline is based in part on the assumption that matrix flow is present and the flux through the unsaturated zone is less than 1 mm/yr. Evidence is not convincing that all flow is through the rock matrix; some portion of fracture flow may be present especially during periods of high recharge. All analyses and models should be revised to consider a component of fracture flow, and the EA should be revised to reflect the results. The results may show that the site does not satisfy the qualifying condition for postclosure rock characteristics.

6.3.1.4 Climatic Changes (10 CFR 960.4-2-4)

P. 6-193: The draft EA states "The relation between precipitation and recharge to the water table beneath Yucca Mountain is not well understood. Conceptual models of flow in the unsaturated zone are not yet sufficiently developed to permit quantitative studies of relations between precipitation amounts, flux, and recharge." This statement questions the accuracy and even reasonableness of 1 mm/yr flux value calculated for the unsaturated zone and utilized throughout the draft EA to support qualifying and favorable conditions for a number of guidelines. A lack of understanding of key factors that contribute to moisture flow through the unsaturated zone raises concern about the certainty of meeting technical guidelines.

6.3.1.4.3 Climatic Changes Favorable Conditions

(2) A geologic setting in which climatic changes have had little effect on the hydrologic system throughout the Quaternary Period.

P. 6-196: In the discussion of pluvial climates, the text states "Winograd and Doty (1980) hypothesize that a progressive and continued uplift of the Sierra Nevada and Transverse Ranges during the Quaternary may have led to a long-term trend of increasing aridity in Nevada" and "The rising mountain ranges would have produced a rainshadow effect that would have modified the distribution and the amount of precipitation in Nevada and resulted in increased aridity." Winograd and Doty (1980) make no such statement. There are references to the effects of a rising Sierra Nevada in that document. Smith et al. (1983) present evidence from Searles Lake for the rising Sierra Nevada as a cause for increasing aridity. In a later paper, Winograd et al. (1983) link the rise of the Sierra Nevada with increasing aridity from deuterium changes in calcite veins. This is not contradicted by the evidence from the Lake Lahontan sequence for wet pluvials, contrary to what is stated in the draft EA.

P. 6-196: The draft EA states that most investigators believe that even during pluvials semiarid conditions persisted in southern Nevada; however, the draft EA cites only one reference to support this statement. What other reports support this conclusion?

P. 6-198: In the section on hydrologic effects, Winograd and Doty (1980) report that in Frenchman Flat, 58 km northeast of Ash Meadows, the maximum water-table elevation in the carbonate aquifers probably did not exceed 30 m above the modern levels. The authors further report that the paleo-water table was a minimum of 5 m higher during the early to mid-Pleistocene based on the distribution of spring-related calcite veins at Ash Meadows. The 30 m rise may be more reasonable, but it is not based on geologic evidence. Winograd and Doty (1980) apply theoretical pluvial precipitation values and modified aquifer transmissivities and calculate a probable range of paleo-water-table elevations. This method has limitations.

Czarnecki (1984), on the other hand, estimates 130 m of maximum water-table fluctuation including perennial flow in Fortymile Wash. This has serious implications for an "unsaturated zone" repository at Yucca Mountain.

These various data sets all point out that much additional study is necessary on past and present geohydrologic conditions and predictions of future conditions, and that any findings are premature.

6.3.1.4.4 Climatic Changes Potentially Adverse Conditions

(1) Evidence that the water table could rise sufficiently over the next 10,000 years to saturate the underground facility in a previously unsaturated host rock.

P. 6-201: The conclusion that the proposed facility will remain unsaturated is not supported by the evidence. The use of the "predicted" 130 m maximum rise to state that this allows a 40 m buffer before the repository becomes saturated is not based on direct geologic evidence. As noted in previous comments, the existing and postulated recharge rates are questionable and not supported by hard data. As a result, there is uncertainty surrounding the rise of 130 m in water level. Rather than conclude, as DOE does, that this potentially adverse condition is not present at Yucca Mountain, the EA should state that additional information is needed before any conclusion can be drawn.

(2) Evidence that climatic changes over the next 10,000 years could cause perturbations in the hydraulic gradient . . . sufficient to significantly increase the transport of radionuclides to the accessible environment.

P. 6-202: The draft EA states that calculations by Sinnock et al. (1984) show that, even for fluxes through the host rock that are many times that of the present, the EPA-allowed release limits would be met. The reference does not support the statement. Sinnock indicates that under pluvial conditions (presumed higher fluxes) retardation of radionuclides could be required to meet EPA release limits.

6.3.1.4.6 Climatic Changes Plans for Site Characterization

P. 6-203: Section 6.3.1.4.6 indicates future studies will focus on determination of conclusive evidence for past water-table positions. Experience with geotechnical studies shows that conclusive evidence is difficult to obtain; peer-review consultations and scientific judgment are usually required to reach a conclusion. What will be the approach and plan if conclusive evidence is not obtainable? The final EA should discuss this issue in considerable detail.

6.3.1.5.4 Climatic Changes Potentially Adverse Conditions

(2) A geologic setting where the nature and rates of geomorphic processes that have been operating during the Quaternary Period could, during the first 10,000 years after closure, adversely affect the ability of the geologic repository to isolate the waste.

P. 6-212: The draft EA states that rates of tectonism during the Quaternary are so low that significant changes in geomorphic processes at Yucca Mountain are highly unlikely during the next 10,000 years. Section 6.3.1.7 is cited as the source for this statement. However, Section 6.3.1.7 indicates the opposite--active tectonism is present at Yucca Mountain. Quaternary-Age volcanism and recurrent Quaternary faulting is found in the vicinity of the site. A future increase in frequency or magnitude of earthquakes around Yucca Mountain cannot be ruled out. The EA should be revised to indicate that this potentially adverse condition may be present at Yucca Mountain.

6.3.1.7.3 Tectonics Favorable Condition

P. 6-222: The draft EA states that "The most recent probability calculations for basaltic eruptions at a site on Yucca Mountain range from 4.7×10^{-4} to 3.3×10^{-6} for a 10,000-year period (Crowe et al., 1982)." This statement implies that only basaltic eruptions are possible near Yucca Mountain. However, Crowe et al. (1984, p. 86) state that ". . . new work and recent discovery of two additional sites of past hydrovolcanic volcanism have raised questions about the hydrovolcanic activity associated with possible future volcanism at Yucca Mountain." Probability calculations for hydrovolcanism should also be included in the EA before any conclusion can be drawn relative to this favorable condition.

P. 6-222: The draft EA, quoting Carr (1984), reports the average rate of faulting at Yucca Mountain during the last two m.y. has been less than 0.01 m/1,000 yrs. This statement implies that all faults at Yucca Mountain have slip rates of 0.01 m/1,000 yrs or less. Carr (1984, p. 95), however, actually shows that some faults, such as the Windy Wash fault, have slip rates of 0.11 m/1,000 yrs or greater. This is an order of magnitude greater than the stated average rate. It is inappropriate to assign an average slip rate to a fault that may have a potential for movement significantly higher than the average.

P. 6-223: The draft EA states "The primary cause of earthquake-induced failure in underground excavations is movement along preexisting faults, or collapse at the portal of the tunnel or shaft." Given this statement and the substantial literature indicating that Yucca Mountain is internally faulted, fractured, and jointed, and the distinct possibility that a 6+ magnitude earthquake could occur at Yucca Mountain, there is a question of mine safety and future integrity of repository openings. This question warrants further discussion in the EA.

The conclusion that this favorable condition is present at Yucca Mountain is not supported by available evidence.

6.3.1.7.4 Tectonics Potentially Adverse Conditions

(1) Evidence of active folding, faulting, diapirism, uplift, subsidence, or other tectonic processes or igneous activity within the geologic setting during the Quaternary Period.

P. 6-223: The draft EA states "Available data indicate no unequivocal evidence that surface fault displacement has occurred within an 1100 km^2 (425 square mile) area around the Yucca Mountain site in the past 40,000 years." Available data are incomplete, and the evidence is equivocal. Not all faults were investigated (Swadley et al., 1984) in sufficient detail to allow the determination that they are not capable faults (see comments of John Bell, Nevada Bureau of Mines and Geology). A field review of DOE-excavated trenches suggests that there may be evidence of young movement on some faults at Yucca Mountain. Examination of exposures in Trench 14 across the Bow Ridge fault and Trench CF-1 across the Solitario Canyon fault suggest that movement less than 40,000 years old may have occurred.

P. 6-224: In Section 6.3.1.7.4 W. Carr (1984) states that repeated movements of any consequence on normal faults at or near Yucca Mountain would surely have left prominent scarps. This definitive conclusion is untenable based on generally recognized structural-tectonic concepts for the Basin and Range. While it is recognized that large-magnitude earthquakes have generally been accompanied by large surface displacements, there have been some notable exceptions that suggest that the absence of a large scarp is not sufficient evidence to preclude significant earthquake activity. The 1932 Cedar Mountain earthquake (M = 7.3) occurred on north-trending faults in central Nevada that are structurally analogous to Yucca Mountain faults. Vertical surface displacements associated with this earthquake were relatively small, ranging in general from 0.3 to 0.5 m in height (Gianella and Callaghan, 1934; Molinari, 1984). Similarly, the 1934 Excelsior Mountains earthquake (M = 6.3) produced only fracturing and small scarps less than 15 cm high. Surface rupturing associated with the 1903 Wonder earthquake (magnitude unknown) produced only fracturing and fissuring; this fault subsequently reruptured in 1954 (Slemmons et al., 1959). All of the above examples are possible conjugate structures related to wrench-fault movement on the Walker Lane structural zone. There is some evidence to suggest Yucca Mountain is located within the Walker Lane zone. Similar conjugate relationships can be postulated for the structures in and around Yucca Mountain. Geologic evidence (Scott and Bonk, 1984) also suggest that Yucca Mountain is (1) highly faulted and fractured, and (2) cut by numerous strike-slip faults. Both conditions may lead to the absence of prominent scarps; faulting may have been distributive in nature, and strike-slip movement would not be anticipated to produce large vertical scarps.

P. 6-224: Section 6.3.1.7.4 does not consider the evidence reported by B. Szabo on dating of fault-related fractures in drill core from Yucca Mountain (Geological Society of America, Annual Meeting, 1984). Szabo reports four age groups for fracture fillings: 28,000 $\pm$ 5,000, 170,000 $\pm$ 30,000, 280,000 $\pm$ 50,000 and greater than 400,000 years B.P. These results suggest at least four episodes of recurrent faulting at Yucca Mountain. This data is further indication of fault activity at Yucca Mountain younger than 40,000 years. The EA should be revised to include this recent information.

(2) <u>Historical earthquakes within the geologic setting of such magnitude and intensity that, if they recurred, could affect waste containment or isolation.</u>

P. 6-225: The draft EA states "If the historical earthquakes recurred, they would not be large enough or close enough to Yucca Mountain to have any demonstrable effect on waste containment or isolation. 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." These statements have no basis in fact and are not supported by the draft EA or literature. Yucca Mountain is located along a major tectonic zone (Walker Lane-Las Vegas shear zone) with a historical 7+ magnitude earthquake. Yucca Mountain is also located within an east-west seismic belt with documented 6+ magnitude earthquakes. Earthquakes in the seismic belt have not been correlated with known faults; therefore, they must be considered random. A conservative conclusion would be that at least a random 6+ magnitude earthquake is possible and perhaps probable at Yucca Mountain.

Limited water flux in the unsaturated zone and long travel times are uncertain based on information presented in the draft EA. It is probable that a large earthquake beneath Yucca Mountain could alter the hydrologic regime, and influence flux and resulting travel times.

The evidence does not support the draft EA's conclusion that this potentially adverse condition is not present at Yucca Mountain.

(3) <u>Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or the magnitude of earthquakes within the geologic setting may increase.</u>

(4) <u>More-frequent occurrences of earthquakes or earthquakes of higher magnitude than are representative of the region in which the geologic setting is located.</u>

P. 6-226: In Section 6.3.1.7.4 the draft EA and support references cite examples of earthquakes and fault scarps in the eastern part of the Basin and Range Province, mainly in Utah, Idaho, and Montana. In the vicinity of Mammoth Lakes, California, a major earthquake swarm has been in progress since 1978 and has been associated with magmatic resurgence in the Long Valley caldera. The Mammoth Lakes sequence has been studied in more detail than perhaps any earthquake sequence of comparable size, and dozens of papers have been written covering all aspects--geologic, geophysical, seismological--of this sequence. In view of the close connection between tectonic and volcanic activity in the development of the western Great Basin in general and the NTS area in particular, it is strange that the wealth of material on this sequence has been overlooked by DOE and the draft EA.

(6) Potential for tectonic deformations--such as uplift, subsidence, folding, or faulting--that could adversely affect the regional ground-water flow system.

P. 6-228: According to W. Carr (1984), "Calculations . . . show that over the last few million years Yucca Mountain and adjacent areas have been relatively stable, particularly in comparison with tectonically active areas, such as Death Valley and Owens Valley." Table 6-33 of the draft EA lists the uplift rate of the Black Mountains in Death Valley as 0.3 m/1,000 yrs. Carr (1984, p. 95) lists the uplift rate on the Windy Wash fault near Yucca Mountain as also 0.3 m/1,000 yrs. It appears from these data that the uplift rate at or near Yucca Mountain is comparable to that in Death Valley. These data further substantiate that Yucca Mountain may be tectonically active.

P. 6-230: Data on fault scarps presented in this section conflict with fault data in Section 6.3.1.7.3. Section 6.3.1.7.4 indicates that approximately 180 fault scarps or lineaments have been identified within 100 km of Yucca Mountain (Carr, 1984). One fault shows evidence of Holocene displacement (Carr, 1974). Szabo et al. (1981) identify other faults with possible Holocene displacement (the draft EA does not identify or locate these faults). In contrast, Section 6.3.1.7.3, based upon information from Swadley (1984), indicates no faults with evidence of surface faulting within the last 40,000 years are observed within a 1100 km^2 area around Yucca Mountain. Apart from our belief that evidence is present at Yucca Mountain to suggest fault movement within the last 40,000 years, the draft EA is internally inconsistent and is conflicting in its own reference literature.

The draft EA's conclusion that this potentially adverse condition is not present at Yucca Mountain is not supported by the available evidence. A more appropriate finding would be one that indicates that current data are insufficient for drawing conclusions.

6.3.1.7.5 Tectonics Disqualifying Condition

P. 6-231: The draft EA statement that "Under the assumption that Yucca Mountain faults are not active, the most likely peak deterministic ground acceleration is estimated to be 0.4 g . . ." is not defensible. Based on the conclusions of Rogers et al. (1983), USGS (1984), and Carr (1984), faults at Yucca Mountain should be considered active. The estimated peak ground acceleration (0.4 g) at Yucca Mountain is too low based on a reasonable interpretation of future tectonic events. If a large (M = 6-7) earthquake were to occur on a Yucca Mountain fault, peak ground accelerations approaching or exceeding 1.0 g could be possible. The EA should be revised to also consider the assumption that the Yucca Mountain faults are active.

P. 6-232: On this page, Pratt et al. (1978, 1979) indicates that earthquake damage to underground facilities is generally much smaller than surface damage. While we would generally agree with that statement, it has not been demonstrated for Yucca Mountain. To our knowledge no earthquake measurements have been made at the proposed repository horizon. The need to develop site-specific ground-motion parameters is critical. Site-specific monitoring of both natural-occurring events and weapons-test events should be initiated at the earliest possible time. Also, high-gain instrumentation should be installed to monitor microseismicity at Yucca Mountain. Recurrence rates obtained from microseismicity data elsewhere in the Basin and Range Province have been shown to agree reasonably well with recurrence rates obtained from long-term geologic recurrence rates, and thus could provide valuable information about future site conditions.

P. 6-232: Given that Yucca Mountain faults may be sites for future tectonic activity, return periods could be significantly shorter than times presented in the draft EA. The estimated recurrence rate of 2.5 earthquakes in 100,000 years per 1,000 km^2 yields a rerupture time of 40,000 years per 1,000 km^2. This is an estimate of the activity occurring randomly within a 17 km radius (1,000 km^2) of the site. The recurrence rate (2.5×10^{-5} events/year/ 1,000 km^2) is comparable to rates measured in areas of Holocene and historic faulting in western, central, and north-central Nevada (Bell, 1984a, b; Wallace, 1978). Using an average displacement rate of 0.11 m/1,000 yrs on the Windy Wash fault (Carr, 1984), 1.1 m of slip would be anticipated in the next 10,000 years. This is equivalent to at least a single earthquake of M 6.5-7 (Bonilla et al., 1984).

P. 6-233: The conclusion to Section 6.3.1.7.5 states "There is, however, no clear evidence that a major earthquake is likely to occur at Yucca Mountain." To the contrary, based on data provided in the draft EA as well as in major supporting publications such as Rogers et al. (1983) and U.S. Geological Survey (1984), a large earthquake is not only possible but probable during the 10,000-year life of the repository. The conclusion in the draft EA is clearly incongruous in light of the existing evidence.

This disqualifying condition may very well be present at Yucca Mountain. A level 1 finding is not supported.

6.3.1.7.6 Evaluation and Conclusion for the Qualifying Condition on the Postclosure Tectonics Guideline

P. 6-233: The draft EA states, "To evaluate trends in tectonic activity, it is desirable to consider a period longer than the Quaternary Period." This assumption is not compatible with observed patterns of tectonic activity in the Great Basin (Wallace, 1978). Trends in activity have been recognized as being episodic or cyclic in nature with periods between major episodes of faulting ranging up to tens or hundreds of thousands of years. The Quaternary, especially the late Quaternary, record must be used to establish the present state of these cycles.

P. 6-233: The draft EA indicates that the probability for major earthquakes in the area is about 2.5 per 100,000 years. This is not a probability; this is a recurrence rate. In addition, this is a recurrence rate normalized for an area of 1,000 km^2. In other words, it is an estimated rate anticipated to occur anywhere within a 1,000 km^2 area regardless of existing geologic structure. If geologic structure is included, individual faults will have higher rates. This rate (2.5×10^{-5} events/yr/1,000 km^2) is also comparable to rates calculated in western, central, and north-central Nevada by Bell (1984a, b) and Wallace (1978) where numerous historic surface faulting events have occurred.

P. 6-234: The draft EA states "Neither major tectonic activity nor the resumption of large-scale silicic volcanic activity in the area near Yucca Mountain is likely in the next 10,000 years." Based on existing evidence, this conclusion is premature. Evidence for tectonic activity is available and has been discussed in previous comments. Recent studies (Crowe et al., 1984) also suggest that possible hydrovolcanic activity at Yucca Mountain has not been sufficiently evaluated.

P. 6-234: The conclusion for Section 6.3.1.7.6 states "No mechanisms have been identified whereby future tectonic processes or events could lead to unacceptable radionuclide releases." This conclusion is inconsistent with existing geologic and hydrologic evidence. The scientific information available indicates, in fact, that the site may not meet the qualifying condition for postclosure tectonics.

6.3.1.7.7 Postclosure Tectonics: Plans for Site Characterization

P. 6-235: From the discussion presented in the draft EA, it is clear that the role of nuclear-weapons tests in containment and isolation of wastes at Yucca Mountain has not been fully defined as yet. While there are some undocumented negative aspects of nearby weapons testing on future repository integrity, past testing may provide important information about the suitability of the site. Weapons testing can provide a significant data base to assess the state of present-day stresses. Aki (early 1970s) and, more recently, Wallace and Helmberger (1984) have discussed the decrease in excitation of Love waves or SH generation in tests done on the Test Site. Therefore, the potential exists to estimate the stress available to cause earthquakes to a depth of about 5 km on the Nevada Test Site. The method uses the fact documented by Aki and Wallace that when tests are fired repeated in a part of the test site, the amount of Love wave and SH excitation drops essentially to zero. Thus, by looking at the combined release by the explosions and their aftershock sequences, one could determine the stresses available to produce seismic radiation. This method appears every bit as fruitful as in-situ stress measurements to assess the present-day capability of faults in the region. Some discussion should be given in Section 6.3.1.7.7 (Plans for Site Characterization) to weapons-test data and their application to a variety of geologic issues.

6.3.1.8 Human Interference Technical Guideline (10 CFR 960.4-2-8): Natural Resources (10 CFR 960.4-2-8-1) and Site Ownership and Control (10 CFR 960.4-2-8-2)

P. 6-236: In Section 6.3.1.8.2 all relevant data have not been considered and other data are misrepresented. The draft EA does not consider the minerals inventory for NTS by Tingley and Quade (1984). The referenced study by Garside and Schilling (1983) does not evaluate hot springs, only inventories them.

6.3.1.8.3 Human Interference Favorable Conditions

(1) No known natural resources that have or are projected to have in the foreseeable future a value great enough to be considered a commercially extractable resource.

P. 6-236: The statement that there is no potential for any commercially attractive geothermal resources is not defensible. There is presently insufficient information available to determine geothermal-resource potential.

6.3.1.8.4 Human Interference Potentially Adverse Conditions

(1) Indications that the site contains materials with potential for economic extraction, etc.

P. 6-241: The statement that no energy, metal, or nonmetal resources unique to the site vicinity or critical to foreseeable national needs have been identified is incorrect. According to Spengler et al. (1981), gold and silver (contained in pyrite) were encountered in drill hole USW G-1. Both are listed on the U.S. Bureau of Mines list of strategic and critical minerals. Additional research is needed before DOE can conclude that this potentially adverse condition is not present at the site.

(5) Potential for foreseeable human activities--such as ground-water withdrawal, etc.

P. 6-243: The discussion of the potential for ground-water extraction evaluates the potential for Yucca Mountain and Jackass Flats but fails to consider the potential for Crater Flat, west of Yucca Mountain. Also, the discussion fails to consider the deep regional aquifer as a potential source for future water supplies. The information and analysis contained in the draft EA is inadequate to determine if this potentially adverse condition is present or not.

6.3.1.8.6 Evaluation and Conclusion for the Qualifying Condition on the Postclosure Human Interference and Natural Resources Technical Guideline

P. 6-245: The statement that "A thorough examination of the resource potential of Yucca Mountain has been made . . ." is not defensible. A thorough examination has not been made. No comprehensive surface examinations, geochemical-sampling surveys, core examinations, or alteration studies have been performed; and according to Section 6.3.1.8.7 (Plans for Site Characterization), none are planned. No reasonable defensible conclusion on the resource potential can be made without such surveys.

6.3.2.2.1 Quantitative Analyses for the Postclosure System Guideline (10 CFR 960.4-1)

P. 6-249: We find the conclusion at the bottom of p. 6-249 overly optimistic and unsupported by the information presented in the draft EA. Based on the evidence presented for the postclosure system guideline, it is impossible to determine whether the assumptions proposed are conservative. Certainly, the values of flux are not conservative, and may not be reasonable. The total amount of water infiltrating Yucca Mountain, especially during a pluvial period, is unknown. Sorptive capabilities of tuffs remain in question. This conclusion should be deleted.

6.3.2.2.2 Qualitative Analysis for the Postclosure System Guideline

P. 6-250: The text states "The potential of the site to meet the guidelines on geohydrology and tectonics engenders the most uncertainty. In no instance, however, is the level of confidence low enough to justify a finding that Yucca Mountain does not qualify, or is disqualified, with respect to any of the technical guidelines."

A review of the draft EA and supporting literature suggests that the site may not meet many of the specified guideline conditions. Guidelines established by DOE (see p. 6-4) require that conservative assumptions be made in the absence of an adequate data base. They also require that the existing data "clearly support" a condition for a conclusion to be drawn. A review of the data indicates that not only are the data bases inadequate, but the existing data in some instances directly conflict with the draft EA conclusions. The "confidence levels" presented in Section 6.3.2.2.2 are unsupported and are not relevant to the analysis of postclosure system guidelines. The discussion should be removed.

P. 6-250: The analysis of adverse effects on ground-water flow due to tectonic motion is incomplete. Sinnock et al. (1984) did not consider the possibility of tectonic fracturing (increase in fracture density and fracture aperture-width) in their parametric analysis using higher flux values. Yucca Mountain is acknowledged to have been tectonically active in the past and may be similarly active in the future. It is not unreasonable to conclude that any future near-field tectonic activity could alter both the fracture regime and ground-water flow conditions at Yucca Mountain. A conclusion that "overall, tectonic processes will probably have negligible effects on flow mechanisms" cannot be supported based on the current level of knowledge about site conditions.

P. 6-251: The draft EA states "the hydrologic and geochemical conditions are sufficiently favorable to allow a conclusion that they will more than compensate for the potentially adverse conditions outlined above, and the level of confidence about this conclusion is high." Given the high level of uncertainty relative to many parameters and the total absence of data on some parameters, it is extremely difficult for us to draw the same conclusion, especially with the same confidence level. It is doubtful any independent reviewer of the draft EA would have a similar high level of confidence in this conclusion.

<u>6.3.2.3 Summary and Conclusion for the Qualifying Condition on the Postclosure System Guideline</u>

P. 6-252: The text states "This conclusion [that Yucca Mountain is qualified under all eight of the postclosure technical guidelines] is supported by the overall balance between favorable and potentially adverse conditions identified at Yucca Mountain." How is "overall balance" defined when comparing favorable and potentially adverse conditions? Technical conditions are <u>not</u> comparable and therefore cannot be balanced, except, of course, if one favorable condition equals one potentially adverse condition numerically. This section should be revised to clearly explain how DOE will consider favorable and potentially adverse conditions in assessing the site's ability to meet systems guidelines. Using available information, there are serious questions about the site's ability to meet this qualifying condition. A level 3 finding is totally unwarranted.

<u>6.3.3.1 Surface Characteristics (10 CFR 960.5-2-8)</u>

P. 6-253: In Section 6.3.3.1.2 the cited reference (Lipman and McKay, 1965) pertains only to the topographic map. The DOE should cite the reference for the aerial photographs.

P. 6-253: Analysis of flood potential by Squires and Young (1984) and the discussion in the draft EA does not address sheet-wash flooding. Review of the draft EA suggests that the surface facilities will be located in an area subject to sheet wash and in the floodplain of Drill-Hole Wash. Therefore, based on this information, the finding on p. 6-257 must be that the potentially adverse condition guideline for surface flooding <u>is</u> present at Yucca Mountain. Conclusions reached for this guideline should be revised.

<u>6.3.3.1.4 Surface Characteristics Potentially Adverse Condition</u>

P. 6-257: The conclusion for Section 6.3.3.1.4 state there are no existing or planned surface-water impoundments. This statement conflicts with the discussion of exploratory-shaft surface facilities (Section 4.1.2.1), which describes a sewage lagoon and a rock-storage pile for disposal of drilling fluids and wash water. This discrepancy should be examined.

As noted above, the surface facilities for the repository will be located in an area that is subject to sheet wash and in the flood plain of Drill-Hole Wash. Therefore, this potentially adverse condition is present.

6.3.3.2 Rock Characteristics (10 CFR 960-5-2-9)

P. 6-261: The draft EA states that many of the engineering properties of the Topopah Spring tuff are assumed to be similar to properties of the Grouse Canyon tuff in G-tunnel at Rainier Mesa. Although some similarities may exist between the two units, a comprehensive comparison of physical properties of the units is not presented in the text. There is insufficient information to make an assessment of the site's ability to meet preclosure guidelines for rock characteristics.

6.3.3.2.3 Rock Characteristics Favorable Conditions

(1) A host rock that is sufficiently thick and laterally extensive to allow significant flexibility in selecting the depth, configuration, and location of the underground facility.

P. 6-264: Comments provided previously argue against conclusions stated in Section 6.3.3.2.3 that the potential host rock is sufficiently thick to provide vertical flexibility.

(2) A host rock with characteristics that would require minimal or no artificial support. . . .

P. 6-266: None of the draft EA reference literature presents any field-measured RQD values for the rock units. Empirically derived RQD values are contained in Dravo (1984) but only for drill hole USW G-4. Are field-measured RQDs available for drill holes at Yucca Mountain? The suitability of the underground-support system for the repository cannot be adequately assessed without field-measured information. The finding that this favorable condition is present at the site is, therefore, unsubstantiated.

6.3.3.2.4 Rock Characteristics Potentially Adverse Conditions

(4) Potential for such phenomena . . . that could lead to safety hazards or difficulty in retrieval during repository operation.

P. 6-271: The draft EA indicates only minor amounts of smectite and trace amounts of zeolite are present in the proposed repository horizon. This discussion does not consider smectite and zeolite lining walls of fractures and joints. Elsewhere in the text is reported a higher percentage of smectite and zeolite in fractures than in host rock. Also, it is anticipated that if the hydrologic regime becomes wet either due to the near-field heating or higher-than-anticipated vadose flux, rock stability will degrade with respect to failure. Therefore, this information needs to be considered relative to the conclusion that there is little potential for hydration or dehydration of minerals that could affect safety of repository operation or impact waste retrieval.

6.3.3.4.3 Tectonics Favorable Conditions

P. 6-286: The draft EA should utilize the most current evidence available. According to Section 6.3.3.4.3 the peak deterministic acceleration assigned to Yucca Mountain (USGS, 1984) is based upon work by Rogers et al. (1977) for the Bare Mountain fault. Rogers et al. use Schnabel and Seed (1973) attenuation relations to estimate maximum ground motion. Aside from the State's belief that the peak acceleration for Yucca Mountain is not reasonable nor conservative, the calculations are not based on state-of-the-art methodology or current data. Schnabel and Seed (1973) has been revised by Seed and Idriss (1982). Maximum credible earthquake magnitude estimations utilizing fault-length relationships reported by Slemmons (1984) should be incorporated. The seismic hazard at Yucca Mountain is a critical concern and requires the use of the most sophisticated methodologies currently available.

P. 6-286: According to the definition of "active fault" contained in the draft EA glossary (p. G-1), many faults at Yucca Mountain should be considered to be active. Many faults--Solitario Canyon, Ghost Dance, Bow Ridge, Windy Wash, for example--display evidence of multiple movement. If an earthquake such as postulated for the Bare Mountain fault would occur on the Solitario Canyon fault, accelerations of 1.0 g or greater are possible. Fault movement along the Ghost Dance fault, which is located within the repository block, could produce great damage to underground openings and repository facilities.

P. 6-287: There is agreement that nuclear facilities have been and continue to be constructed in tectonically active areas such as California and Japan, where high surface accelerations are common. However, nowhere are nuclear facilities sited on or adjacent to "active faults" (i.e., faults capable of movement within the life of the facility). A number of faults on Yucca Mountain display evidence that fits the NRC definition of a capable fault and the DOE definition of an active fault.

6.3.3.4.4 Tectonics Potentially Adverse Conditions

(2) Historical earthquakes or past man-induced seismicity that . . . could produce ground motion . . . in excess of reasonable design limits.

P. 6-289: It seems premature to conclude that seismic-design criteria and return periods are overly conservative for geologic repositories. From the State's perspective the rate at which radionuclides disperse from a damaged facility to the environment is the major difference between geologic repositories and nuclear reactors. There will be much discussion between DOE, NRC, the State of Nevada, the scientific community, and the public before a consensus seismic-design requirement for geologic repositories is established.

It is likewise premature to conclude that this potentially adverse condition is not present at Yucca Mountain. There is evidence to suggest that it may be present.

6.4.1 Preclosure Radiological Safety Assessments

P. 6-300: Elsewhere in the draft EA is described the possibility of utilizing radioactive-source materials for in-situ testing during site characterization. There is no assessment of the affect of this activity on radiological safety in this section. We are concerned that this testing could produce some underground contamination prior to a Presidential decision to construct a repository and before a radiological monitoring program is implemented, as well as possible worker exposure during construction.

6.4.2 Preliminary Analysis of Postclosure Performance

P. 6-303: The draft EA states in Section 6.4.2 "The objective of this preliminary analysis is to estimate the likelihood of satisfying the regulatory performance criteria contained in 10 CFR Part 60 (NRC) and 40 CFR Part 191 (EPA). The results of the analysis are used in Section 6.3.2 in evaluating the site against the postclosure system guideline, which is based on these NRC and EPA regulations." However, on p. 6-304, the draft EA states "Because of limitations in the data base and analytical methods, this preliminary analysis is not intended to demonstrate compliance with the postclosure system guideline; . . ." The statements appear contradictory. Section 6.3.2 on p. 6-249 states ". . . after site characterization, the Yucca Mountain site will be shown to meet the postclosure system guideline (10 CFR 960.4-1(a))." That section concludes on p. 6-252 by stating ". . . the evidence does not support a finding that the site is not likely to meet the qualifying condition for the postclosure system guideline (level 3)."

The EA appears to have made a positive finding relative to a key qualifying condition--and assigned a high confidence level to that finding--despite statements in the document itself indicating that information sufficient to draw conclusions is not yet available.

6.4.2.1.2 The Natural-Barrier Subsystem (The Geohydrologic Setting)

P. 6-309: Applicable information on the geochemical properties of the Yucca Mountain site is limited. Sorption properties of the whole rock have not been sufficiently investigated for conditions above ambience. Under ambient conditions, it is unknown which minerals may provide retardation because:

1. Little is known concerning their chemistry (cation composition) with respect to their sorption.

2. Data have not shown that the clays are effective sorption agents.

3. Water chemistry in the vadose zone is unknown, especially cation composition and oxidation state.

4. Water chemistry is known, in part for the saturated zone. However, there seem to be wide fluctuations in chemical composition with time from single wells, and significant variations in chemical composition within the stratigraphic streamlines in the water table itself. As very little detailed water-chemistry data are available with reasonable stratigraphic controls, the nature of the authigenic mineral response with respect to retardation becomes uncertain.

6.4.2.2 Preliminary Performance Analyses of the Major Components of the System

P. 6-310: In Section 6.4.2.2.1 it is questionable that the experimental analysis of the corrosion rate of 304L stainless steel in J-13 water represents a reasonable analogy to the Yucca Mountain vadose zone. It would appear that this issue (corrosion of the canisters) is important relative to waste containment, yet there are no data reported for anticipated real-world conditions. Until vadose-zone water (which may be more acidic and more oxidizing) is used in waste-package integrity experiments, the results are not definite. Therefore, the containment period is unknown. Further, scratched canisters may not react similarly to unscratched canisters; consequently, the analyses may not be conservative.

P. 6-313: The draft EA describes various ground-water travel-time estimation methods that provide an "average" or "expected" travel time. Average ground-water travel time is different from expected ground-water travel-time. Which (average or expected) is estimated in this section?

6.4.2.3 Preliminary System Performance Analysis

P. 6-318: The draft EA is inconsistent in its reporting of ground-water travel times; this page reports a minimum travel time of 47,000 years, while p. 6-121 reports a travel time of 25,000 years. While there is much uncertainty connected with data utilized in the estimates and the results are highly questionable, the final EA should at least present a consistent value.

6.4.2.5 Preliminary Evaluation of Disruptive Events

P. 6-323: Two comments are appropriate in the section concerning fracture flow:

1. The text indicates that if the percolation rate in nonwelded tuffs exceeds 1 mm/yr, fracture flow will begin. However, in Section 6.3.1.1 Sinnock (1984) was cited as reporting that fracture flow would not occur even if the 1 mm/yr flux was 50 times greater. This discrepancy needs to be resolved. The State believes that fracture flow may occur at rates lower than 1 mm/yr. The data base is insufficient for a definitive conclusion.

2. This section is the first mention of the diffusion of fracture water into the matrix. Although a large gradient could exist between the fracture water and the matrix water, the hydraulic conductivity of the matrix is quite low, and diffusion may be slow (Travis, 1984). There is also a contradiction here since the draft EA's conceptual model allows for saturated fracture flow to move completely through the Tiva Canyon tuff without any matrix diffusion occurring. The data base for these scenarios is <u>not</u> sufficient for either statement.

P. 6-323: Three comments are appropriate in the section discussing climatic change:

1. A 50-percent moisture increase in the Pleistocene is reported in Spaulding (1983). This figure was revised to as much as 100 percent of modern in Spaulding et al. (1984). Neither figure may represent a worst case in terms of effective moisture in the future, a parameter the draft EA fails to recognize. Spaulding's estimates apply to the late Pleistocene (10,000 yr. B.P.). Spaulding (1983) and other references (see Section 6.3.1.4, Climate Change) suggest increased moisture (up to 70 percent) and cooler full-glacial conditions (18,000 yr. B.P.). With a larger proportion of winter precipitation and less evaporation, effective moisture and, therefore, recharge probably was greater during the full-glacial than the late Pleistocene. This is supported by stratigraphic evidence from the Las Vegas Valley (Quade, 1983).

2. Even with a reliable estimate of full-glacial climate, the problem of translating that climate into recharge remains. That recharge figure is still unknown, as the draft EA admits in Chapter 7, where it states that: "One exception may be the effect of increased recharge on the hydrologic system, but the magnitude of the increased recharge has not yet been quantified" (p. 7-31).

3. Estimated matrix flux is stated in this section as "much less than 1 mm/yr." Elsewhere in the draft EA estimated matrix flux is 1 mm/yr.

The conclusion on p. 6-325 that "no information . . . indicates the Yucca Mountain site is unsuitable for further characterization or that it is likely to be disqualified under the postclosure system guideline (Section 6.3.2) after site characterization and more-refined analyses of system performance" is not supported by the evidence contained in the draft EA.

SPECIFIC COMMENTS ON CHAPTER 7

COMPARATIVE EVALUATION OF SITES PROPOSED FOR NOMINATION

7.1.1 Purpose and Requirements

P. 7-1: Section 112(b)(1)(E)(iv) of the Nuclear Waste Policy Act requires that there must be "a reasonable comparative evaluation by the Secretary of such site with other sites and locations that have been considered."

The State contends that, at the very least, the Act requires DOE to compare all nine sites identified as "potentially acceptable" under Section 112(a). There may also be grounds for requiring that such comparison be done for all locations considered by the Department before selecting the nine sites.

DOE's narrow interpretation that only the five sites nominated as candidates for characterization need be compared against each other is a violation of both the letter and intent of the Nuclear Waste Policy Act.

7.1.2 Approach and Organization

P. 7-3: Section 7.1.2 states: "For the disqualifying conditions, the findings are summarized in the tables compiled for each of the guidelines, but the bases for the findings are not directly discussed, because the disqualifying conditions did not enter directly into the comparison of sites." That statement would be incredible were it not for the fact that the disqualifying conditions did not enter into the comparison simply because DOE subjectively found no disqualifying conditions to exist at any site.

P. 7-3: Any comparison that measures and ranks sites as the basis of how each site fared when evaluated against the guidelines will be valid only to the degree that the findings relative to the guideline evaluation are sound. The assessment of the Yucca Mountain site vis-a-vis the siting guidelines is not sound and is not supported by information contained in the document or in the references. In instance after instance, DOE cites references or data to support its finding that a favorable condition is present or a potentially adverse one is absent when, in fact, the information itself does not support such a finding or conclusion.

Numerous examples of this misrepresentation of data can be found in the State's comments relative to Chapter 6 of the draft EA. This can be graphically illustrated by reviewing the treatment of the guideline concerning tectonics in Section 6.3.1.7. Both the State comments and those of the Nevada Bureau of Mines and Geology (John Bell) point out that the findings made by DOE relative to tectonics at Yucca Mountain are not only not supported by the references cited, but those findings actually contradict the conclusion they are cited as supporting. Nevertheless, DOE goes on to use these erroneous conclusions in performing the comparative rankings of Yucca Mountain and the other sites vis-a-vis the tectonic guideline. As a result, Yucca Mountain appears to rank favorably in relation to other sites on this guideline when, in fact, the entire comparison is based on unsupported findings.

When this process is repeated for other guidelines (as it is in the draft EA), the favorable technical aspects of the Nevada site are grossly overstated. The result is that the entire comparison contained in Chapter 7 has been distorted.

The final EA must remedy this situation if the site-selection process is to have any credibility. This can be done in one of two ways: (1) more data can be collected in order to allow for findings to be made using more adequate information, or (2) DOE can conclude that there is not enough information to make findings with regard to most of the guidelines.

P. 7-4: The discussion of the approach and organization of Chapter 7 clarifies that the siting guidelines are subjective. The draft EA states: "The discussion of each qualifying condition for the technical guidelines contains a relative ranking of sites. The general approach to determine the ranking for technical guidelines is qualitative and followed several general principles. The principles can be summarized as follows: 1. . . . simply tallying the number of favorable or potentially adverse conditions for a guideline, to arrive at a judgment of which site ranks highest or lowest, is misleading and is not consistent with the intent of the siting guidelines." The use of the average method of ranking sites comes suspiciously close to such a simple "tallying" of favorable or potentially adverse conditions.

P. 7-4: The draft EA states that "The potentially adverse conditions can also be used to rank sites, especially those that, if present in the extreme, are disqualifying. Such potentially adverse conditions were given greater significance in deriving the site rankings" (emphasis added). This is totally disingenuous since DOE found no "such" potentially adverse conditions to exist at any site, i.e., conditions that are present in such an extreme as to be disqualifying. Also as discussed in comments on Chapter 6, we believe that both preclosure and postclosure disqualifying conditions for tectonics exist at Yucca Mountain.

P. 7-4: The method that DOE has selected for application of the siting guidelines, set out in Appendices 3 and 4 to the guidelines, too often utilizes insufficient information, nonsupportive assumptions, and a double-negative test (i.e., "the evidence does not support a finding that the site is not likely to meet the qualifying condition"). The text at p. 7-4 suggests the inadequacy of this approach: "the evidence is not adequate to compare or rank the sites for any of the system guidelines, principally because at this stage in the siting process there is not enough information to provide a full understanding of the interrelationships among the technical features of a site and of their functioning in a complete system."

P. 7-4: In the paragraph describing the implementation guidelines it would be more accurate and informative to state that certain elements of the implementation guidelines, namely 40 CFR 191, are not final and the requirements of the standard are unknown.

7.2 Comparison of Sites on the Basis of the Postclosure Guidelines

7.2.1.1 Geohydrology

P. 7-5: The comparisons contained in Section 7.2.1.1 and Table 7-1 compare four saturated-zone sites with one unsaturated-zone site. Because of the lack of understanding of the unsaturated zone, it is unrealistic to compare both kinds of sites against each other. If DOE were in fact comparing the waste-isolation capabilities of each site, be it saturated or unsaturated, the comparison would be meaningful, but where DOE has concluded that knowledge of the waste-isolation capability of the Yucca Mountain site is uncertain, the comparison as to geohydrology is invalid.

P. 7-10: In its evaluation of the guideline on geohydrology (960.4-2-1) DOE relies on "the results of testing in two wells in the unsaturated zone and 30 wells in the saturated zone at and near Yucca Mountain." Because the proposed repository horizon is in the unsaturated zone, more unsaturated-zone data are required upon which to base the conclusions relevant to geohydrology. The extrapolation of saturated-zone data to unsaturated-zone conditions may not be reasonable nor appropriate.

P. 7-10: As noted in previous comments, the draft EA is inconsistent in its statements of ground-water travel-time. One section of Chapter 6 states a travel-time of 25,000 years from the repository to the accessible environment; elsewhere in Chapter 7, a minimum travel-time of 47,000 years is stated; Chapter 7 also states various other travel-times--45,000 years, 55,000 years, and greater than 50,000 years. The final EA should present one travel-time value or a range of possible travel-times.

P. 7-10: It should also be noted here that draft #5 of the EPA Standard has changed the boundary of the accessible environment from 10 kilometers to 2 kilometers. The final EA should discuss the impacts this change will have upon these ground-water travel-time estimates.

P. 7-11: The draft EA states: "The hydrologic processes that operated at Yucca Mountain during the Quaternary Period include cyclic fluctuations in precipitation and changes in water-table elevation. The nature, rates, and ultimate effects of these processes, if continued into the future, are not sufficiently understood at present. Although preliminary analysis indicates there would be no adverse effect on the waste-isolation capability of the site, the uncertainty is too high to support the presence of the favorable condition at Yucca Mountain." Though this conclusion is intended to relate solely to 960.4-2-1(b)(2), it is obvious that the insufficient understanding of the cyclic fluctuations in precipitation and changes in water-table elevation is relevant to any positive determination that a repository located in the unsaturated zone at Yucca Mountain would successfully isolate waste from the accessible environment. In that regard, the finding, in Table 7-1 (p. 7-6), that the evidence does not support a finding that the site is not likely to meet the qualifying condition at Yucca Mountain is self-serving. A more appropriate finding would be that the current understanding of the geohydrologic conditions at Yucca Mountain is too incomplete to determine that Yucca Mountain meets the qualifying condition 960.4-2-1(a).

P. 7-13: The draft EA states that "Potentially adverse condition 1 [960.4-2-1(c)(1)]--expected changes in geohydrologic conditions sufficient to significantly increase the transport of radionuclides--is not present at any of the sites." This statement conflicts with the earlier statement on p. 7-11 that hydrologic processes operating within the geologic setting of Yucca Mountain are not sufficiently understood. To the extent that expectation of changes in geohydrologic conditions is based on an insufficient understanding of the present hydrologic setting, the expectation is unfounded.

P. 7-13: The text concludes that "Potentially adverse condition 2 [960.4-2-1)(c)(2)]--the presence of usable ground-water resources along flow paths to the accessible environment--is present only at the Yucca Mountain site." This language conflicts with DOE's finding at p. 7-51 regarding 960.4-2-8-1(c)(5).

P. 7-14: The draft EA states that "Notwithstanding these uncertainties, the limited hydrologic information does not support a finding that any of the sites are not likely to meet the qualifying condition" [960.4-2-1(a)]. This is a prime example of the subjective application of the §112(a) siting guidelines. The amount of information that would be most likely to "not support a finding that any of the sites are not likely to meet the qualifying condition" would be no information. In order to evaluate sites under the guidelines as anticipated by §112(a) of the Act the DOE is required to conclude that the available information supports a finding that the sites are more likely to meet the qualifying condition. In the event that finding cannot be made, no conclusion should be drawn with respect to the qualifying condition. The Department of Energy should acknowledge that it must gather more data before it can proceed to any conclusion with respect to the site.

P. 7-15: The draft EA states that "The dry conditions likely at Yucca Mountain are thought to almost balance the fact that the site has a shorter time of ground-water travel than Richton, Davis Canyon, and Deaf Smith and probably cannot be as readily characterized and modeled because the structural and stratigraphic complexities appear to be greater." This statement is wholly conclusory. In what way do "dry conditions" balance "shorter time of ground-water travel?" What is the implication of the fact that Yucca Mountain "cannot be as readily characterized and modeled because of the structural and stratigraphic complexities" on the ultimate question of site suitability?

7.2.1.2 Geochemistry

P. 7-16: The presence of clays and zeolites at Yucca Mountain does not necessarily contribute to the isolation capability of the site. Little data have been obtained on the sorption capacities of known zeolites and clay. No data have been developed on sorption capacities under thermal conditions. In addition, other potential sorption agents such as ferromanganese oxyhydroxides are present and unstudied.

P. 7-20: The draft EA states that at Yucca Mountain no heat-induced alteration of the tuff is expected. There is the distinct possibility that the obsidian and perlite fractions may alter under thermal conditions. Also, it has not been documented that zeolites will form by alteration, nor if zeolites were formed there would be effective retardation by sorption.

P. 7-21: The text states that "Potentially adverse condition 3 [960.4-2-2(c)(3)]--ground-water conditions in the host rock that are chemically oxidizing--exists in the unsaturated zone at Yucca Mountain. . . . All other sites have reducing ground-waters, as already mentioned." It does not appear that the ranking of the five sites under geochemistry gives any weight to the fact that this potentially adverse condition is present only at Yucca Mountain.

7.2.1.3 Rock Characteristics (Postclosure)

P. 7-26: In discussing the qualifying condition and ranking of sites for postclosure rock characteristics, the draft EA concludes that ". . . the characteristics of, and the processes operating within, the geologic setting are to permit compliance with the limits specified by the EPA for radionuclide releases to the accessible environment and with the limits established by the NRC for radionuclide releases from an engineered-barrier system that uses reasonably available technology. For all of the sites, the evidence does not support a finding that any of the sites are not likely to meet this qualifying condition." The EPA's limits for radionuclide releases to the accessible environment and the NRC's limits for radionuclide releases from engineered-barrier systems are not yet finally determined. It is therefore impossible to determine, from any evidence, that those limits could be met. DOE's findings are self-serving, really constitute no finding at all, and fail to acknowledge that EPA's and NRC's limits must be known before any conclusions can be drawn.

P. 7-27: The draft document states that "The differences among sites in their potential for phenomena that could affect isolation (potentially adverse condition 2)[960.4-2-3(c)(2)] are not considered significant for this evaluation, because these phenomena are not expected to have significant effects at any of the sites." If these phenomena are not expected to have significant effects at any of the sites, why are these phenomena introduced in the siting guidelines as potentially adverse conditions? The DOE should define "significant" as used here.

7.2.1.4 Climatic Changes

P. 7-31: Relative to potentially adverse conditions for climatic changes, the draft EA states that "At Yucca Mountain, renewed glaciation would result in wetter conditions in the vicinity of the site. (Summer rainfall may have been up to 50 percent greater than at present.) Part of this precipitation would be lost by evapotranspiration and by runoff; the remainder would serve to increase the ground-water flux through the unsaturated zone. . . . Because the expected rate of flux is very low, estimated increases in flux (some fraction of the increased precipitation) are not likely to have a significant effect on the hydrology system." Two comments are appropriate:

1. The 50 percent greater moisture figure for the Pleistocene comes from Spaulding (1983). That figure was revised to as much as 100 percent of modern moisture in Spaulding et al. (1984). However, neither figure may represent a worst case in terms of effective moisture in the future.

2. Even if a reliable estimate of full-glacial climate exists, the translation of climate into recharge remains a problem.

7.2.1.5 Erosion

P. 7-35: Regarding the favorable conditions for erosion, the draft EA states that "At the preferred repository location in Yucca Mountain, much of the waste could be emplaced below 300 meters, but available data show that the potential host rock in the lower part of the preferred tuff formation--the Topopah Spring Member--cannot accommodate all of the waste at depths greater than 300 meters." To what extent, if any, would the inability of the Topopah Spring Member to accommodate all of the waste at depths greater than 300 meters cause any portion of the underground facility to be situated less than 200 meters below the directly overlying ground surface, thereby disqualifying the site? See 960.4-2-5(d).

The evaluation of Yucca Mountain under the guideline for erosion (960.4-2-5) does not discuss this likelihood. At p. 7-36 the text states "The fact that Yucca Mountain does not possess favorable condition 1 (waste emplacement below 300 meters) does not appear significant. Much of the waste can be placed at depths greater than 300 meters. In addition, the presence of the other two favorable conditions at Yucca Mountain compensates for the lack of favorable condition 1. Therefore, all sites appear to rank equally with respect to this qualifying condition" [960.4-2-5(a)]. Why doesn't the inability to emplace waste at a depth greater than 300 meters appear significant? Why is 300 meters set as a measurement unless it is significant? How much of the waste can be placed at depths greater than 300 meters? And why, as a result of these subjective conclusions, do all sites appear to rank equally?

7.2.1.7 Tectonics (Postclosure)

P. 7-40: Under Favorable conditions for postclosure tectonics, the text states "The Davis Canyon, the Hanford, and the Yucca Mountain sites have relatively higher levels of tectonic activity, but the available data do not suggest that tectonic activity at these sites could both alter the hydrologic flow system and lead to radionuclide releases after repository closure." Once again, little data have been utilized to justify a conclusion favoring and ratifying DOE's desire to proceed at pre-selected sites. Are the available data sufficient to suggest that the tectonic activity at the discussed sites would neither alter hydrologic flow systems nor lead to radionuclide releases after repository closure? DOE's reference to available data and preliminary analysis suggests that the data are not sufficient.

Pp. 7-40 to 7-45: A review of Section 7.2.1.7 indicates the conclusions are incomplete, inadequate, and in some instances, incongruous. On the surface, the draft EA appears to assess all pertinent aspects. Upon a comprehensive review of the supporting literature, however, it is apparent that the document has not objectively assessed all available evidence. In fact, some of the conclusions drawn in the text are in direct conflict with the available data. The selective use of data in the draft EA also significantly detracts from the adequacy and credibility of the conclusions. With regard to postclosure tectonic conditions, the favorable condition is not present, five of six potentially adverse conditions are present, and the disqualifying condition is possibly present. A detailed discussion of each condition follows:

Postclosure Favorable Condition (Sec. 6.3.1.7.3)

> **Favorable Condition: The nature and rates of igneous activity and tectonic processes (such as uplift, subsidence, faulting, or folding), if any, operating within the geologic setting during the Quaternary Period would, if continued into the future, have less than one chance in 10,000 over the first 10,000 years after closure of leading to releases of radionuclides to the accessible environment.**

The data do not support the DOE finding that "the evidence indicates that this favorable condition is present at Yucca Mountain." The principal assumption that the geologic history of the last 1-2 million years allows the prediction of future events must be tempered by the fact that, at least with regard to tectonics, the history is not completely understood at the present time. The evidence suggests that the nature and rates of igneous and tectonic activity may in fact be episodic or cyclic (draft EA, p. 6-227). This observation is acknowledged in most of the current literature related to seismotectonics of the Basin and Range Province (Carr, 1984; Rogers et al., 1983; U.S. Geological Survey, 1984; Wallace, 1978). Consequently, the principle of "uniformitarianism" is applicable only if these episodes or cycles are reasonably well understood, especially if they are to be used to gauge activity over the next 10,000 years.

The probability calculations for volcanic eruptions are incomplete. The very low rates of projected volcanic activity are based only on basaltic eruptions. According to Crowe et al. (1984, p. 86), new work has raised questions about the effects of hydrovolcanic activity at Yucca Mountain, a possibility not considered in previous volcanic-consequence analyses.

Postclosure Potentially Adverse Conditions (Sec. 6.3.1.7.4)

> **Condition 1: Evidence of active folding, faulting, diapirism, uplift, subsidence, or other tectonic processes or igneous activity within the geologic setting during the Quaternary Period.**

The data support that this potentially adverse condition is present. However, the supporting evidence is in dispute. In particular, there is disagreement with the finding that there is no unequivocal evidence for surface faulting in the geologic setting within the last 40,000 years. The study of Swadley et al. (1984) is incomplete and should not be used as a basis for inferring that all faults in the Yucca Mountain area are more than 40,000 years old. To the contrary, some field evidence indicates that the Paintbrush Canyon, Bow Ridge, and Solitario Canyon faults have had demonstrable movement within the last 40,000 years. In addition, the work of Szabo (1984) indicates fault activity as young as 28,000 years on Yucca Mountain.

Condition 2: Historical earthquakes within the geologic setting of such magnitude and intensity that, if they recurred, could affect waste containment or isolation.

This finding is based on a poorly documented seismic record within the geologic setting--a record that is far too short (less than a few years at Yucca Mountain)--to allow extrapolation over the next 10,000 years.

Condition 3: Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or the magnitude of earthquakes within the geologic setting may increase.

The data support that this potentially adverse condition is present. The draft EA (pp. 6-226 to 6-227) summarizes the present state of knowledge concerning earthquakes and tectonic processes fairly well.

Condition 4: More-frequent occurrences of earthquakes or earthquakes of higher magnitude than are representative of the region in which the geologic setting is located.

The data do not support the DOE finding that this potentially adverse condition is not present. The instrumental seismic record is only a few years long, and although it indicates that Yucca Mountain is relatively seismically quiet, it is far too short a record to allow extrapolation. Regional seismic data in fact show that Yucca Mountain lies within a fairly active seismic zone, the East-West Seismic Zone (Rogers et al., 1983). In addition, Yucca Mountain lies in an area of moderate seismic energy-release according to Carr (1984, p. 48). Studies by Algermissen et al. (1983, plate 3) also show Yucca Mountain to be within a zone of fairly high tectonic flux especially if it is structurally related to Pahute Mesa. Rogers et al. (1983, p. 22) also point out that seismic monitoring of the Southern Great Basin indicates that the southern part of the Nevada Test Site is more active than the rest of the region and may have a higher "b-value."

Condition 5: Potential for natural phenomena such as landslides, subsidence, or volcanic activity of such magnitudes that they would create large-scale surface-water impoundments that could change the regional ground-water flow system.

The evidence does not indicate that this potentially adverse condition is not present.

Section 6.3.1.1.3 of the draft EA (p. 6-122) states that hydrologic processes are to be evaluated for the next 100,000 years, and it has not been demonstrated that the above natural phenomena have a low probability of occurrence during this time frame. In particular, the evidence for disruption of the ground-water flow system by volcanic activity is incomplete. Only basaltic eruptions were considered by Crowe et al. (1982). Crowe et al. (1984) now suggest that their original assessment was incomplete and should include an evaluation of hydrovolcanic activity.

Condition 6: Potential for tectonic deformations--such as uplift, subsidence, folding, or faulting--that could adversely affect the regional ground-water flow system.

The evidence does not support that this potentially adverse condition is not present. The potential for tectonic activity disrupting the ground-water flow system should be based on a 100,000-year time period (Sec. 6.3.1.1.3). None of the cited studies assess the probability of occurrence during this time frame.

The rates of late Cenozoic vertical displacements (Table 6-33) are listed only for specific range-bounding faults and do not reflect regional trends. The listed rates are low, but cumulative regional effects may be significantly higher, especially if coupled with tilting or warping. Carr (1984) indicates that regional warping of Quaternary deposits is present, but no estimated rates of deformation are given. Regional tectonic tilting in southern Nevada has also been recognized by Longwell (1960). No data are presented on the numerous regional leveling surveys conducted by the National Geodetic Survey, which also could document the amount and rate of modern tectonic tilting.

No assessment of potential tilting in relation to the hydraulic gradient is presented. The hydraulic gradient of 3.5 m/10.3 km (EA, p. 6-137) should at least be evaluated with regard to anticipated effects from regional tectonic events.

Postclosure Disqualifying Condition (Sec. 6.3.1.7.5)

Disqualifying Condition: 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.

We disagree with the finding that the "existing information does not support the finding that the site is not likely to meet the qualifying condition." The evidence suggests, to the contrary, that the data base is incomplete and often conflicting, and that a reasonable interpretation of the available information is that fault movement could occur near or within the repository during the lifetime of the facility. The evidence supporting this interpretation consists of the following:

1. Seismic data suggest that north-northeast-trending faults are susceptible to slip in the current stress field (Rogers et al., 1983).

2. Lack of surface (fault) rupture is not sufficient evidence to discount active faulting at Yucca Mountain (U.S. Geological Survey, 1984, p. 78).

3. The estimated peak ground acceleration (0.4 g) at Yucca Mountain is too low based on a reasonable interpretation of future tectonic events.

4. The estimated recurrence rate of 2.5 earthquakes in 100,000 years per 1,000 km^2 (EA, p. 6-232) yields a rerupture time of 40,000 years per 1,000 km^2. Since previous work has established that Yucca Mountain faults may be preferred sites of tectonic activity, rerupture times at Yucca Mountain could be significantly shorter than 40,000 years.

5. Low ground-water flux rates and travel times (> 20,000 years) are not tenable arguments against radionuclide release in the event of fault-induced disruption.

Amplification of these points is found in the comments of John Bell, Nevada Bureau of Mines and Geology (see Chapter 4 of this compilation).

7.2.1.8 Human Interference

P. 7-49: The draft EA states: "Favorable condition 1 [960.4-2-8--1(b)(1)]--the absence of commercially extractable resources--is present only at the Yucca Mountain site." At p. 7-13, the text states that "At Yucca Mountain, ground water occurs at depths of more than 250 meters along ground-water-flow paths. Although the potential for the development of ground-water resources is small in comparison with that of nearby more-economical sources, the condition refers only to the presence of such resources, and therefore [the potentially adverse condition 960.4.2-1(c)(2)] is present." On what basis is the conclusion founded that development of the ground-water resource will not in the future be economical? Why is ground water not a "commercially extractable resource," when the ground water at Yucca Mountain has a concentration of total solids "substantially lower than 10,000 ppm" (p. 7-49)? Nowhere in the draft EA or any supporting literature is there an analysis that documents that "more economical" sources are available.

P. 7-51: The draft EA states: "Disqualifying condition 2 [960.4-2-8-1(d)(2)] requires a site to be disqualified if ongoing or likely future activities to recover valuable natural resources outside the controlled area would be expected to lead to an inadvertent loss of isolation." The presence of the ground-water resource at Yucca Mountain (acknowledged at pp. 7-13, 7-49, and 7-51) suggests that the finding in Table 7-8 that "the evidence does <u>not</u> support a finding that the site is disqualified" under that guideline is misleading. A more appropriate finding would be that the presence of the ground-water resource suggests that the site could be disqualified. Though 960.4-2-8-1(d)(2) is limited to "presently valuable natural mineral resources," §112(a) of the Act makes no distinction regarding "mineral" or other natural resources, and the limitation of 960.4-2-8-1(d)(2) to "mineral" resources violates the statute if it prohibits analysis of non-mineral resource as well. Additionally, as noted in Chapter 6, mineral resources (gold and silver) are present beneath Yucca Mountain. Although these deposits are presently "not commercial," the future value is unknown.

7.3.1 Preclosure Radiological Safety

P. 7-68: The draft EA concludes that "The favorable condition [960.5-2-4(b)] is the absence of contributing radionuclide releases from nearby facilities or operations subject of 40 CFR Part 191, Subpart A; it is present at the Yucca Mountain and Richton sites. At the Yucca Mountain site, there is the remote possibility that an underground nuclear test at the Nevada Test Site could release radioactive material into the atmosphere, but the testing is not regulated by 40 CFR Part 191, Subpart A." This distinction is arbitrary and unrealistic. The objective of the guideline is to determine whether radioactive releases from other nuclear installations would contribute to releases from a repository that could collectively violate 40 CFR 191, Subpart A. While 40 CFR 191 does not apply to underground nuclear-test activity at the Nevada Test Site, the releases from such activity can nevertheless be included in an analysis of the potential radioactive releases from the combination of those activities and repository operations. Since §112(a) of the Act requires that the guidelines include disqualifiers pertaining to the location of atomic energy defense activities, the manner in which 960.5-2-4(b) has been drafted and applied clearly violates the intent of the statute.

P. 7-71: In discussing the preclosure radiological safety disqualifying condition, the draft EA states that "This condition [960.5-2-4(d)] specifies that a site shall be disqualified if atomic energy defense activities in proximity to the site are expected to conflict irreconcilably with repository activities. . . . Although atomic energy defense activities are in proximity to the Hanford and the Yucca Mountain sites, they are not expected to conflict irreconcilably with repository operations." What is the basis for this conclusion? What is the standard by which irreconcilable conflict is measured? What projected activities of the atomic energy defense program at the Nevada Test Site have been taken into consideration in arriving at this conclusion? If, in fact, the atomic energy defense activities in proximity to the Yucca Mountain site present no irreconcilable conflict, why is "the Yucca Mountain site . . . ranked fifth because of the presence of the Nellis Air Force Range and the underground weapons testing at the Nevada Test Site, about 25 miles away" (p. 7-72)? The draft EA also fails to consider the very real possibility that nuclear-weapons tests in future years may be carried out considerably closer to Yucca Mountain than they are at present.

7.3.2 Environment, Socioeconomics, and Transportation

P. 7-77: The text indicates that "Potentially adverse condition 2 [960.5-2-5(c)(2)]--significant adverse impacts that cannot be avoided or mitigated--is not present at any of the sites. . . . Similarly, it is expected that adverse impacts at the Yucca Mountain site can be mitigated by siting, engineering, or operating procedures." What are the adverse impacts at the Yucca Mountain site that can be mitigated?

The analysis of environmental, socioeconomic, and transportation conditions and impacts in preceding chapters of the draft EA is inadequate and seriously incomplete. Adverse impacts have not been adequately identified. There is no basis for concluding that all such adverse impacts can be mitigated.

7.3.2.1.2 Socioeconomic Impacts

P. 7-80: Since data relative to socioeconomic effects of a repository at Yucca Mountain appear to be significantly incomplete and, in many instances, unsubstantiated (see our comments relative to Secs. 3.6, 4.2.2, 5.4, and 6.2.1.7), the comparisons and rankings employed in Chapter 7 of the draft EA are suspect. Especially significant in this regard are the comparisons of the various sites against the favorable, potentially adverse, disqualifying, and qualifying conditions. Our review indicates that DOE does not have sufficient information to justify its findings regarding these conditions vis-a-vis the Yucca Mountain site.

P. 7-83: The draft document states: "Favorable condition 4 [960.5-6(b)(4)]--no projected substantial disruptions of primary sectors of the economy of the affected area--is present at all sites. . . . The area surrounding the Yucca Mountain site is not expected to experience substantial disruptions in its primary economic sectors, because there is no evidence that a repository would cause a substantial disruption of tourism. . . ." What is the basis for the conclusion that a repository would not cause a disruption of tourism? There is no discussion of the other economic sector, agriculture. A repository would also disrupt mining by diverting labor resources from present mining ventures. The State's comments in Chapter 6.2.1.7 demonstrate that this favorable condition may not be present at Yucca Mountain.

P. 7-84: The draft EA states: "Potentially adverse condition 3 [960.5-2-6(c)(3)]--the need to purchase or acquire water rights that might significantly affect the future economic development of the area--is not present at any of the five sites. Because the Federal Government already owns the necessary water rights for development at the Hanford and the Yucca Mountain sites, the evaluation of this condition is conclusive." At p. 7-61 the text states "A portion of the Yucca Mountain site is currently controlled by the DOE; the remainder is managed by the Bureau of Land Management or controlled by the U.S. Air Force. No impediments to eventual complete ownership and control by the DOE have been identified, but because congressional action is required for a permanent transfer to the DOE, the [favorable] condition [960.5-2-2(b), present ownership and control of land and all surface and subsurface mineral rights by the DOE] is considered to be not present." Two comments are appropriate:

1. Relative to water rights on NTS land, the EA states (correctly) in Chapter 6 that there may be "superior water rights" that could prevent ownership for repository use.

2. In correspondence dated December 26, 1984, from Donald L. Vieth to Robert R. Loux, the Department of Energy Nevada

> Operations Office stated its intention to seek water-right permits from the Nevada State Engineer in connection with water extracted from points on public land that are not currently withdrawn.

The statement that DOE already owns the water rights at Yucca Mountain is thus false. It appears that the evaluation of 960.5-2-6(c)(3) is in fact "not conclusive."

P. 7-85: In discussing the qualifying condition on socioeconomics, the draft EA states that "There is, however, some uncertainty about the effects of a repository on tourism. . . ." This statement is entirely inconsistent with the earlier statement on p. 7-83 that there is no evidence that a repository would cause a substantial disruption of tourism. If there is some uncertainty about the effects on tourism, there must be at least some evidence that its presence would cause a disruption. The inconsistency between those two statements must be explained.

7.3.2.1.2 Transportation

P. 7-85: The method by which sites are ranked according to transportation variables does not provide for an adequate and reasonable comparative evaluation with regard to this important issue.

One cannot tell from the draft EA what weight was given to the various factors within the transportation group of guidelines. Clearly, some "favorable conditions," such as national cost and risk, should be weighted more heavily than other "favorable conditions," such as whether federal condemnation is needed to secure a right-of-way or the number of interchange points at which train-crew and equipment changes would be required (960.5-2-7(b)(1)(ii) and (b)(4)). (According to verbal reports from DOE, the weighting of national cost and risk factors was considered to be one-half of the total transportation ranking, but that is not substantiated in public documents.)

The ranking of sites by the averaging and pair-wise methods does not indicate the degree to which one site may be better than other sites. The third ranking method used, the utility-estimation method, does permit a qualitative comparison among sites. However, the draft EA does not identify the qualitative rankings each site received for national transportation factors.

The method of sorting sites prior to ranking further diminishes the importance of transportation in overall site selection. Under the procedure, sites are grouped according to their geohydrologic settings. This means that the Hanford site, which is the only basalt site, and the Yucca Mountain site, which is the only tuff site, will automatically make it into the final five (since no sites were eliminated by the "disqualifying conditions"). The remaining seven sites are grouped into three geohydrologic regions, thus only three of those sites make the final five. This means that of the original nine sites, it is guaranteed the three sites with the highest transportation costs and risk (Hanford, Yucca Mountain, and one of the two Utah sites) will be among the five semi-finalists.

The analysis of national transportation factors in the final EA must be upgraded since the weight given transportation factors in site selection will be greater at this stage of the siting process than at any future stages. Under the ranking scheme, national and local transportation factors cannot have a weight greater than 5.4 percent of the total (and national transportation factors are, at most, one-half of that) in the selection of the sites for characterization. In all likelihood the weight given to transportation factors when the cut is made from three sites to one site will be even less. That is because the information needed to apply many of the geologic guidelines is not available at the EA stage but will be available at the EIS stage and will thus be given even greater weight. Consequently, even though we may have much better transportation analysis at the EIS stage than we have at the EA stage, in all likelihood the product of that transportation analysis will be given even less weight than the transportation analysis contained in the draft EA.

Finally, a contractor for the State of Washington (see Analysis of the Methods Used to Rank Potential Sites for Nuclear Waste Repositories, As Reported in the USDOE Draft Environmental Assessment, December, 1984, prepared for the Joint Legislative Committee on Science and Technology of Washington State, by ECO Northwest, February 1985) made the following findings on the ranking system:

- In the averaging and pairwise-comparison methods, changes in the relative weights of the three preclosure groups did not, by themselves, change the top three sites as long as the relative weights were consistent with the requirements of the guidelines that the radiological safety group is weighted more heavily than the environmental/socioeconomic/transportation group, which in turn is to be weighted more heavily than the site-cost group.

- Under the utility-estimation method, ranks are not sensitive to changes in weights of preclosure groups as long as radiological safety is weighted more heavily than the environmental/socioeconomic/transportation group, which in turn is weighted no less than site costs.

P. 7-87: Table 7-15 indicates that favorable condition 3 (960.5-2-7, "Proximity to regional highways, mainline railroads, or inland waterways that provide access to the national transportation system") is present at Yucca Mountain but is not present at any of the other sites. Has DOE misplaced the Columbia River?

Table 7-15 also indicates that favorable condition 6 for the same guideline ("Availability of regional and local carriers--truck, rail, and water--which have the capability and are willing to handle waste shipments to a repository," emphasis added) is present at all sites. How far from Yucca Mountain is the nearest barge operator who has the capability and is willing to handle waste shipments to the repository?

P. 7-91: The draft EA states "Of all the sites, Yucca Mountain would have the most convenient access to the regional and national highway and railroad network, and the site is judged to possess the favorable condition.

The Deaf Smith and Richton sites are somewhat less conveniently located, while Hanford is at a considerable distance from a mainline railroad." Immediately preceding that statement is a table showing comparative proximity of the site-access roads or rail spurs to regional highways, mainline railroads, or inland waterways. Distance is measured from the outer end of the access road or rail spur to the junction with the State, U.S., or interstate highway or railroad. The table, for example, shows the Hanford site to be 48 miles from a major railroad and the Yucca Mountain site 0 miles away. That is simply incredible! While it is true that, if "proximity" is measured from the outer end of the rail spur, Yucca Mountain is indeed 0 miles from a major railroad because the outer end of the rail spur joins with the major railroad itself. This method of measuring "proximity" appears to be a deliberate attempt to mislead, however, for it totally ignores the fact that for the Yucca Mountain site, 137 km (85 miles) of railroad, including a bridge, will have to be constructed, at considerable expense. At present no rail spur exists, whereas at Hanford, for example, an existing rail spur is only some 3 miles from the referenced repository location and connects directly to the major regional railroad at Pasco, 48 miles away.

P. 7-93: Favorable condition 9 ("a regional meteorological history indicating that significant transportation disruptions would not be routine seasonal occurrences") is found to be present only at Hanford and Yucca Mountain, while the Deaf Smith site may experience delays due to snow and heavy rain, and the Davis Canyon site may experience delays due to snow. That is fundamentally erroneous. That favorable condition, in reality, exists at none of the sites. The key word in the guideline is "regional." Any repository in the western United States, to which waste must be transported from the Midwest and East, will experience significant transportation disruptions because of snow and blizzard conditions on the Plains and in the Rocky, Cascade, and Sierra Nevada mountain ranges. To ignore that fact and find the favorable condition present only in the immediate area surrounding the Hanford and Yucca Mountain sites is wholly inappropriate.

7.3.3 Ease and Cost of Siting, Construction, Operation, and Closure

P. 7-98: The draft EA states "At Yucca Mountain there is a potential for localized minor flooding during extreme, infrequent storms, but such minor flooding can be accommodated by routine drainage-control methods." Chapter 7 confirms the potential for sheet flooding of repository surface facilities, as presently located. However, the potentially adverse condition for guideline 960.5-2-8 has no allowance for mitigation of the condition by "routine drainage-control methods." Table 7-16 is incorrect; the potentially adverse condition is present at Yucca Mountain.

7.3.3.1.2 Rock Characteristics (Preclosure)

P. 7-103: Favorable condition 2 considers host rock that requires minimal or no artificial support for safe repository activities. For Yucca Mountain, the draft EA indicates that standard mine-safety practice for NTS will be utilized, and that experience on NTS suggests only minimal artificial supports will be required. Nowhere in the draft EA is the term "minimal supports" discussed in reference to underground construction technology. Given that most of the Yucca Mountain site is off the Nevada Test Site, the use of NTS mining practices may not be appropriate. What do applicable federal and State mining regulations say about safe supports for underground activities? Hypothetically, what would be the specific support requirements of other civil works projects if they were constructed in the tuffs of Yucca Mountain? Without such an analysis, there is insufficient information to draw any conclusion relative to this condition.

P. 7-103: The draft EA states "Potentially adverse condition 1 [960.5-2-9(c)(1)]--little design flexibility because of a thin or laterally restricted host rock--is present at the Yucca Mountain and the Deaf Smith sites. Although the host rock at Yucca Mountain is sufficiently thick to provide significant flexibility for selecting the depth of the repository, the primary area of investigation provides only a limited flexibility in lateral placement." Though this potentially adverse condition exists only at Yucca Mountain, it is dismissed in the subjective ranking of sites at p. 7-106. "The Yucca Mountain site seems to have somewhat limited lateral flexibility for repository placement in the primary area of investigation, but contiguous areas may provide significant flexibility." However, these contiguous areas are not discussed or assessed against the guidelines in the draft EA. The acceptability of the areas is unknown.

<u>7.3.3.1.4 Tectonics (Preclosure)</u>

Pp. 7-113 to 7-114: We do not concur with the conclusions presented in Section 7.3.3.1.4. With regard to preclosure tectonic conditions, the favorable condition is not present, two of three potentially adverse conditions are present, and the disqualifying condition is possibly present.

<u>Preclosure Favorable Condition (Sec. 6.3.3.4.3)</u>

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.

This principal assumption (draft EA, p. 6-283) that the present low rate of tectonic processes will continue is incongruous in relation to existing literature as well as to evidence provided in the draft EA. The instrumental seismic record at Yucca Mountain is only a few years long and is clearly too short to extrapolate into the near future. Geologic, seismicity, and stress studies conducted in the region (Carr, 1984; Rogers et al., 1983; U.S. Geological Survey, 1984) all suggest that Yucca Mountain lies within an area of relatively high seismic activity and that faults at Yucca Mountain may be stressed to near the rupture point.

Studies of faulting in the geologic setting (Carr, 1974, 1984; Scott and Bonk, 1984; Swadley and Hoover, 1983; Swadley et al., 1984; U.S. Geological Survey, 1984) have not sufficiently demonstrated the lack of capable faults. These studies do not establish the assumption that "Yucca Mountain faults are not active" (draft EA, p. 6-286). To the contrary, these studies indicate that the Yucca Mountain faults should be considered potentially active in light of existing data.

Since the assumption that Yucca Mountain faults are not active is not valid, the estimated peak ground acceleration of 0;4 g is too low. If faults at Yucca Mountain ruptured, peak ground accelerations approaching or exceeding 1.0 g might be associated with a magnitude 6-7 earthquake. Such vibratory ground motion could exceed accepted design parameters for nuclear facilities.

Preclosure Potentially Adverse Conditions (Sec. 6.3.3.4.4)

Condition 1: **Evidence of active faulting within the geologic setting.**

This potentially adverse condition is present at Yucca Mountain. Seismic data summarized in Carr (1984) and Rogers et al. (1983) support the conclusion that active faulting is occurring in the geologic setting.

Condition 2: **Historical earthquakes or past man-induced seismicity that, if either were to recur, could produce ground motion at the site in excess of reasonable design limits.**

Because there are no regulatory-design limits for geologic repositories available, DOE should conservatively assume that this potentially adverse condition is present.

Condition 3: **Evidence, based on correlations of earthquakes with tectonic processes and features (e.g., faults) within the geologic setting, that the magnitude of earthquakes at the site during repository construction, operation, and closure may be larger than predicted from historical seismicity.**

The data support that this potentially adverse condition is present at Yucca Mountain. The assumption that "Yucca Mountain faults are not active" is not reasonable based on existing evidence. The estimated peak ground acceleration of 0.4 g is, therefore, too low. Historical and instrumental evidence suggest such an earthquake could produce vibratory ground motion approaching 1.0 g. Such levels of ground motion are higher than those generally anticipated in seismic design of nuclear power plants (0.6 to 0.75 g).

The instrumental seismic record at the site is far too short (a few years long) to allow inferences to be made concerning anticipated seismicity during the next 90 years.

Taken together, stress data, historic seismicity, and the indication that fault activity is more dependent on fault orientation than fault age all suggest that the potential for significant seismicity at Yucca Mountain should be considered (Rogers et al., 1983, p. 27). There is substantial evidence that earthquakes larger than those predicted from historical seismicity may be anticipated at the site. It has not been demonstrated that these earthquakes are not likely to occur during the 90-year lifetime of the operating facility.

Disqualifying Condition (Sec. 6.3.3.4.5)

A site shall be disqualified if, based on the expected nature and rates of fault movement or 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 evidence supports a finding that the site may be disqualified. The evidence is, at best, incomplete and equivocal. Existing evidence fails to demonstrate that the faults at and near Yucca Mountain should not be considered capable by Nuclear Regulatory Commission criteria. The evidence for lack of faulting in the last 40,000 years is incomplete; the evidence for lack of recurrent faulting in the last 500,000 years has not been addressed.

It is not reasonable to assume that all important fault scarps have been detected (draft EA, p. 6-290). The fault studies to date have not utilized several commonly accepted state-of-the-art investigative techniques in tectonic analyses for nuclear facilities.

Based on existing literature, it is unreasonable to attribute the greatest potential seismic hazard to an earthquake of magnitude 6.8 on the Bare Mountain fault. The U.S. Geological Survey (1984, p. 75) stipulates that this interpretation is based on the assumption that Yucca Mountain faults are inactive. However, should active faults be discovered at or near the site, the potential for damaging earthquakes and considerably larger accelerations are possible. In addition, other published studies suggest that the calculated magnitudes are too low. New statistical relationships (Bonilla et al., 1984) suggest that the Bare Mountain fault could generate at least a magnitude 6.9 earthquake. Algermissen et al. (1983) include the Yucca Mountain geologic setting in an area that could experience a magnitude 7.3 earthquake.

P. 7-115 to 7-116: In discussing the qualifying condition and ranking of sites with regard to preclosure tectonics, the draft EA states "Although active faulting has been identified within the geologic setting of the Hanford, the Yucca Mountain, and the Davis Canyon sites, no active faults are known within the boundaries of these sites. . . . The Yucca Mountain site appears to be the least favorable because the preliminary results of in-situ stress measurements indicate that north-northeast trending faults at Yucca Mountain may be close to failure, the data on the age of the last movement on faults at Yucca Mountain are limited, and the predicted horizontal ground acceleration is highest of all the sites, although within the design limits of existing nuclear facilities." As stated in previous comments, the design limits for Yucca Mountain, if active faults are present, could be above the limits of existing nuclear facilities. Why were the preliminary results of in-situ stress measurements not considered in arriving at a conclusion that the "rates of future volcanism and faulting would not lead to radionuclide releases after closure" as analyzed under 960.4-2-7(b) at p. 7-40 and 7-43?

7.3.3.2 System Guideline on the Ease and Cost of Siting, Construction, Operation, and Closure

P. 7-117 and 7-118: The costs of construction and operation are based on four "representative" sites in each of the four host rocks. Comparing costs this way, for only "representative" sites, does not allow costs associated with the construction of the road and rail system or of transportation of waste to the site throughout the life of the repository to be taken into consideration and disclosed. Those costs should be considered in order to provide a more accurate comparison than is now shown by Table 7-20.

P. 7-118: The draft EA states that "To provide some perspective on the uncertainty of these preliminary estimates, consider that actual costs for other large construction projects may vary from 20 percent less to 40 percent more than preliminary estimates." That is completely inaccurate and not appropriate. It is common knowledge and well documented that in the nuclear-reactor field alone cost overruns on some projects have greatly exceeded 100 percent.

P. 7-119: Table 7-20 shows comparative costs of construction and operation, and a maximum receipt rate of 3,000 metric tons of uranium per year constant from start-up through the end of operation. What would the comparative cost be for DOE's Mission Plan two-stage construction and operation concept? Do these costs take into account differences in local labor costs, availability of material locally, etc.? Because they are based on "reference" sites, it is doubtful that they do.

7.4 Preferred Sites for Recommendation for Characterization

Pp. 7-120 to 7-132: Section 7.4.1 describes the comparative evaluations of the five sites (Yucca Mountain, Hanford, Davis Canyon, Richton, Deaf Smith) proposed for nomination to identify the three candidate sites for recommendation for site characterization. (As noted previously, we contend that all nine sites should have been compared in this section.) Three different methods are utilized for determining rankings for a guideline or group of guidelines (preclosure and postclosure). The following comments are the result of evaluation of the three ranking methods (averaging, pairwise-comparison, and utility-estimation).

1. There is evidence that suggests that the siting guidelines are redundant. If so, all of the ranking methods involve double-counting; and, therefore, the results are invalid.

2. The ranking methods, the averaging method and the pairwise-comparison method, are inappropriate for the site-evaluation problem. They are flawed because either (a) they use cardinal (how much distance between A and B) techniques on ordinal (greater than/less than) data or, or (b) they make arbitrary conversions of ordinal measures to cardinal measures, disregarding the supposedly more accurate cardinal measures used in the utility-estimation method. Ordinal rankings obscure the extent to which one site is superior to all

other sites, generating rankings that do not fully utilize the available information about site characteristics.

3. The rankings generated by the utility-estimation method are of questionable validity. From the information presented in the draft EA, it is questionable whether the method was properly executed.

4. The exclusion of four "potentially acceptable" sites from the ranking process could, in theory, change the three sites recommended for characterization. Whether the three sites would have changed, in fact, is an empirical question requiring that the rankings be reconsidered including the excluded sites before it can be answered.

5. The draft EA is incomplete because it does not report the results of a thorough sensitivity analysis. There is considerable uncertainty associated with (a) the derivation of guideline scores from the implicit aggregation of pass/fail evaluations of "favorable" and "adverse" conditions, and (b) the specification of weights for the individual guidelines. A thorough sensitivity analysis would expose the uncertainty associated with the computational methods.

Our concern with the lack of a sensitivity analysis in the EA led to a thorough review of draft EA Appendix B (Aggregation Methods and Sample Results From Their Application) and the data base for each of the five sites. The application of the data base to the methods presented in Appendix B lends little support to the intent of Appendix B that the ranking results of Chapter 7 could be reproduced. The subjective nature of some decisions did not lend themselves to reproducibility. As a result, a limited sensitivity analysis was performed. The following conclusions were drawn:

1. If postclosure is weighted significantly over preclosure, Davis Canyon replaces Yucca Mountain as one of the top three sites. The Act supports this weighting, in that long-term geologic barriers are primary in a repository site.

2. Changing the scale of scores for the averaging or pairwise-comparison methods changed the order of the top three sites.

3. Ranks are not sensitive to changes in weights of preclosure groups, as long as radiological safety is weighted more heavily than environmental/socioeconomic, which in turn is weighted more than site costs.

4. Ranking can change by changing the raw (unweighted) scores of sites on individual guidelines. Yucca Mountain would rank lower if the draft EA objectively assessed all available evidence for individual guidelines.

5. It is unknown if the overall ranking is sensitive to selective changes in weights of individual guidelines. If the relative importance of individual technical guidelines were

considered for each group, the overall rankings might be different.

One overall conclusion is clearly discernible from Section 7.4 and Appendix B--the sites the draft EA has selected for characterization cannot be shown to be the best three sites of all sites evaluated for the first repository.

7.4.3.3 Overall Ranking

P. 7-130: While DOE acknowledges (on p. 7-123) that postclosure guidelines must be given primary importance and thereby significantly greater weight in applying the guidelines against sites, the assignment of a 51 percent to 49 percent ratio of postclosure to preclosure guidelines does not reflect this importance.

The Nuclear Waste Policy Act, in Section 112(a), requires that "Such guidelines shall specify detailed geologic considerations that shall be the primary criteria for the selection of sites in various geologic media" (emphasis added). Given this clear statutory directive and the fact that high-level nuclear waste must remain isolated from the biosphere for over 10,000 years, it would be reasonable to expect that these postclosure guidelines would be given much greater weight than 51 percent. We believe that the postclosure guidelines must be weighted between 80-90 percent of the total.

SPECIFIC COMMENTS ON APPENDIX A

TRANSPORTATION

P. A-1: Numerous comments relative to many aspects of the Transportation Appendix are contained in "Local Government Comments." Our comments here will focus primarily on transportation cost and risk analyses that form the basis for the impact assessments contained in Section 5.3 of the draft EA and for the evaluation of Yucca Mountain against the transportation guidelines in Chapter 6. Comments presented relative to Appendix A should also be considered to apply directly to other sections of the draft EA where transportation analyses are discussed.

Cost and risk estimates for transportation of nuclear waste to a repository are inadequate for a number of reasons. These inadequacies can be expected to obstruct or prevent a "reasonable comparative evaluation" of potential repository sites, as is required by the Nuclear Waste Policy Act (Section 112(b)(1)(E)(iv)).

The following comments focus on transportation cost and risk factors that have been omitted from the draft EA or that have been insufficiently evaluated.

A.8 Risk Analysis

P. A-15: The risk estimates contained in the draft EA are flawed for a number of reasons, including:

1. Regional risk analyses. Regional risk analyses vary among draft EAs both in terms of the land area considered within such "regional" evaluations and presentation of expected radiological impacts. For example, "regional" transportation, with associated risk factors, is defined differently in each of the draft EAs for potential repository sites in Nevada, Utah, and Washington. The draft EA for Nevada's Yucca Mountain site evaluates "regional" risk impacts associated with nuclear waste transportation within state boundaries (see p. 5-75). Draft EAs for Utah's Lavender Canyon and Davis Canyon sites evaluate "regional" transportation impacts within a 200-kilometer (125-mile) radius extending from the potential repository sites (see pp. 5-93 and 5-100 in the respective draft EAs). The draft EA for Washington's Hanford site defines "the outer boundary for regional effects . . . as the highway intersection with the nearest major interstate highway or the railroad connection with major rail lines" (see p. 5-46 of the Hanford-site draft EA). Presumably, the definition refers to the intersection

of repository access routes with existing general transportation routes.

Since the area being considered for regional transportation risk varies among draft EAs, comparison of regional risk factors among the various sites is difficult. A clear definition of the term "regional" that is applicable to all sites under consideration is essential if a comparative transportation evaluation is to be possible. Such a definition should encompass, at least, the entire state within which the site is situated, all adjoining states, and the major corridors to the site starting at point(s) where significant funnel effects of waste transport will begin to be strongly felt.

Draft EAs for potential repository sites in the West also quantify the radiological risk of regional transportation differently. The draft EA for Nevada's Yucca Mountain estimates regional radiological risk for transportation in terms of radiation dose (man-rem). In contrast, the draft EAs for potential repository sites in Utah and Washington express regional radiological risk factors in terms of latent cancer fatalities estimated for present and future generations due to radiation exposure. Again, such variation among draft EAs makes comparative evaluation difficult.

2. Generic national risk analysis. The risk analysis used in the draft EA for evaluation of national transportation impacts is a generic analysis, using national or average accident data and generalized transportation assumptions. DOE failed to compare such a generic analysis with route-specific case studies. Such a comparison is necessary--and should have been conducted--to verify the validity of generic transportation models and risk estimates.

3. Transportation factors not considered in risk analysis. The risk estimates for nationwide nuclear waste transportation are inadequate because they fail to reflect key variables that must be included in any valid assessment of risk. These include:

- weather conditions and weather-related stops, and the associated effect on transportation risks;
- health effects due to ingestion of contaminated material in the event of a serious transportation accident involving radioactive release (if DOE considers such an analysis to be unnecessary, reasons and data supporting such a decision should be outlined);
- the effects of barge transportation, and unit- or special-train service;

- present DOE estimates as to percentage of waste transport using different shipping modes. Current risk estimates are based on use of 100-percent rail or 100-percent truck transport, while DOE estimates that 70 percent of the waste will be shipped by rail, 30 percent by truck;

- an analysis by DOE of least-risk transportation alternatives (including both mode of transport and routes used for waste transport to each site); and

- radiation exposure during normal highway transport to vehicles in adjacent lanes of traffic.

- effects of peak transportation conditions that reflect real-world conditions (as opposed to idealized "average" conditions assumed in current analyses).

4. Probability of accidents. General accident probabilities for spent-fuel accidents were estimated using actual spent-fuel shipping experience from 1971 to 1980 (see McClure, J. D., 1981, The Probability of Spent Fuel Transportation Accidents, SAND80-1721, cited in Appendix A). Available shipping data for years before 1971 and after 1980 also should have been used.

5. Probability of serious transportation accidents involving release. Since there are no accident data for serious accidents involving radioactive release (no such accidents have occurred), the probability of such accidents was estimated (McClure, 1981, cited above). Confidence limits should have been placed on such estimates. In addition, probability estimates should have included the potential for sabotage as well as routine highway accidents.

6. Sensitivity analyses. Neither the draft EA nor any of the reference documents cited in the draft EA include sensitivity analyses of risk models used to reach the estimates in the draft EA. The effects of variations in the following model inputs on total risk estimates should be examined, including:

   - accident rates for rail and truck transport in urban, suburban, and rural population zones;

   - changes in the accident severity assumptions;

   - changes in radioactive release assumptions in the event of a serious transportation accident;

   - changes in assumptions regarding the percent of radionuclides released, aerosolized, and inhaled;

- changes in stop times, including reductions in stop times due to use of unit or special trains and increases in stop times caused by weather, road conditions, or the effects of "peak" shipping conditions;

- changes in meteorological assumptions that determine the dispersion of radionuclides in the event of a release;

- changes in assumptions related to the configuration of truck stops; and

- changes in assumptions related to population densities (day-time versus night-time populations, distance of nearest individuals, etc.).

7. Criteria for data inputs for risk models. DOE should clearly distinguish between risk-model inputs that are based on real data and those areas where inputs are based on engineering judgment. Currently, references cited in Appendix A fail to readily distinguish between such data inputs.

A.9 Cost Analysis

P. A-20: The cost analysis relative to the transportation of high-level waste to the various repository sites, as contained in the draft EA, is incomplete and inconsistently applied with regard to the various sites being evaluated. The key deficiencies identified are as follows:

1. Total estimated costs of shipping nuclear waste to a repository reflect only shipping charges, hardware (cask) capital expenditures, and "maintenance allowances" (costs associated with cask-maintenance and licensing activities). (See Appendix A, p. A-27.) Such a total cost estimate fails to include other costs associated with transportation to a repository, including:

   - costs associated with emergency planning, preparedness, and response;

   - costs associated with evacuation and cleanup in the event of a serious accident involving radioactive release;

   - costs of constructing roads and rail lines needed for direct access to a repository;

   - costs associated with upgrading road-beds and rail lines in support of nuclear waste transportation on a national scale;

- costs incurred by increased damage to highway road-beds from nuclear waste shipments (both within normal weight limits and overweight); and

- costs associated with inspection and enforcement.

2. Costs of transporting defense wastes to a repository from all three DOE sites (Savannah River Plant, the Hanford Reservation, and the Idaho National Engineering Laboratory) were not included in total transportation cost estimates. Instead, total estimated costs of shipping nuclear waste to a repository were based on the transport of commercial spent fuel (using spent-fuel discharge data published by DOE); high-level waste from West Valley, New York; and defense waste only from the Savannah River Plant. Since defense wastes are currently generated and stored at all three DOE sites noted above, the costs of shipping such wastes from all three facilities must be included in the final EA.

3. Certain elements of DOE's evaluation of total transportation costs vary among draft EAs for potential repository sites. For example, the draft EA for the Yucca Mountain site in Nevada specifically states that certain "transportation-related costs, such as the costs of constructing access roads" are not included in total transportation cost estimates (p. 5-83). Such a statement is lacking in the draft EAs for the Lavender Canyon and Davis Canyon sites in Utah, and the Hanford site in Washington.

   Another example of variation among draft EAs' discussion of transportation costs is found in the draft EAs for Utah's Lavender Canyon and Davis Canyon sites. Those draft EAs include in total transportation costs charges for physical security in transit, based on current spent-fuel escorting experience (see pp. 5-90 and 5-92 in the respective draft EAs). Discussion of such costs is lacking in the Yucca Mountain site and Hanford site EAs.

   Where such elements of cost vary among draft EAs, an adequate comparative evaluation of DOE's estimates is impossible. As a result, any conclusions DOE attempts to draw are relatively meaningless.

4. Sensitivity analyses have not been included for cost estimates contained in the draft EAs. The effects of variations in model inputs should be reflected in the documents.

A.10.4 Insurance Coverage for Transportation Accidents

The draft EA states in this section that all repository-related activities including packaging and handling at the reactor sites, transportation to a repository, packaging and handling at the repository, emplacement, and long-term containment are covered by insurance or otherwise indemnified for liability associated with any accident under the Price Anderson Act. The text notes that the maximum government indemnification is $500 million. What studies or analysis have been conducted that suggest that $500 million represents adequate coverage? Who would be liable for damages in excess of $500 million under various accident scenarios? Does DOE believe that public confidence is promoted by setting limits on liability?

Nearly every state supports the concept of strict and unlimited federal liability for any and all accidents that might occur under this program. Does DOE support this concept? If not, why not?

We believe that all liability rests with the federal government on this matter, and that public confidence in DOE's ability to carry out the provisions of the Nuclear Waste Policy Act would be enhanced if the Department would support the concept of strict and unlimited federal liability for all activities under the Act.

PART III

LOCAL GOVERNMENT COMMENTS

Clark County

Clark County

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COMMENTS FROM THE CLARK COUNTY BOARD OF COMMISSIONERS
TO THE DEPARTMENT OF ENERGY CONCERNING THE ENVIRONMENTAL
ASSESSMENT FOR THE PROPOSED HIGH LEVEL NUCLEAR WASTE
REPOSITORY AT YUCCA MOUNTAIN, NEVADA

The attached comments constitute Clark County's submittal to the Department of Energy (DOE) relative to the review of the Yucca Mountain Environmental Assessment. The General Comments were approved by the Board of County Commissioners on March 15, 1985. The Detailed Comments were finalized by Clark County Department of Comprehensive Planning subsequent to the Board Meeting.

It should be noted that both the General and Detailed Comments were submitted to the Department of Energy (DOE) prior to the March 20, 1985 deadline. We would appreciate, however, having our comments included, as well, for submittal with those from the State of Nevada and other entities.

To reiterate an earlier concern, we would hope that the State would press for a 60-90 day extension of the review process. Given the size of the document, as well as its importance to the State and local communities which will be influenced by the decisions made from the data in the assessment, it is imperative that more time be available for review.

Sincerely,

ADVANCED PLANNING DIVISION

Dennis A. Bechtel

Dennis A. Bechtel
Assistant Planning Coordinator

DAB:sg
Attachment
cc: Senator Paul Laxalt
Senator Chic Hecht
Congressman Harry Reid
Congressman Barbara Vucanovich
Lee West, Boulder City
Robert Wilson, Henderson
Larry Brown, Las Vegas
Jane Poulos, North Las Vegas
Steve Bradhurst
Mike Baughman, Resource Concepts

COMMENTS FROM THE CLARK COUNTY BOARD OF COMMISSIONERS
TO THE UNITED STATES DEPARTMENT OF ENERGY (DOE)
CONCERNING THE ENVIRONMENTAL ASSESSMENT FOR THE PROPOSED
HIGH-LEVEL WASTE REPOSITORY AT YUCCA MOUNTAIN, NEVADA

1. GENERAL COMMENTS

The Yucca Mountain environmental assessment (EA) is, on the whole, well written and articulates in a general sense the main components of the nuclear repository siting program. There are, however, major deficiencies in the document that make it incomplete and less than acceptable in providing a rationale for selecting the Yucca Mountain site as one of three "preferred" sites for a nuclear waste repository. The following commentary relates our concerns about the assessment and the manner in which it purports to meet the requirements of the Nuclear Waste Policy Act of 1982 (hereafter the "Act") and the General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories (hereafter the "Guidelines").

On January 8, 1985, the Clark County Board of Commissioners adopted a resolution opposing the location of a high-level nuclear waste repository in Southern Nevada. Review of the environmental assessment, which resulted in the following general comments, confirm the concerns raised in our resolution. Preceding the topic by topic general comments, we offer commentary on the methodology used in selecting the nine original sites. We feel that this is important because it places in question the process employed in choosing potential sites for characterization.

Site Nomination

The manner in which the nine sites were nominated and the relationship of this process to the siting guidelines appears to be biased. Nine locations were recommended by DOE in early 1983 for further analysis. After these sites were selected DOE subsequently published its Guidelines, (Draft document June 1984 after Nuclear Regulatory Commission (NRC) concurrence and final document December 1984 - 10 CFR Part 960). It would seem that the process should have proceeded the other way around; first the guidelines are released, with criteria for eligibility specifically cited, and then potential sites are chosen. This is, in fact, the manner in which the selection of the second repository is taking place.

Section 112(a) of the Act states that general guidelines be issued "not later than 180 days after the date of the enactment of this Act" and that the "Secretary shall use guidelines established under this subsection in considering candidate sites for recommendation under subsection (b)" [e.g., to nominate 5 sites for characterization]. The guidelines recognize the disparity in process between the first and the second repositories in Section 960.3-2 (Siting Process):

> The siting process begins with site screening for the identification of potentially acceptable sites. This process was completed for purposes of the first repository before the enactment of the Act, and the identification of such sites was made after enactment in accordance with provisions of Section 112(a) of the Act.

It then goes on to state that the second and subsequent repositories will be identified by use of the guidelines.

It is difficult to see how you can proceed, under the Act, in selecting nine sites, of which three are to be considered for detailed characterization, without having guidelines, and therefore specific standards, initially. On what basis were the first grouping chosen? The Nuclear Regulatory Commission (NRC), which has responsibility for approving standards related to nuclear activities, only concurred with the Guidelines in June of 1984, over one year after the nine sites were selected. Doesn't this leave the selection process for the first repository group open to question? It would appear that the DOE "jumped the gun" on choosing candidate sites in the first round. It thus seems that in the case of the first repository guidelines are employed after the fact to confirm the locations already selected.

An additional concern is the methodology employed in reducing the nine original sites to the five candidates for further characterization. The manner in which the Decision Process is stated in the environmental assessment is open to interpretation. Statement 2.1.3 on Page 4 of the assessment, although worded somewhat differently than the Guidelines, indicates that preferred sites shall be selected on the basis of all potentially acceptable sites in that [geohydrological] setting (Section 960.3-2-2-2). Section 960.3-1-1 (Diversity of geohydrologic settings) which is cited in 960.3-2-2-2, however, notes that "to the extent practicable, sites recommended as candidate sites for characterization shall be located in different geohydrologic settings." DOE, in selecting one preferred site per geohydrologic setting, therefore, may in fact be eliminating locations which are potentially more acceptable than one or several of those selected. This is not a hypothetical situation since, according to the environmental assessment, all nine sites are acceptable (Page 5-EA, Section 2.2.1).

In order to determine the relative position of each candidate, however, all nine would have to be ranked. It is impossible to determine the true overall position of an individual site because only the five selected are ranked competitively. Thus, as an example, the Texas site which was "non-preferred" may, in fact, be superior to those in Richton, Mississippi or Hanford, Washington. (The close proximity of the Deaf Smith and Swisher sites makes this a strong possibility). The eligibility criteria is especially unfair to Yucca Mountain and Hanford, Washington which, not being in competition with other nominees in their respective areas, automatically proceed into the next round.

The methodology appears to be biased if the true intent of the selection process is to select the area most suitable for depositing the high-level nuclear waste.

Site Evaluation Criteria

The intent of Chapter 7 is to provide a comparative analysis of sites for nomination purposes. With the realization that in many respects apples and oranges are being compared, it is impossible, from the discussion, to determine the relative ranking of individual sites. It is made more difficult, given the fact that only five of the nine were ranked in Chapter 7, although nine environmental assessments were released and purportedly nine decisions made as to suitability. On what basis were the other four sites removed from consideration? Especially given that all nine were judged to be suitable for a repository. Even accepting the premise that preferred sites within geohydrologic basins should be the only ones selected for possible site characterization, there still should be some internal accounting in the document to justify recommendations.

In order for the rationale for the rankings to become apparent to the reader (and more importantly to provide a rationale for the relative position of a particular site) a more suitable basis has to be provided to compare the sites.

The connection between the Condition Tables and evaluating criteria, the discussion, the final ranking, and the rationale for the ranking in Chapter 7 is not always apparent. The tables themselves should include meaningful information to enable the reviewer to determine how the decision on final rankings is reached (numerical ratings?). The methodology employed notes in general terms whether a site characteristic meets the specific criteria but not how it compares in relative terms to its competitors. Without a more comprehensive comparative analysis and retaining the current entries, which in many cases are the same between sites and not very informative, it is difficult to determine how the conclusions for nomination were reached.

Also missing in the evaluative process of Chapter 7 is an indication of the relative importance of the variables involved. Is Geohydrology more significant than geochemistry, and if so, how much? What is the importance of transportation and socio-economic information in site selection? All of the variables are obviously not of equal significance. Determining how the DOE weighted individual attributes is an important factor in assessing how conclusions were reached. This information should be included in the environmental assessment.

The consideration of off-site impacts, in the main, in the socioeconomic and transportation categories are unfortunately given minimal treatment in the site nomination process. Although, as was noted in a previous section, it is impossible to determine the weighting of individual attributes, the conditions selected for evaluation indicate minimal emphasis. Specifying the cost and impact of transportation, as intended in Section 112(a) of the Act, appear to go far beyond that provided in the Assessment. Although transportation is critiqued in greater detail in the next section, it should be noted here that potential transportation impacts are obviously more extensive than those specified in the document. Merely evaluating impact from the nearest existing highway to the repository site obviously does not take into consideration the multitude of potential transportation-related impacts which can influence surrounding communities.

Transportation

The transportation section of the Environmental Assessment is totally inadequate and needs considerable modification before it can meet the requirements of the Act, the Guidelines, and the intent of a true assessment. The Act specifies in Section 112(a) that the Guidelines developed by which sites are to be selected shall "take into consideration . . . safety factors in moving such waste to a repository" and "the cost and impact of transporting to the repository site the solidified high-level radioactive waste and spent fuel." It further notes in Section 112(b)-(1)-(E)-(vi) that the Environmental Assessment shall include ". . . an assessment of the regional and local impacts of locating the proposed repository at such site."

The Guidelines translate the Act's requirements, which provide the basis for regional analysis, into criteria related only to impact assessment adjacent to the site. Both the Guidelines and the Assessment, therefore, seem to fall short of the intent of the law.

The Assessment's sole contribution to transportation issues is an analysis of adjacent-to-site impact, coupled with a transportation section in Appendix A common to all nine assessments. The adjacent-to-site issues provide only minimal treatment of pertinent concerns. The generic Appendix A does nothing to provide a comparative analysis between sites nor provides site-specific information in a broader sense (e.g., regional) to test true impact. It is difficult to see the utility of including a transportation attribute in the site ranking matrix that measures only a minor part of the potential impact.

The Yucca Mountain Environmental Assessment, as well as the other eight assessments, need to address more site-specific issues with regard to transportation. The DOE has produced a considerable number of maps during the past several months illustrating potential waste routing scenarios to the Yucca Mountain site. Among the routes considered include ones that would transport waste across Hoover Dam and on Interstate 15, and U.S. Route 95 through urbanized Las Vegas. These are obviously items of concern to local residents and appropriately topics of discussion. The potential risk to local citizens of such proposed routings should be assessed comprehensively in the document. Likewise the other sites examined have analogous local transportation characteristics that would require analysis. Because all nine sites have been deemed to be acceptable for repository siting by DOE analysts, it would appear that issues such as transportation (as well as socioeconomic and other potential off-site issues) would be greater determinants in deciding the final three locations. The document, however, treats each site as an isolated phenomenon and not, more appropriately, in the context of its regional relationships.

Because of the importance of transportation issues during the thirty-year operational period, it is imperative that these factors be weighed proportionately in the ranking. As was noted earlier, however, the weightings of attributes are not included in the text. It, therefore, would be helpful to note the relative ranking of transportation in the total methodology.

In order to make the section on transportation acceptable a number of issues require substantive analysis. Routing, risk assessment, liability, and cost should all be incorporated into the assessment on a route-specific basis. Other issues of a more general nature that could be discussed as such would include prenotification, escorts and mode selection and mix. The issue papers generated by the DOE during the past several months are a beginning but, to reiterate, the information needs to focus on individual locations.

Monitored Retrievable Storage (MRS)

The question of MRS needs to be examined in detail in the Assessment. There appears to be a greater emphasis by DOE in recent months in ensuring that an MRS is available in the event that the scheduled opening of the first repository in 1998 is delayed. Consequently, the Assessment needs to examine the associated MRS issues in relation to the first-round states. In particular, the transportation-related impacts should be evaluated. Without this information the document does not adequately analyze the total scope of the problem.

Defense Waste

Defense waste shipments, which may comprise a substantial segment of the total waste transported, are barely mentioned in the assessment. Aside from the lack of an estimate of potential number of defense related shipments, there are numerous associated issues that need to be addressed. For example, will defense waste be subject to the same transportation regulations as civilian shipments? How will the public be assured that these are being enforced.

Because of the potential magnitude of defense shipments, it is necessary to provide a more substantial analysis in the assessment.

Socioeconomic Issues

The socioeconomic sections of the assessment while providing a somewhat comprehensive treatment of background issues and current quantifiable information (some of which we question, however) is totally inadequate in its analysis related to the potential effect of the repository on Clark County. The assessment analysis should include a more detailed description of potential resources needed (even a range of numbers would be helpful) and current deficiencies. This obviously would require a considerable degree of interaction with local officials, which we feel is appropriate because of the likely influence a project of this magnitude will have on the resources and service capabilities of local government. Elements which need to be evaluated include required schools, police and fire protection and approximations of needed infrastructure.

There are a number of subjective statements laced throughout the assessment that dismiss potential impacts (see Table 6-11, Page 6-76 (1) - Department of Energy finding) without providing the rationale to confirm these accusations. To place our comment in perspective the current Citicorp development should be considered. The 1000 employees (it is our understanding that this could reach 2000) will translate into approximately 3-5000 additional residents, including several hundred students, requirements for additional police and fire, and so forth. While a detailed examination of Citicorp has not been completed, it is evident that a project of this size will require additional services, notwithstanding the fact that Clark County is a high-growth area. When you consider that the repository will generate employment of a magnitude 3-5 times that of Citicorp, you can understand our concern relative to its lack of treatment in the assessment. When you also consider that government mitigation funding to local communities would be available to ameliorate impact you can also see why quantification is appropriate in the assessment.

What is perhaps most striking about the socioeconomic segment of the assessment is its lack of substantive analysis relative to potential influence of the project on tourism. Tourism is a major economic activity in southern Nevada that may be adversely influenced by, in particular, the transportation element of the program. Merely stating as on Page 6-81 that "information to date suggests that the repository is not likely to significantly effect tourism" and that this is a "favorable condition" for the area without providing substantiating evidence is unacceptable. A more comprehensive discussion of the SAI report cited (see Page 5.4.1.6 - Page 5-92) should be included in the assessment to enable the reviewer to determine how the conclusions cited were reached.

A comprehensive treatment of the issues associated with tourism as they relate to all the activities of the repository is thus needed in the assessment. Determinations of potential adverse reactions of tourists to visiting Las Vegas because of either the repository or the transport of the radioactive waste can, if true, translate into loss of revenue and employment. The information can thus provide a basis for modifying elements of the program such as waste shipment routing.

As noted previously, the off-site issues are significantly more important than given credence to in the assessment. The Socioeconomic and Transportation sections should be given greater weight in the assessment attributes.

2. DETAILED COMMENTS

Comment Number	Page	Paragraph	
		Chapter 1	(Process For Selecting Sites For Geologic Repositories)
1	1-2	4	The fact that the preliminary screening process has been ongoing since the 1950s lends credence to our concerns about whether the first round sites comply with the Siting Guidelines.
2	1-6	4	The site-screening process described on Page 1-5 seems to break down relative to the basalt and tuff sites. The federal land criteria appears to the most significant element with geohydrologic considerations after the fact. Were other tuff sites investigated?
3	1-13	-	Comparison of argillite and tuff relative to suitability to contain radioactivity?
4	1-14	Item 3	As discussed in the General Comments section, the Guidelines can be interpreted such that several sites could be selected from one geohydrologic region (see 10 CFR 960 - Section 960.3-1-1).
5	1-16	1	The statement "to the extent practicable" would not appear to preclude the use of even one geohydrologic region, however.

Comment Number	Page	Paragraph	
6	1-17	1	Is a geohydrologic region the same as a geohydrologic setting or system? Not defined in Glossary. It seems in the table that surficial and subsurficial descriptions are mixed; Columbia Plateau (surface), Permian Basin (subsurface).

Comment Number	Page	Paragraph	
		Chapter 2	(Decision Process by Which The Site Proposed For Nomination Was Identified)
1	2-1	3	References as to the characteristics of tuff?
2	2-26, 2-27		Sometimes the placement of tables and identifying text is inconsistent making reading difficult.
3	2-30 to 2-32		A similar table of weighted attributes would be of great assistance in Chapter 7.
4	2-33	2	How does the rating system evaluate three dimensional differences?
	2-55	(Off-site Installations and Operations)	How does the DOE define minor effect? There seems to be less than strong assurance by the DOE that the site is secure from impact from nuclear testing activities. Further analysis to determine whether or not this is a disqualifying factor would seem to be warranted.

Comment Number	Page	Paragraph	
		Chapter 3	(The Site)
1	3-4	4	Land withdrawal?
2	3-21	2	Although disqualifying conditions are dismissed for DOE nuclear testing activities (2-49) and tectonics (2-51), this paragraph indicates that more study is needed before minimal impact can be proven conclusively.
3	3-22	3	What about low-to-moderate geothermal energy for use by a low populated rural area in the Amargosa Valley? This potential should not be dismissed.
4	3-23	1	DOE's dismissal of gold mining activities as producing only worth $1.8 million of gold appears to be a subjective judgement. DOE's assessment is probably not held by the owners of the mine(s) in the area.
5	3-24	1	What is the assessment of the non-metal worth of the minerals? Although this section and the previous entry would not seem to be important to DOE, these are foregone resources and revenue which would not be available to citizens. Quantification, therefore, is important, perhaps to determine mitigation requirements.

Comment Number	Page	Paragraph	
		Chapter 3	
6	3-56	4	The detailed discussion about highway structure and current use with regard to construction material and workers should be replicated somewhere with respect to the transport of the waste.
7	3-58	Table 3-7	The Table should be expanded to include traffic counts on U.S. Highway 95 to the Arizona border. An additional Table is required for Interstate 15, since it is conceivable that waste shipments will traverse at least part of this route.
8	3-60	1	This paragraph summarizes well why Interstate 15 and parts of U.S. 95 should not be used to transport nuclear waste.
9	3-60	3	How does the discussion relate to the characteristics noted in Table 3-8 (Page 3-59)? The Union Pacific has to traverse several major arteries in urbanized Las Vegas, that are crossed by heavy vehicular traffic with access restricted only by gate. Does this mean that no restrictions would be necessary in transporting nuclear waste through Las Vegas? (speed restrictions, for example).

Comment Number	Page	Paragraph	
10	3-62	2	The Union Pacific line between Salt Lake City and Barstow should be evaluated with regard to its ability to transport a highly dangerous material. The discussion relative to the line's present use and capacity, may be inconsequential.
11	3-87	1	This paragraph ignores the fact that the Clark County urban area also has most of the characteristics of an "average" community as well. The conclusions I would draw from this paragraph are that of a "boom or bust" economy that may not be dramatically affected by the project. The statements made should be balanced by the "normal community" aspect of Las Vegas as well.
12	3-88	3	Transients? Those associated with gaming and tourism are not necessarily "transients" but are generally part of the "more settled population groups." This paragraph is obviously written by someone not familiar with the area.

Comment Number	Page	Paragraph	
13	3-90	3.6.4.4	The perceptual issues should be examined more comprehensively in the Assessment. "Perception" could influence whether or not tourists would be willing to visit Las Vegas because of the project; whether or not it would influence Las Vegas as a choice for industry, etc. The paragraph makes a statement which needs to be carried to a conclusion.
14	3-90;3-92		This section should provide some mention of the impact that the 1983 legislative rulings have had on local governments. Revenue are far less prevalent than in pre-1983 era for government to provide services.

Comment Number	Page	Paragraph	
		Chapter 4	(Expected Effects of Site-Characterization Activities)
1	4-1	4	The Environmental Assessment should analyze many of the "non-geologic" items noted in order to test the regional impacts required in the Act. By waiting until the site-characterization phase many of the factors that should be used to determine which of the sites will be "preferred" are ignored or not analyzed in a comprehensive manner.
2	4-9	4.1.2.1	In the southwest alluvial fan flooding (sheet wash) can cause considerable problems. This information,however, is often not mapped. This should be considered when siting surface (and subsurface) facilities.
3	4-33 4-39	4.2.2.4 Table 4-5	Rather than making a statement saying that no impact will occur, Chapter 4 should discuss what impact will take place from site characterization activities. The number of workers involved, although less than the construction and operations phase, can still translate into employment equalling one Citicorp (1000 employees provide direct and indirect) which will provide a demand as community services.
4	4-32	Table 4-3	Source?

Comment Number	Page	Paragraph	
		Chapter 5	(Regional and Local Effects of Locating a Repository at the Site)
1	5-1	1	The first paragraph provides ample evidence why the environmental assessment is inadequate.
2	5-1	2	How have the basic assumptions changed?
3	5-1	3	The transportation analysis should be more site-specific. Transportation in Appendix A and other chapters deal only in generalities and say nothing about local and regional impacts.
4	5-2	2	The analysis should consider realistically the potential repository storage. Since 70,000 MTU is only a limitation until the second repository is opened, it is conceivable that more waste could be deposited at Yucca Mountain. The assessment should discuss what would occur if a token second site were opened (MRS?) and Yucca Mountain were required to accept most of the waste. The 70,000 MTU also does not consider the potential additions of defense waste.
5	5-5	4	Where would this waste be stored? No discussion.
6	5-8	1	What is the estimated demand for electricity; how would it potentially impact local demand?
7	5-12	1	How would the 80,000 lb. gross-vehicle-weight affect existing roads considered for transport?

Comment Number	Page	Paragraph	
8	5-12	3	This paragraph illustrates the assessments deficiency with regard to transportation. The DOE makes a definitive statement about a rail line (as well as implicitly about U.S. 95 in the previous paragraph) yet does not evaluate site-specific transportation issues. What are the effects of transport on the Las Vegas Metropolitan area, for example? Without such analysis the assessment is incomplete.
9	5-13	1	The retrievability phase, since it is mentioned, should be discussed with regard to transportation effects and any other potential impacts.
10	5-13	3	What is the source of these numbers? How are they derived?
11	5-14	1	A more comprehensive discussion is needed about the types of material needed, the source of the materials and potential conflicts of supply given the requirements of a Las Vegas Metropolitan area that will double its population within twenty years.
12 13	5-15, 5-16	Tables	Explanation of indirect employees?
14	5-19	1	What various routes?
15	5-19	Table 5-7	Footnotes d and e. Does the routing noted (U.S. 95) influence the number of shipments?

Comment Number	Page	Paragraph	
16	5-19	Table 5-8	Source of table? Discussion of source of purchases?
17	5-20	Last	Meaning of this paragraph is unclear.
18	5-22	Table 5-10	How does this translate into shipments? Why is defense waste examined here and not elsewhere?
19	5-23	1	Under what conditions would incoming shipments not meet "repository acceptance standards"? What remedial measures would have to be taken? This statement needs explanation.
20	5-23	2	Other locations where fuel-assemblies could be consolidated?
21	5-23	3	High-integrity package?
22	5-23	3	If the minimum lifespan of the packages is estimated to be less than 300 years, would this change the conclusions about the repository?
23	5-23	3	The DOE seems to be building a case to use engineered barriers to overcome any deficiency in natural conditions that may be present.
24	5-23	3, 4	The differentiation between canisters, casks, and packages is not clear in this paragraph. The paragraph should explain in more detail the process and the shielding media from transport vehicle to repository storage.

Comment Number	Page	Paragraph	
25	5-23	5	When is a waste package determined to be suitable for emplacement?
26	5-24	2	When would a canister be unacceptable? At what point in the process would it be determined to be unacceptable? What would be done to make it acceptable? Statements such as these worry local officials.
27	5-24, (goes on to 5-25)	5	Will the monitoring of subsurface openings be performed during the operational phase of the program to verify stability?
28	5-25	2	If contaminated material were not to be placed underground (". . . may be placed . . .") what would other options be?
29	5-25, 5-26	5	Defense waste is discussed inconsistently throughout the text. Because it obviously will be included with the materials to be stored in the repository, a more detailed treatment of defense waste is needed in the assessment.
30	5-26	Last Item	A site-specific transportation section is needed to discuss the implications of interrupted shipments and how DOE would mitigate potential impact.
31	5-26	Table 5-11	Is the number of spent fuel shipments in the Stage 2 and Total columns for years 6 through 27 correct? (See Table 5-12 "Receipt Rate", Column 1.)

Comment Number	Page	Paragraph	
32	5-27	2	The NWPA only notes the 70,000 MTU cap until the opening of the second repository. The total material stored could thus be higher.
33	5-27	3	The discussion of staged repository development and its impact is totally inadequate. Possible variations should be discussed in more detail, (e.g., in what manner could community services be potentially impacted?).
34	5-31	Table 5-12	Reduction of impact (Footnote e) may not necessarily translate into "none" in the "Environmental" column, especially if "required" impacts are taken into consideration, which is in part the intent of this chapter.
35	5-34	1	The effects of the "retrievability" phase would, in most respects, be the same as the "operations" phase because the same processes would be occurring only in reverse. To say that the effects would necessarily be small is incorrect, (e.g., noise levels).
36	5-35	3	The regional effects of groundwater withdrawal during the life of the facility should be examined based upon the planned development potential of surrounding lands in Nye County.
37	5-36	2	100 or 500 year floodplain delineations in the southwestern U.S. do not always depict the total extent of flooding. Areas of sheet wash, which are not always defined on maps, can cause

Comment Number	Page	Paragraph	
37	5-36	2 (Cont'd)	serious problems as well. The surface facilities, etc. could be located outside of defined 100, 500 flood flow areas and still be affected by flooding. The potential effect of flooding from side washes should be determined.
37	5-36	2	(The water supplied for dust control.) How much water would be used for dust control? What is the potential for infiltration into the subsurface system?
38	5-36	3	The withdrawal of 50,000 acres of BLM land should be examined against potential future land use in the area.
39	5-37	5	The probable existence in the project area of both the fishhook cactus and the desert tortoise, both being reviewed for inclusion on the Federal Endangered Species list, indicates the need for a plan specifying protection measures to be employed during construction and operation.
40	5-38	1	The endangered status of the pupfish, dace, plants and mollusks in the Ash Meadows area necessitates assurances greater than ". . . are not expected to have any impact . . ." in the analysis.
41	5-41	3	Do the modelling parameters correspond to historical meteorological records?

Comment Number	Page	Paragraph	
42	5-46	Table 5-19	How does this table relate to standards?
43	5-46	Table 5-20	Useless unless related to standards.
44	5-47	2	What will the DOE do to maintain the 55 dBA noise level?
45	5-49	Table 5-22	Railroad line and construction in the Las Vegas urbanized area?
46	5-50	2	What is the length of time for the construction activities?
47	5-51, 5-52	5.2.6.2 Operations Section	There needs to be discussion in this section of the noise levels from the truck transport of waste.
48	5-52	1	With regard to truck transport there needs to be an evaluation of the noise levels in the Las Vegas metropolitan area (since I-15 and U.S. 95 are conceivably preferred routes).
49	5-53	2	Where is Dike Siding? The map on Page 3-57 is too general.
50	5-53	3	Potential indirect effects should be discussed.
51	5-54	2	Are the archaeological investigations to be coordinated with the Nevada Historic Preservation Officer and the requirements of the federal government?

Comment Number	Page	Paragraph	
52	5-60	Table 5-27	Transportation accidênts in an urbanized area, a potential occurrence (and probably more likely than a tornado in Nevada), should be evaluated as well because such activities are part of operations.
53	5-62	5	The conclusions stated in the brief paragraph obviously ignore potential regional impacts.
54	5-68	1	As will be stated many times throughout Clark County's comments, this analysis is totally inadequate in its treatment of transportation issues. A discussion of potential alternative routes should be provided, "safe havens," possible road-upgrading (vehicle weight) and similar.
55	5-71	4	Regulations applicable for rail transport?
56	5-71 5-72	4	Interstates as preferred routes should be evaluated, however, with regard to urbanized conditions. United States routes (U.S. 95, as an example) would not necessarily be included as a preferred route, however.
57	5-72	3	What is the definition of "low-level" of radio activity?
58	5-72	4	What if a severe accident does occur? (Sabotage?) An assessment should evaluate a potential "worst-case" scenario to test possible emergency response implications.

Comment Number	Page	Paragraph	
59	5-75	1	The Titanic was supposedly invincible also. An assessment should include in its evaluation a potential worst-case scenario. It is important to local communities to have the implications of a destructive accident (which is possible) considered. (resources needed, etc.)
60	5-76	2	A map showing routing would be helpful. U.S. 93 from north or northbound?
61	5-76	2	
	5-78	Table 5-40	Based, of course, on no worst-case scenario.
62	5-77	1	More significant would be the population density in the urban areas through which the waste would be transported and not the mean density which is highly misleading.
63	5-83	2	The DOE should spell out what the responsibilities of local government are with regard to emergency response. Because DOE has information related to equipment needed for an acceptable emergency response system, local communities in the assessment should be evaluated to determine shortcomings and needs.
64	5-85	1	What is the source of the Las Vegas Review-Journal numbers?
65	5-86	4	This is not an acceptable analysis.
66	5-91	5.4.1.6	A considerable number of questions posed but no analysis.

Comment Number	Page	Paragraph	
67	5-92	1	Why would a situation in which "all employees would come from and return to areas <u>other than Nye and Clark</u> counties [emphasis added] ..." be a conservative assumption? Why would this be examined at all given the experience of current test site worker migration patterns?
68	5-92	5.4.3	"...impacts in urban areas, such as the Las Vegas Valley, would probably be insignificant." Speculative. What is the definition of an impact? What may not seem significant to DOE may in fact be significant to the community.
69	5-93	Tables 5-49	Sources of footnotes a,b,c.?
70	5-99	2	DOE is being selective without basis in assessing impacts. (e.g. Education section relative to Clark County).
71	5-101	3	Sewage treatment in Clark County?
72	5-102 104	5.4.3.7	The section on transportation looks solely at road capacity and does not consider factors such as weight of trucks which may impact the system in an adverse manner.
73	5-103	Table 5-55	What is the basis for the selection of these roads? Are they being considered for the transport of waste? A number of these are not limited access and traverse densely populated segments of urbanized Las Vegas.

Comment Number	Page	Paragraph	
74	5-105	4	This paragraph refutes earlier statements of insignificant impact in urbanized Las Vegas.
75	5-108	1	This provides the rationale for why the assessment should examine the impacts to tourism in a more comprehensive fashion.
76	5-108	4	Why should the impact from a potentially highly negative federal program (as viewed from a local perspective) be required to be funded by state resources? This is not acceptable.
77	5-109	3	DOE has predetermined that no significant impacts will occur without providing an analysis to substantiate their claims.
78	5-110	4	It is precisely the reason that significant radiological releases could affect workers and residents adversely that the assessment should evaluate the impacts of an accident of this type in an urban area.
79	5-116	Table 5-57	Radiological effects of an accident?
80	5-117	Table 5-57	"Standard Operating Practices" to minimize the exposure of citizens could be to route the waste away from urbanized areas. "Residual Impacts" could be significant if an accident occurred. These should be noted in the Table.

Comment Number	Page	Paragraph	
81	5-119 5-120	Table 5-57	Neither the "standard operating practice" nor the "residual impacts of significance" columns reflect impacts or potential solutions. The immigration of workers, particularly in the smaller communities, would require an upgrading of systems by the federal governments, for example (Page 5-119). The lack of impact noted on Page 5-120 is not substantiated.

Comment Number	Page	Paragraph	
		Chapter 6	(Suitability of the Yucca Mountain Site for Site Characterization and for Development as a Repository)
1	6-2	4	It is relatively easy for a site to be "qualified" if not all the potential conditions are examined. Why wouldn't disqualifying conditions for "transportation" be present (1960.5-2-7) nor "Environment, socio-economics and transportation" (9670.5-1) (listed as NA)? If disqualifying conditions would be identified, transporting waste through urbanized Las Vegas, for example, couldn't this lead to other, more acceptable solutions to the problem (routing the waste through less densely populated areas)?
2	6-9	6.2.1.1.2	A general comment related to this section, what is the basis for the 50,000 acre requirement for the Yucca Mountain repository?
3	6-10	6.2.1.1.4	If DOE is unable to obtain Department of Air Force land will this mean that additional acreage will be necessary from the Bureau of Land Management?
4	6-12	6.2.1.2.1	This condition, population density and distribution, is noted as favorable by DOE. Yet if one considers the Act's requirement to evaluate regional impacts it ignores potential situations such as transportation-related impact of an accident and subsequent release of radioactive material in the Las Vegas Metropolitan area.

Comment Number	Page	Paragraph	
5	6-18	5	An emergency preparedness program would appear to include more elements than those noted in the text in the plan. A program should also provide a comprehensive list of the resources needed to effectuate a plan.
6	6-19	6.2.1.2.6	What is the definition of a "worst-case" single accident exposure rate (the glossary definition is not helpful). Since transportation of the waste is part of the operations of the facility a worst-case scenario would be an accident occurring in urbanized Las Vegas. DOE in its analyses seems to avoid potentially true worst-case happenings.
7	6-25	Table 6-5	Extreme weather phenomena with regard to flooding should not be dismissed lightly. Yucca Mountain has a higher annual average rainfall figure than the Las Vegas Valley (5.73" versus 3.7" average). The assessment that this potentially adverse condition does not exist is not necessarily consistent with Table 3-4 on Page 3-45 and the text on Page 3-46.
8	6-32	Table 6-6	Interruption in operations if shipments are curtailed again touches upon the transportation question. Issues such as where shipments will be kept until service can be restored are significant topics that should be addressed in the assessment.

Comment Number	Page	Paragraph	
9	6-79	2	The conclusion should reflect the previous paragraph which notes that DOE will work with local entities to mitigate impact. "Significant disruptions" could have different meanings to DOE and local communities.
10	6-81	5	The information available (see SAI Page 6-346) did not examine potential impact to tourism from the repository but rather performed a literature survey of other disasters (not too detailed) and set forth a brief proposal for future work. There is no way, based on this study, that the conclusion can be reached that potential impacts to tourism are minimal.
11	6-86	6.2.1.8	The transportation analysis falls far short in assessing potential regional impacts as specified in the Nuclear Waste Policy Act. The "...preliminary nature of the transportation studies" (Page 6-91-paragraph 5) makes the conclusions readied in Table 6-12 very tenuous. Missing in the analysis are DOT route selection criteria, the requirement of avoiding populated areas (and the potential consequences of not doing so), highway conditions, environmental hazards (flash flooding), routes with specific sensitivity (Hoover Dam) and the myriad of other transportation-related issues worthy of analysis in an assessment. Until these issues are addressed on a site-specific basis the assessment is incomplete and the conclusions reached unsubstantiated.

Comment Number	Page	Paragraph	
12	6-93		The "preliminary" nature of the transportation studies (See Comment 11) does not lead to the conclusion that "regional highways and railroads are adequate to serve the repository without significant upgrading." First the routing would have to be specified and then terms such as "adequacy" should be defined to determine meaning (e.g. adequacy has connotations that go far beyond road condition).
13	6-97	4	The responsibilities and resource requirements of local authorities, who will be the first-on-scene in the event of an accident, should be specified. A response in an urban area may require resources to evacuate a large segment of the population in addition to those required for material handling and cleanup. This should be examined in the Assessment, as well.
14	6-98	2	Lowest frequency of occurrence does not necessarily translate into minimal problem condition. Flash flooding, for example, can cause considerable damage from a brief incident. Potential damages to road systems and attendant potential operational impacts should be assessed accordingly.

Comment Number	Page	Paragraph	
15	6-107	Table 6-14	The assessment of an accident and worst-case release of radioactivity in an urbanized area, as noted previously, would truly test impact and the veracity of the DOE finding in Table 6-14.
16	6-110	2	(See Comment 15)
17	6-241	5	Quantification of those minerals available, however, may be needed to quantify in-lieu-of tax consideration.
18	6-253	6.3.3.1.2 Table 6-35	High-resolution aerial mapping and topographic maps with contour intervals of 20 feet may not provide an accurate portrayal of geomorphic characteristics. The potential for flooding should not be underestimated in the study.
19	Chapter 6		A number of the conclusions reached in Chapter 6, especially with regard to socio-economic issues are based on incomplete information.

Comment Number	Page	Paragraph	
		Chapter 7	(Comparative Evaluatión of Sites Proposed for Nomination)
1			A numerically weighted comparative analysis among all nine nominated sites would have provided a true ranking of candidates. Because the Act does not necessarily seem to preclude the selection of several sites from one geohydrologic region, such an analysis would have determined which sites and geologic media were actually superior.
			The methodologies employed in ranking sites are totally inadequate. Because there is variation in importance between the attributes examined, a system of weightings should be provided to reflect these differences. Based on the siting guidelines each candidate should then be given a numerical rating in the Condition Tables and compared with the other sites to test suitability and superiority. The values derived could then be multiplied by the weightings to develop total numbers for individual attributes. These would then be summed to provide a figure which could then be used for comparative analysis. A matrix of the type used in Chapter 2 to select an appropriate tuff site would be another example of a methodology which could be employed to rank sites.

Comment Number	Page	Paragraph

Although the lack of a rating system precludes understanding of the relative importance of attributes in the selection process, it appears that off-site issues are perhaps not given their true consideration in the evaluation. DOE had downgraded the importance of socio-economic and transportation factors by failing to provide a comprehensive examination of all the issues involved. Transportation, for example, is merely analyzed adjacent to the site and not in its regional context. A true evaluation would consider distance from the generating facilities, transport through urban areas and the potential implications of a "worst-case" release of radioactivity in a "worst-case" area - an urbanized setting. Socioeconomic questions are dismissed as not being significant without substantiation. Since all nine sites are deemed to be acceptable by DOE, generally because of on-site considerations, it would seem, therefore, that off-site issues would attain greater significance in the site selection process.

A number of the conclusions reached in Chapter 7 are based on incomplete information. More properly, shouldn't the studies be completed to substantiate the conclusions?

Chapter 7 needs to be modified in order to meet its stated objectives.

Comment Number	Page	Paragraph	
2	7-85	2	The conclusions reachéd are not substantiated in the study.
3	7-82	Table 7-14 (c)(4)	The NP status not proven with regard to Yucca Mountain.
5	7-120 to 7-132	Section 7.4	(See Chapter 7 preliminary comments)

APPENDIX A (TRANSPORTATION)

Comment Number	Page	Paragraph	
1			The discussion analysis in Appendix A should, more appropriately, be site-specific and be an integral part of the text. The Act, as stated previously, requires that an Environmental Assessment address the potential local and <u>regional</u> impacts of the repository program. This is especially necessary in the case of transportation issues. Lacking this, the document is incomplete and its conclusions open to question. Issues that should be examined are routing, "preferred routes" and urban areas, liability, emergency response and similar, all analyzed in the context of a "worst-case" accident scenario. Until the DOE begins to investigate issues such as these it will be impossible to determine the total implication of the repository program.

Nye County

P. O. Box 153
Tonopah, NV 89049
March 20, 1985

Comments--EA
U.S. Department of Energy
Attention: Comments--EA
1000 Independence Avenue, S.W.
Washington, DC 20585

I am transmitting with this letter the Nye County, Nevada, response to the United States Department of Energy Draft Environmental Assessment, Yucca Mountain Site, Nevada Research and Development Area, Nevada, dated December 1984.

The proposed Yucca Mountain high-level radioactive waste repository site is in south-central Nye County, and it appears that Nye County would be the government entity receiving most, if not all, of the adverse impacts associated with the construction, operation, decommissioning, and closure of a nuclear waste repository at Yucca Mountain, Therefore, it is not surprising that Nye County has requested the that Department of Energy (DOE) make sure the County is a full participant in all phases of the project.

Nye County feels the Draft Environmental Assessment (EA) provides the County its first formal opportunity to comment on the project. The County would like to do the best job possible in reviewing the EA. The County requests DOE allow it to submit additional comments on the EA up to April 20, 1985. This request is made in light of the fact that County EA reviewers received the EA some nineteen to twenty-one days after the start of the EA review period (December 20, 1984).

Finally, Nye County appreciates the opportunity to comment on the Draft EA, and the County hopes the enclosed comments, and any comments the County might provide in the future, help DOE in its mission of selecting a nuclear waste repository site that will not adversely impact man and his environment.

Sincerely,

Stephen T. Bradhurst

Stephen T. Bradhurst
Nye County Planning Consultant

STB:jls

Comments enclosed

DEPARTMENT OF ENERGY DRAFT ENVIRONMENTAL ASSESSMENT, YUCCA MOUNTAIN SITE, NEVADA RESEARCH AND DEVELOPMENT AREA, NEVADA

REVIEW AND COMMENTS

GENERAL COMMENTS

The scope of the review and comments of the Draft Environmental Assessment (EA) covered by this effort refers to most of the subject areas addressed in the EA with emphasis on socio-economic and transportation concerns from the perspective of the host community of Nye County. In general, the EA appears to have considered the major areas of concern relating to location specific technical aspects of the project. The amount of data collection, assembly, and analyses represented by the body of work contained in the document is prodigous. There are several areas, however, that clearly require more work to assure an in-depth understanding of the potential effects of establishing a high-level nuclear waste repository at Yucca Mountain and to support a decision on site selection for further characterization studies.

The major areas of concern to be indicated in greater detail by the specific comments which follow center on:

1) Emphasis on location specific criteria in the EA thereby reducing the importance of system-wide considerations in the site selection screening process. This problem is particularly acute with respect to safety and security during transportation of high-level radioactive waste from point of source to location of the repository. This emphasis also introduces a methodological bias in which distortion of the weighting of performance conditions and attributes of the proposed site location takes place. As a result, important factors which should figure prominently in the site selection screening process are discounted. Indeed, the preliminary criteria for Yucca Mountain in connection with conducting an EA appear to be land use considerations.

2) The lack of sufficient analysis on infrastructure and operating systems in the EA. Surface transportation system upgrades (both highway and rail) that may be necessary at the outset or as a result of degradation from heavy haul traffic should be considered. Similarly, safety and security systems relative to the transport of nuclear waste should be considered in detail. Institutional arrangements, such as regulation of waste transport within and between states, should be investigated carefully. Legal questions of responsibility for damages in the

event of accidents or perceived emergencies, emergency preparedness policy, and planning guidelines and procedures need to be investigated fully. In particular, management systems are needed which address the issues of chain of command in the event of emergencies, provision of trained manpower and appropriate equipment as well as financing in connection with state and local response capability.

3) The need for validation of economic data and analysis of project characteristics and economic impacts. In particular, details of the methods used to estimate project cost, direct and indirect employment, and materials and services procurements are necessary. Assumptions regarding net employment changes, worker commutation and residence patterns, and inmigration of project-related worker households need clarification and justification.

4) The lack of sufficient community specific data and analysis relative to transportation, community services, and fiscal effects of establishing a geologic repository. Impacts on public services including transportation and finance can not be evaluated adequately on a jurisdictional basis with the information presented in the EA.

5) The lack of discussion and analysis of social equity in measuring the benefits and costs of repository siting. The EA notes that the Nuclear Waste Policy Act of 1982 (NWPA or Act) provides mitigation and compensation for costs born by the host state and local governments. Alternative procedural mechanisms should be developed to assure that necessary planning and mitigation assistance is directed to both state and local goovernments affected by establishment of a waste repository. Furthermore, an equitable means should be developed for determining the amount of compensation required to offset social costs that fall outside traditional community impact assistance formulae.

6) The lack of sufficient information on hydrological and geological matters from all points of view. For instance, the earthquake potential and severity of shock to the repository discussion should be augmented to indicate worst and likely cases in the event of such an earthquake. Scenarios of implications should be developed for these cases. Similarly the process of aging of the repository and its contents should be spelled out, with both known and unknown consequences to underground water sources spelled out in detail. Consequences to water should be traced through interconnecting aquifers and from aquifers to surface water and water consumption by human and other life forms.

7) The experience of effects of subject nuclear waste under conditions brought about by transportation accident. Details of experience with health implications for humans should be quantitatively and qualitiatively reviewed. Likelihood of risks, with justification of how developed, should be indicated. The types of accidents and measures subsequently developed to avoid

them should be specified. An approach of what the hazards are and are not associated with nuclear waste would be helpful in assessing the strengths and weaknesses of specific repository sites such as Yucca Mountain.

The requirements for operations workers including transportation workers are inadequate for assessing necessary health and safety standards. Effects of handling nuclear waste as regards health under non-accident conditions deserve consideration. Implications for associates of repository workers if decontamination standards are not upheld should be indicated. Both long and short-term hazards should be considered and implications drawn. For example, is there a maximum exposure and thus an implicit maximum work term associated with various repository occupations?

SPECIFIC COMMENTS

Page 2-1

Reference is made to the attractiveness of the Nevada Test Site (NTS) and contiguous area due to land use, namely DoE control of NTS and the fact that some of the land was already contaminated with radioactive material. While it is understandable that land use considerations might be a natural starting point in the search for a suitable repository site, the guidelines established by DoE in 1982 for determining the existence of suitable site alternatives require rigorous investigations of geological and hydrological conditions. (A host-rock approach). By applying land use considerations first in designating repository alternatives, the appearance is given that scientifically based procedures for site selection, namely, geological, hydrological, as well as other important site selection criteria are applied merely to justify a site preferred due to land use considerations. Moreover, repository site selection screening which formally should begin with nation-to-region and then to area appears to have been short circuited by the process described in the EA which begins with area-to-location screening evaluation. Presumably some consideration was given to geophysical, hyrdrological, and population in the initial selection of the 9 candidate sites. The rationale should be indicated.

Page 2-3

Reference is made that irrigation is practiced where ground water is shallow enough to be tapped by wells. A discussion is needed on the existence and condition of deep aquifers in southern Nevada and their potential for augmenting existing domestic and irrigation resources.

Page 2-5

It is stated that ground water in the southern Great Basin generally flows through major aquifers. A discussion is needed on the potential for minor aquifers in the area of study indicating the likelihood of finding such minor aquifers and the possible character of such aquifers including linkages to other water sources if found during site exploration or development based on experience in similar locations.

Page 2-12

According to the EA the U.S. Geological Survey proposed that the NTS be considered for a number of geotechnical reasons including the existence of long flow paths between potential repository locations and ground water discharge points. Taken at face value this statement calls into question the very ability to contain the stored waste over the period of risk of contamination to the accessible environment. A full discussion is needed on the danger of loss of containment, decay rates of various radioactive materials, potential hazards to human health at various stages of decay, the amount and rate of movement of radioactive material into the accessible environment under assumed conditions of containment loss, and the potential damage from such release of hazardous material into the environment.

Page 2-15

It is stated that the National Academy of Sciences Committee for Radioactive Waste Management was solicited for its views on the potential advantages and disadvantages of tuff as a repository host rock and that the concept of investigating tuff as a potential host rock was supported. Details of the declaration of the Committee's views supporting this conclusion including any substantive information should be provided.

Page 2-17

A formal system for confirmation of site selection is described based upon area-to-location evaluation criteria. The system utilizes a rating system which compares physical attributes of the alternative locations against weighted performance objectives that reflect ideal or desired site conditions. A fairly broad range of objectives is considered. The performance objectives are prioritized into a three-tiered arrangement indicating the importance of each objective for site selection confirmation.

The formal site selection evaluation method described in the EA is oriented to a system-wide rather than to the area-to-location nuclear waste repository site screening process which is actually applied. As such, there are conceptual problems in the evaluation of suitable alternative sites in southern Nevada. The primary difficulties associated with applying the screening method from area-to-location include the necessity to satisfy a large number of objectives, some of which refer to system-wide considerations, simultaneously within a narrow site specific focus, to assign appropriate weights to the individual objectives, and, finally, to assign appropriate weights to the physical attributes of the site alternatives evaluated. The numerous performance objectives considered by the screening process in the EA encompass four main areas of concern: isolation, containment, operations, and environment. All of the objectives are considered within a common framework with the focus of analysis on sub-area or location specific concerns. It is not surprising, therefore, that the results of the screening evaluation emphasize the importance of isolation and containment performance objectives over operations objectives such as transportation and environment objectives such as socioeconomic impacts. The weights given to the operations and environment classes of performance objectives by the EA study reflect this emphasis, i.e., they are assigned low weights. Clearly the isolation and containment objectives must be viewed as critically important in the process of evaluating alternative site locations. Indeed, they are of such importance that they might appropriately be considered separately from the other performance objectives. The inclusion of the other performance objectives within a common framework emphasizing a narrowly defined set of location specific factors has the result of diminishing or neutralizing the importance of them. For example, defined along the lines of a narrow location specific performance objective, transportation concerns are limited to configuation of terrain and distance. Such concerns have fairly low significance within the context of a comparison of alternative locations from within a limited geographical area. Viewed from broader perspective, however, transportation of high level nuclear waste is a major issue. Modes of transportation, assignment of routes, operation and control of shipments, accident risk, environmental damage of accidental release of radioactive substances during transportation, cost of cleanup resulting from accidental release of nuclear material, population exposure, and et cetera are issues of paramount concern. Performance objectives oriented toward these issues must be evaluated independently, though not without consideration, of specific location site alternatives. Failure to do so results in an assignment of relatively low weight to such objectives as evidenced in the EA study. A similar arguement can be made for the treatment of socio-economic performance objectives in area-to-location alternative site screening. Socio-economic issues associated with nuclear waste repository siting cover a broad range of concerns, including regional economic effects, such as changes of income, employment, and population; fiscal effects on state and local governments; effects on the safety and health of nearby populations; life style effects; psychological effects and so on. The breadth of these issues makes it difficult for them to be evaluated in the context of a narrow framework of analysis. A pertinant example is the safety and health of populations at risk along the transportation network between source of generation to site of disposal. Performance objectives relating to this issue must be evaluated within a broader context than provided by location specific alternative site screening. The transportation Appendix similarly emphasizes containment (packaging) and insurance but not hazards or security.

Pages 2-27 and 2-28

According to the EA the relative importance weights given to perfomance objectives are based on a poll of technical experts.

Detail on the survey and questionnaire or other medium used to elicit the response values should be provided.

Pages 2-30 and 2-31

According to the EA weights were assigned to the various physical attributes used to evaluate alternative locations. Detail should be provided on the methods applied to calculate the relative importance weights.

Page 2-49

The synopsis relating to the disqualifying conditions associated with potential environmental impacts states that no unacceptable adverse environmental impacts have been identified in the affected area or are expected. This statement appears to prejudge a definitive assessment of environmental consequences which would be determined, if necessary, during or following site characterization study.

Page 2-55

The EA indicates as part of a disclaimer on disqualifying conditions set out by the NWPA of 1982 that the State of Nevada has an existing emergency preparedness plan covering radiological emergencies. While the existence of the plan is factual, it is questionable whether the plan provides an effective procedure for handling a significant uncontrolled release of radioactive material in the event of an actual radiological emergency, especially one resulting from an accident during transport. Details of the procedures for dealing with emergent situations contained in the Nevada plan should be provided. For example, who responds if a disaster occurs in some rural Nevada county? In addition, information should be provided on actual circumstances when the plan was activated, if available, and on tests or exercises involving implementation of plan procedures under simulated emergencies. Finally, are those in charge of operations during an emergency properly informed and trained?

Page 2-57

The EA indicates as part of a discussion on water consumption that based on current information water supply is unlikely to be significantly impacted in Nye County as the project-related population during the maximum average year increase is estimated at only 5.4 percent. Based on the assumptions and analysis applied in the EA study, this growth rate appears to be conservative. In any event, a population growth rate of 5.4 pecent per annum in an area of small population size is substantial and may cause significant impacts to local community infrastructure including water system capacity. Specific information should be supplied on the existence of potable and other water system capacity, use, and need in the Nye County area.

Page 3-14

Reference is made in the EA that surface displacements at Pahute Mesa and Yucca Flat north of Yucca Mountain and along a trend between the Las Vegas Valley shear zone and the Walker Lane shear zone have been triggered by nuclear explosions suggesting that some residual structural deformation may still be occuring along this zone. More detail should be provided on the history of changes to structural features and the potential implications of such changes in the geological integrity of the area with particular reference to establishing a nuclear waste repository.

Page 3-19 through 3-22

The discussion in the EA on seismicity indicates that Yucca Mountain lies in an area of relatively low historical seismicity. It is noted, however, that relatively high magnitude earthquakes have occurred in recent history in southern Nevada. It is also noted that the maximum expected magnitude earthquake of the nearest area (Owens Valley, California, a distance of 95 miles) with a potentially active fault is estimated at 6.8 on the Richter scale. This would result in an estimated maximum acceleration at Yucca Mountain of 0.4g, a level of acceleration, it is claimed, that nuclear facilities can survive using current engineering practices. Finally, it is noted that low seismic activity may actually indicate unreleased strain, thereby dictating caution in concluding that large earthquakes are unlikely.

The information provided (as paraphrased above) is somewhat contradictory and indefinite with respect to the possibility of earthquake hazard in the Yucca Mountain area. First, low historical seismicity in the immediate area of Yucca Mountain appears irrefutable. However, the information is incomplete as to whether this gives sufficient grounds for assuming that large magnitude earthquakes will not occur. Second, the maximum possible acceleration resulting from an earthquake at the nearest known active surface fault is estimated to be quite high, possibly at the upper end of the scale that current engineering for nuclear facilities is capable of handling. There is no reference, however, to engineering for deep underground buried high level radioactive waste repositories. A more complete base of information on potential seismicity and accordingly necessary engineering techniques is needed.

Page 3-28

The EA indicates the existence of various types of aquifers in the Yucca Mountain area. Some useful information is provided on ground water movement. However, information is lacking on aquifer size, recharge rates, and potential for production.

Page 3-31

The EA states that water use during repository siting, construction, operation, and decommissioning is expected to cause only a very localized drawdown of the regional water table. This assertion appears to be inconsistent with information provided on current ground water use. For example the EA indicates that the principal users of ground water in the area of concern are in the Amargosa Desert south of the town of Amargosa Valley and in the Pahrump Valley. The latter, it is stated, uses about 58 million cubic meters (47 thousand acre feet) per year, presumably for agricultural production primarily. Because of a declining water table, the State Engineer stopped granting ground-water permits for irrigation in the Pahrump Artesian Basin in 1970. Similarly, the EA states that a well field developed for irrigation in the Ash Meadows area along the east side of Amargosa Desert caused a substantial reduction in the water level in the pool in nearby Devils Hole, thereby threatening the survival of the Devils Hole pupfish. These examples suggest that a measurable increase in water use associated with repository development might cause a significant drawdown of the regional water table. It is necessary to better establish intra-regional ground water supply patterns than is possible with the limited information provided.

Pages 3-32 through 3-35

The EA mentions land use by type of use but does not indicate the existence of State and local land use regulations. Information is required on a variety of State and local land use regulations and practices governing such matters as incorporation, annexation, environmental protection, platting, zoning, flood plain control, transportation and other infrastructure planning, construction design, and so forth.

Page 3-36

The EA notes that future subdivisions are planned in Ash Meadow and Pahrump Valley. Information is needed on the timing and size (number of housing units) of the developments, the types of development, i.e., recreational or permanent year-round occupied units, and the source of market demand.

Page 3-56

The EA discussion of transportation references the existing and projected transportation network in the vicinity of the proposed site. No discussion is presented in the text (broad reference is made, however, in Chapter 7 and in the transportation Appendix) on systemwide transportation conditions associated with moving high-level radioactive waste material from point of generation to repository. The omission of discussion on systemwide transportation conditions is serious because the impacts of alternative repository site selection are related to the physical, economic, and institutional attributes of the transportation system supporting the waste disposal plan.

Page 3-60

The EA provides traffic volume data and levels of service on U.S. I-95 from Los Vegas to Beatty. (A crude route map is also shown.) It is noted that congestion exists on certain streets and intersections in Los Vegas, however, no detailed information indicating street/intersection locations, ADT and DHV traffic, and levels of service or physical characteristics such as signalization, barrier improvements, and the like is provided. Plans for routing of highway transport of nuclear waste which will likely occur at those locations, given development of a repository at Yucca Mountain, are necessary.

Pages 3-60 and 3-62

The EA provides some information on railroad infrastructure and current use in the vicinity of the proposed repository site. Much additional information is required on railroad operations management; federal, state, and local regulation over rail transportation; railline routes between point of nuclear waste generation; cost of rail transport of nuclear waste including disaster insurance; and potential accident risks along transportation network associated with rail transport. More crudely, are there existing arrangements with rail companies and, if so, how do they work? Are there any Problems?

Page 3-63

The EA indicates correctly that Nye County and Clark County will be impacted if a repository were located at Yucca Mountain. Because rail access would involve potential impacts on Lincoln County that Nevada county should also be included in the area-to-location analysis. Road access may require similar expansion.

Page 3-63

The EA indicates the level of employed workers in the private and public sectors in Nye County. In 1982 the number indicated stood at 7,508. Additional information should be provided indicating if the employment figures refer to employment by residence or workplace and if they refer to total employment including propietors and the uniformed military.

Page 3-65

The EA provides information on projected employment growth in Nye County based on the OBERS forecast of the U.S. Department of Commerce, Bureau of Economic Analysis. The projected growth is substantial, more than doubling employment in all categories between 1978 and 2000. Detailed information is needed to assess the validity and accuracy of the employment (and related population) forecasts. Based on the information provided, service sector employment is expected to increase the fastest among the sectors identified. In an area such as Nye County in which gaming and other tourist oriented activities are not major components of the local economy, it would be unusual for the services sector to lead employment growth over other sectors. An explanation for the projected rapid growth in all categories as well as in the service sector is necessary. There are good reasons for understanding the character and direction of employment changes in Nye County. For example, income and population changes are related to changes in employment. Together, changes in those variables influence, among other things, the demand for housing, the need for local government services and facilities, local government revenues, and so on. To understand the social and economic consequences of establishing a repository in Nye County requires in-depth knowledge of local economic baseline conditions.

The information base on local employment conditions contained in the EA excludes details on gross labor force participation rates; labor force participation rates of married women; levels of employment and unemployment and industrial composition of both; age/sex distribution of persons in employable age groups and proportion of population under 16 and above 64; per capita personal income and personal income components, such as proportion of income derived from non-wage sources; wages by sector; and similar information which would be helpful for understanding demographic and economic conditions in Nye County. In addition, information is needed on certain institutional facets of employment conditions, including whether Nevada is a "right to work" state, levels of union representation, union rules regarding registration and hiring, union versus non-union wage scales and travel allowances, and so on.

Page 3-66

The EA indicates that a substantial (87 percent) portion of employees working at the NTS and Nellis AFB commute from Clark County. Information is needed on average commute distance, modes of travel during commuting, and average hours per day required for commutation. Commuting information is also needed on other (non-federal related) employment (the 1980 U.S. Census Journey to Work file may be a useful source).

Page 3-66

The EA states that some agricultural employment exists in Nye County. Additional detail is needed on historical employment in the agricultural sector.

Page 3-66

The information provided in the EA on background social and economic conditions in Clark County suffers from a lack of detail and analytical depth. Similar information requirements as noted in the comments on the social and economic conditions relative to Nye County are necessary for an understanding of conditions in Clark County.

Page 3-68 and 3-69

The EA indicates that Nye County population growth since 1980 has increased at a phenomenally rapid rate (17 percent per annum between 1980 and 1985). Population growth projections through 1990 shown in the EA suggest a continuation of this trend, albeit at a somewhat reduced level. A thorough discussion of the reasons for this recent growth and projections of future growth is necessary.

Page 3-70

The EA indicates that Nye County had a housing vacancy rate of 17.9 percent in 1980. Given the rapid rate of population growth between 1980 and 1985, it is likely that this high rate has evaporated. Recent housing vacancy information should be provided. Reasons for the apparent "bust" conditions in Nye County in 1980 should be given.

Page 3-70 through Page 3-73

The EA provides information on education, which indicates, among other things, the number of public schools by grade levels and per 1000 residents for Nye County and Clark County. Because of differences in school structure size, presenting the number of schools per 1000 residents is not a useful basis for comparison of capacity. Detailed capacity information should be provided indicating classroom space, special education space, common areas, and any unmet needs. In addition, information should be provided on space per pupil standards, if any, or construction design conventions for particular classes of schools.

Page 3-74 through 3-76

The EA presents information on water supply capacity and use in Nye and Clark Counties with respect to major water systems. For Nye County the information on water supply capacity suggests shortness of source water in most areas, with agricultural uses being transferred to domestic. Most of the existing available capacity is indicated to be in the Amargosa and Pahrump valleys south of the proposed repository site. With respect to Amargosa nothing is indicated about capacity or use. Water capacity in Pahrump valley is shown to be in an overdraft condition. However, with the continued transfer of agricultural rights to water to domestic as a result of purchases by residential real estate developers it is hypothesized that there may be adequate water to support a substantial population (as many as 19,700). Suffice it to say, that water supply appears to be short, based on the limited information contained in the EA, despite a projection of rapid population growth through the year 2000. This suggests a need for new sources and the possibility of conflict over use of existing water sources from normal demands versus repository needs, assuming it is established. A much more in-depth evaluation of water capacity by source and location and use by demand segment in Nye County is required to evaluated potential repository siting effects. In addition, information is required on water treatment and distribution systems, existing and planned.

Page 3-76

Information is provided in the EA on sewage treatment in Nye and Clark Counties. As noted, most treatment is provided by private septic systems in Nye County. Information should be provided on waste water disposal regulations or planning guidelines for Nye County.

Page 3-77

Information is provided in the EA on solid waste for Nye and Clark Counties, indicating the existence of landfills. Additional information should be provided on capacity and number of years remaining in expected landfill life; materials accepted at landfill; and method of disposing hazardous waste materials.

Page 3-77 and 3-80

The energy utility information provided in the EA does not give details on suppliers, capacity, and use in Nye County. This missing information plus information on generation, transmission, distribution, and service facilities and capacity should be provided.

Page 3-79

The discussion on public safety services in the EA indicates number of personnel in the Nye County Sheriff's Office. Additional information is needed on station capacity, jail facilities, including person/day capacity and number of jail personnel (and whether they are distinct from sheriff's personnel), and number of marked and unmarked cars with appropriated replacement cycles. Communication and dispatch services should also be discussed.

Page 3-79

The discussion on public safety services in the EA provides details on fire protection. The information provided indicates numbers of fire departments, stations, and personnel (volunteer and paid). Additional information is required on fire ratings, condition of stations and equipment, replacement cycles for such installations and equipment, number of incidents responded to and average response time. If emergency medical services are provided by the fire departments, similar detailed information should be provided. Similarly, if an emergency information service (such as 911) is available, information on its functions should be provided.

Page 3-80

The EA indicates availability of medical services in Nye and Clark Counties. As noted, services in Nye are thin. Information should be provided on the existence of special trauma or burn treatment facilities and plans for handling cases involving radioactive exposure by medical facilities in the two-county area. In addition to the information on number of licensed beds by class for each facility in the two counties, information should be provided on bed use and need (using appropriate need/capacity factors for establishing the latter planning factor).

Page 3-83

Under social conditions the EA notes that communities that could be affected along transportation routes are not discussed because the routes and therefore the communities have not been identified. While this may be true in a strict legalistic sense, considerable effort has gone into evaluating alternative transportation modes and general routes of travel along the "waste funnel" from points of waste generation to the alternative repository sites. As such, failure to consider transportation effects on communities generically or using a simulation approachis a major shortcoming. Indeed, this failure is part of a broader criticism which can be made concerning the EA in which important system-wide considerations are excluded in the evaluation of repository siting effects.

Page 3-88

Despite the acknowlegement given the Indian tribes by Congress in drafting the NWPA of 1982, woefully little information is provided on them in the EA. Mere reference is given to the existence of two tribal reservations in Nye and Clark Counties. Detailed information should be provided on tribal history in the context of southern Nevada and likely tribal interest in connection with the area being considered for a repository. Also, information should be provided on tribal social and economic conditions and on public services and facilities on the reservation lands.

Pages 3-90 through 3-92

The EA provides limited information on fiscal and government structure relative to Nye and Clark Counties. The fiscal information is limited to revenue by source for school districts and by funding category for the two counties and some selected cities. It serves the purpose primarily of indicating the proportion of revenue support by major source. Two interesting items emerge from the presentation: 1) the state covers more than half of school operating costs and 2) property taxes dont account for much of total operating revenues for the two counties and selected cities. No information is provided on the property tax base or levy structure, however. Nor is there information on bonding capacity and the amount of debt outstanding for major jurisdictions in the study area. These are useful indicators for assessing fiscal capacity. Information is also lacking on expenditures both for operations and capital. For example, school funding needs to meet demands from normal growth as well as from establishment of a repository require consideration of capital sources, including state/federal program support. Similarly, major capital projects such as road construction and repair involve considerations of capital finance. The NWPA of 1982 provides for in lieu tax funding, impact mitigation, and potentially compensation to offset the adverse effects of repository siting and development. It is clear that a broad base of information is required on the fiscal conditions of potentially affected jurisdictions in order to adequately assess financial impacts. The information on baseline conditions is unfortunately inadequate even as a starting point for this purpose.

Page 4-7

A general description of the exploratory shaft facility is provided as introductory material in the EA. Additional information should be provided on the length of time required to construct the facility.

Page 4-18

One of the possible dispositions of the exploratory shaft assuming that Yucca Mountain is found to be unsuitable for a geologic repository is to preserve it for other use. A discussion of potential alternative uses should be provided.

Page 4-23

The EA states that hydrologic exploratory boreholes will be drilled so that the water table can be mapped during site characterization. The locations of the boreholes should be identified.

Page 4-24

The EA states that there are no predicted land use impacts associated with site characterization because Yucca Mountain is located entirely on federally controlled lands. While land use effects per se are not likely, information should be provided on whether compliance with pertinent state and local regulations governing land use and building construction will be accorded.

Page 4-29

The EA provides an equipment list relative to site characterization acitivities. Unfortunately, there is no explanation of how the equipment is moved to the site, stored, used, and removed.

Page 4-30

The EA considers road transportation effects only for U.S. 95. This seems too limited.

Page 4-31

The EA provided information on direct economic effects consists of information on direct manpower required onsite and offsite during particular periods of site characterization activies and on material requirements. Additional information is needed on calendar time phasing for site characterization work, costs associated with construction and testing, and incomes earned by site characterization workers. In addition information should be provided on amenities including housing accommodations for direct workers at the site, if any. Similarly, project provided transportation for commuting direct workers, if any, should be indicated. Finally, information should be provided on the skill/wage mix of direct workers and likely union representation.

The information provided on direct, indirect, and total employment in the EA is described in terms of aggregate effects on both Nye and Clark Counties. A disaggregated approach would enable a more meaningful understanding of potential employment and other socio-economic effects. Obviously, a small increase of employment, say 277 workers (the most likely net increase associated with site characterization as estimated by the EA), would represent an insignificant change for a large urban county such as Clark. This does not follow, however, for a small rural county such as Nye.

The EA states that approximately 60 percent of the estimated direct jobs created during site characterization would be filled by existing workers employed on DOE activities related to the NNWSI Project. Without information on the skill/wage mix of NNWSI workers as well as that required for site characterization work this assumption can not be verified. Detailed information indicating those relationships should be provided.

The EA references an employment multiplier of 1.54 for calculation of indirect and total project-related employment. Information is required on the source of the multiplier; the methods of analysis used to obtain it, e.g., input-output, economic base, econometric, etc.; its applicability to construction workers versus operations workers; and its locational specificity, i.e., whether it describes employment changes in urban versus rural locations. In addition, the multiplier should be described sufficiently to allow the interested reader to know whether it takes into account induced effects associated with project procurements as well as indirect effects associated with the spending of direct project employees. Sectoral detail would also be helpful.

<u>Page 4-32</u>

The EA presents information on total population change associated with site characterization activities in the two county area. Again, as in the case of employment information, disaggregation to single county areas would be preferable for understanding socio-economic effects. The dependency factors applied in the EA for direct and indirect worker categories need supporting documentation. While dependency factors for onsite workers who are employed temporarily at a remote location are likely to be low, such is not necessarily the case for offsite workers who are likely to exhibit demographic characteristics similar to the average for the area or region.

<u>Page 4-32</u>

The EA states that community services are not likely to be significantly impacted by site characterization. The basis for this conclusion is that population increases associated with the project are expected to be small. Disaggregation to county service areas and below, as noted above, may show a contradictory result. A small population change in Nye County would possibly have a significant impact on certain services, especially schools if capacity is short. Other local government services that are likely to be impacted include police protection associated with increased traffic control responsibilities, emergency medical services, and planning/monitoring. These services are likely to be impacted whether there is a significant increase in population or not.

Page 4-33

The EA provides a list of construction materials for site characterization acitivities. It states that they are to be procured locally, but there is no analysis of how they will be hauled, stored, and used. There is also no analysis of road damage attributable to heavy loads. There is no discussion of safety effécts of hauling fuel and explosives. These concerns should be addressed.

Page 4-34

The EA notes that a potentially significant effect of recommending Yucca Mountain for site characterization acitivies is the increase in state and local participation in planning activities. It further indicates that the fiscal implications of state participation is recognized by the NWPA of 1982 and that a mechanism for financial assistance is provided. Unfortunately, no recognition is given to local government participation in planning. Furthermore, financial assistance provided under the Act is directed to the state along with responsibility and control over subsequent allocations to local jurisdictions.

The failure to give prominant recognition to local host jurisdictions in terms of project plan review, implemenation planning, and mitigation is a serious shortcoming of the Act. Participation at the local level is a necessary component if repository siting is to take place in a spirit of intergovernmental cooperation, reflect an equitable distribution of costs and benefits, and achieve acceptance by the populace potentially most effected by the nuclear waste repository program.

Page 4-35

The emphasis of the EA on site characterization activities in connection with transportation is on increased traffic on U.S. Highway 95. For construction traffic especially, information should be provided on other potentially impacted routes, especially for heavy hauls of concrete, aggregate, sand, asphalt, etc.

Page 4-35

With respect to worker safety during site characterization activities the EA notes that approximately 14 injuries are expected during the facility construction and operation period of 55 months. Additional information is needed on safety procedures that will be implemented.

Page 5-5 through 5-8

The EA provides a general description of surface facilities indicating the types of facilities required. Detailed information would be useful on size of structures, method of construction, and cost.

Page 5-9

Reference is made in the EA to two alternative excavation techniques: drill-blast-mucking and continuous miner. The advantages and disadvantages of each should be noted, particularly in connection with excavating welded tuff.

Also, information should be provided indicating the existence of comparable deep mining projects in order to provide a relative measure of the size and scope of the proposed repository.

Page 5-12

The EA presents information on a new access road and rail spur. However, there is no discussion of heavy hauls, safety, and the construction process.

Page 5-13

The EA notes that labor requirements and costs differ depending on whether vertical emplacement or horizontal emplacement is used. Information should be provided describing the advantages and disadvantages associated with each type of emplacement technique.

Pages 5-14 through 5-20

The EA presents considerable planning information on materials and equipment requirements for most elements of the proposed repository. The requirements are substantial. In terms of socio-economic assessment this information provides a basis for: evaluating the size, scope, and cost of the proposed project; assessing transportation impacts, especially heavy haul truck damage to roads; determining the level of induced economic activity in the local and regional economies; and assessing the potential revenue benefits from the sale and use of construction equipment and material to state and local governments. Additonal information is needed regarding the amount of material and equipment by type with appropriate time frames for their use for all aspects of construction and operation of the proposed repository. In addition, information is required on the sources of supply for all material and equipment required and on prices expressed in relevant year constant dollars.

Page 5-20 through Page 5-24

The EA presents a discussion on nuclear waste receipt. It is unclear from the discussion whether the design is for peak or average. The safety problem for vehicles/packages waiting for receipt/containment is not discussed. It is unclear how vehicles/packages are decontaminated before release.

Page 5-21

The EA indicates a 30/70 percent split in favor of rail transportation of radioactive waste material. Information should be presented supporting this assumption. Recent studies on nuclear waste transportation issues ("Social and Economic Aspects of Radioactive Waste Disposal", National Research Council, National Academy Press, 1984 and "The Proposed Waste Isolation Pilot Project (WIPP) and Impacts in the State of New Mexico: A Socio-Economic Analysis", New Mexico Energy Research and Development Program, Santa Fe, April 1981.) associated with repository siting point to potential problems with reliance on railroads. A major problem is reluctance on the part of rail carriers to undertake the burden of high level radioactive nuclear waste transportation. Their concerns involve bottlenecks and breakdowns in management of the rail system which ultimately influence security. As one example, rail cars can be routinely "lost" over a period of days. Another related concern is accident risk. Railroads are known to have favorable experience ratings relative to cargo with respect to accident frequency. However, accident severity with conditions inimical to nuclear waste cask survivability is a serious problem. As a result rail carriers are concerned about insurance liability. Concerns also exist about rail travel speed, cost, and regulation by states.

Page 5-34

The EA notes that locating a repository at Yucca Mountain is expected to have minimal impact on the geologic environment. Moreover, heat and radiation, which would be introduced into the host rocks by decay of radioactive material, would not affect the rock isolation capability, competence or structural stability according to the EA. Detailed information on ambient temperatures and heat generation during isolation of radioactive nuclear waste material should be provided.

Page 5-35

The EA indicates that the regional effects of withdrawing ground water associated with repository development are expected to be minimal. Approximately 400 acre feet per year of ground water is expected to be withdrawn to serve the needs of direct repository workers. Secondary effects of water requirements for workers who locate in the vicinity of the repository site will occur also. Moreover, water will be required for industrial uses such as dust control. Thus, the total water requirements associated with establishing a repository are likely to be larger than indicated by the EA. Given the evidence of water shortages in the immediate vicinity of the repository site, as indicated in the discussion on baseline conditions, the conclusion that water resource impacts are likely to be minimal appears to be premature.

Page 5-36

The EA indicates that land use impacts would be non-existent because the repository would be located entirely on federally controlled property. Other land use considerations exist, however, including secondary development involving establishment of housing and commercial improvements offsite in the vicinity of Yucca Mountain as well as state and local regulations involving the protection of safety, health, and welfare of potentially impacted residents and of the environment. The EA should address those land use concerns.

Page 5-60

The EA presents information on accidental exposure during operation in the vicinity of the proposed repository site. The information is difficult to assess, particularly with respect to probability of occurence. The method of probability assessment should be described fully, i.e., whether it is based on empirically based statistical analysis or fault tree analysis. Moreover, information should be provided on the cost of evacuation and cleanup under various accidental exposure conditions.

Page 5-62

The EA states that effects on highway infrastructure would be limited to those associated with increased traffic only. Other effects on highway infrastructure include need for engineering design for geometric improvements, signalization, barriers, etc required to improve traffic flow and safety at key intersections affected by development of the repository (since the expected increase in traffic from trucks and commuters will probably make such improvements necessary) and road damage associated with heavy truck hauls. Those effects should be given consideration.

Page 5-63

The EA assumes a high level of commutation for construction and operations workers associated with the proposed repository. The basis for that assumption is residential location and commuter patterns of existing workers at the Mercury test facility. It should be noted that Mercury is considerably closer to the urbanized area of Clark County than the site of the proposed repository. Even then travel time amounts to approximately 3 hours per day (round trip basis) using mass transit provided by the DOE. Travel times for commuting would likely increase by 2 hours per day for a total of 5 hours for the repository project. The substantial commuting time involved suggests that a greater proportion of repository workers will prefer establishing residence in the vicinity of place of work than that for Mercury. More study needs to be done on this issue as the residential patterns of the direct work force impact other important social and economic conditions.

Page 5-65

The EA indicates amounts of expected traffic from truck and commuter vehicle trips and corresponding levels of service changes on particular road segments. The information refers to direct project activity only. Trips associated with induced and indirect travel as well as non-commuting travel associated with in-migrating direct worker households are not discussed. On the basis of the information evaluated, the EA projects only 14 repository related accidents per year. This appears to be low. Experience at other locations where large construction and operation effects have been measured, such as the Trident Submarine Base at Bangor, Washington, has shown a large increase in traffic accidents and need for police and EMS services related to those accident increases. Additional work on this issue appears warranted.

Page 5-68

The EA provides information on expected traffic growth during operation of the proposed facility. An increase of eight accidents during operations is expected according to the EA. It is well known that accidents increase with congestion, high speed, bad weather, high truck mix, and 2-lane roads without separation or limitations to access. Additional work on this issue appears warranted.

Page 5-71

The EA notes that rail use during operations is expected to be considerable. The comments referenced to Page 5-21 apply here as well.

Page 5-71

The EA references routing of nuclear waste to the Federal Register. The discussion should summarize routing considerations, including route segments, special way side areas, safety procedures, and federal/state/local regulations.

Page 5-75

The EA notes that if accidents involving either train or truck transport occur, experimental evidence suggests that the consequences would not be great. A summary of that evidence should be provided. It is known that accident severity is important in assessing risks of release of hazardous materials. For a variety of reasons train car accidents are likely to be severe, involving extended periods of uncontrolled exposure hazards, such as fire. These types of hazards may be inimical to waste cask survival and thus represent a threat to significant public exposure. A thorough analysis of train transport giving consideration to probability of severity of accident as well as to incidence is necessary.

Accident rates are usually compared as a function of vehicle miles traveled. It is not so clear how to compare trucks versus rail, but raw total accidents per year is probably inconclusive. There is a need to study types of accident by transportation mode and risk factors to affected populations.

Page 5-75

The EA notes driver/handler exposure from radioactive materials during transportation, however, it does not provide explicit discussion with relevant measures of exposure and health risk.

Page 5-80

The EA presents some information on items which figure in the calculation of costs of radioactive waste transportation. Missing is a discussion on insurance, including Price-Anderson criteria, and a discussion on costs of emergency response along the network of the waste disposal "funnel". Moreover, there is no discussion on the potential cost associated with uncontrolled release of radioactive materials into the accessible environment during transportation. Such costs which include evacuation, cleanup, and compensation for damage can be enormous depending upon the amount of radiation released, size of populated area, and exposure. In a study of the WIPP in New Mexico (Op. Cit.) an accident where relatively modest amounts of short-lived radioactive materials are released in an area of about 300,000 population, costs for clean-up could be on the order of $5 - $10 million. For accidents involving larger increases the consequences could involve land denial and costs in the order of $50 - $150 million in smaller urban areas with, say, 25,000 population and $100 - $300 million in areas with about 300,000 population. Another area of special concern for transportation safety is the geographical nature of major routes. Both train and truck routes in the West follow major river systems which serve the water needs of large agricultural and domestic users. Information should be evaluated on accident experience and route design for route segments following those river systems.

Page 5-83

The EA discusses emergency preparedness, indicating that it has been the traditional responsibility of state and local government to respond to transportation accidents; the role of the federal government in the event of civilian radioactive waste transportation accidents is usually one of supporting the state's lead role. The State of Nevada Health Division is accorded primary responsibility in the event of a radiological emergency as stated in the EA. Detailed information is needed on the State's emergency capability in terms of management on the scene, including decision authority over evacuation, resources, training, and agreements with local governments and medical institutions. This area of concern is as complex as it is important. The viewpoint suggested by the EA that an emergency capability is in place and is adequate to handle both minor and major radiological emergencies must be validated.

Page 5-85 through Page 5-90

The EA provides some detailed information on labor requirements associated with construction and operation of the proposed waste repository at Yucca Mountain. Initial year of construction direct employment (vertical emplacement) is estimated at 1,221. Peak direct employment is 3,348, occuring in year 4 of the construction phase. Operations phase direct employment, during years 6 - 35, is estimated at 2,313. During the retrievability phase, years 36 - 55, direct employment declines to an estimated 594, and finally, during the last phase, decommissioning, years 56 - 60, direct employment again rises to an estimated 1,548. Corresponding levels of indirect employment by project phase and year are also presented in the EA. The EA notes that not all direct employment is included

Employment information on proposed large-scale projects almost always must be considered as preliminary and subject to revision. Typically, in the case of prototypical or unique industrial or military projects estimates of employment tend to understate actual direct employment effects. Underestimation results from failure to anticipate various aspects of project design and scope, a desire to present conservative cost figures to managers or policy makers who have decision authority over project development, and unforeseen technical, institutional, labor market, and price changes, etc. In rare instances one hears about a project that actually required less labor than indicated in planning estimates. A case in point is construction of the Trident Submarine Base at Bangor, Washington. Prefabrication of construction components lowered the amount of construction site labor required to complete the base. The Trans-Alaskan Pipeline System (TAPS) is an example of severe underestimation in the planning figures. Peak employment was estimated at under 10,000 by the TAPS EIS. Actual peak employment was more than double that figure.

Assessing the validity of planning figures on direct employment involves a double edged sword for policy planning. To view the figures presented as representing an overestimate designed to enhance the appearance of economic benefit on the part of the proponent agency, on the one hand, runs the risk of failing to account for the effects of an underestimate on the host local communities, on the other. Concentration on an overestimate is appropriate in order to force a sense of reality and probity on the policy discussions concerning economic benefits. It seems, however, that the greater risk for policy making is the failure to perceive the possibility of underestimation with the outcome that project impacts on local governments may be understated.

The best way to avoid errors of overestimation or underestimation of project employment is to acquire a complete understanding of project design, construction methods, and costs. This usually requires more specific detail than available in figures developed from preliminary design. Information should at the minimum be provided on the methods used to estimate direct project employment for the EA. In addition, information on actual construction and operation of similar systems or components of the systems proposed should be provided in order to give a basis of comparison of the estimation methods used and values obtained in generating employment estimates.

The EA as mentioned presents information on indirect employment as well as direct employment. Details are needed on methods used to generate the employment multiplier (1.54) employed to estimate indirect employment.

Other facets of employment effects need to be spelled out or analyzed by the EA such as the process of labor market clearing and residential preference. Information is required on skill/wage mix, unemployment, union representation and rules, wage supplements for commuting, availability of project provided housing, commute times and cost, availability of market housing and community services and amenities, and so on, in order to evaluate the shares of local and non-local (including commuters) employment associated with the project.

Page 5-87

Materials requirements are listed by the EA. Comments have been provided on this subject in reference to the discussion contained on Pages 14 through 20 of the EA.

The EA presents preliminary cost figures for constructing and operating the proposed repository. The same comment regarding validity of employment figures can be made here. Details of the methods used to estimate costs should be provided.

Page 5-87 and Page 5-88

The EA presents information on wage income of direct and indirect workers. The information presented is based upon fairly low assumptions of average annual wages, particularly for construction and operations workers. Information should be provided on wage rates for construction and operation worker by skill mix based on union scale (Davis-Bacon rules require payment of prevailing union wages on federal projects).

Page 5-88

As in the case of the discussion on baseline conditions and site characterization activities, the EA fails to consider land use effects outside of the federal purview. Effects associated with secondary development offsite and state/local regulations governing health, safety, and welfare as well as environmental issues should be evaluated.

Page 5-92

The EA presents figures on population change and distribution associated with establishing the proposed repository. The figures presented are based upon assumptions concerning the relationship between direct and total employment, commutation patterns and labor force market clearing, and dependency, all of which have been reviewed and commented on previously. Perhaps the most critical assumption for assessing the location specific impacts of the repository project in terms of population is that of commutation. Reliance on the proportions indicated by the Mercury data is questionable. Given the longer commute times involved in the repository case, it is likely that a larger proportion of workers employed at the Yucca Mountain site would choose to locate their residences in the immediate vicinity. More research is needed on this issue.

Page 5-92 through Page 5-99

The EA provides an assessment of public services requirements for the Counties of Nye and Clark. Incremental service requirements are indicated during the various phases of the repository for a variety of services. The approach used is based on extrapolation of service unit to population ratios obtained from an examination of baseline conditions. Existing service levels are assumed.

Aside from the population forecasts which underly the projections of incremental service needs and about which comments have been made previously, the approach used is fairly simplistic as it fails to consider service capacity, scale effects of population change, marginal demand, and other institutional effects, such as the jurisdicational bounds of particular service providers. The schools analysis is especially crude as space requirements are not tied to capacity need, pupil change, or design standards. There are as well many services that are omitted which properly belong to an analysis of service impacts. Among those which deserve special consideration are criminal justice, transportation, planning, and social services.

Page 5-99

The EA provides only qualitative information on housing effects. Information should be provided on the type and tenure and price of housing preferred by construction workers and other workers who inmigrate to the area as a consequence of establishing a geologic repository.

Page 5-101

The water supply effects described in the EA appear to understate the potential impacts of establishing a repository given the information on baseline conditions which points to short supply currently and the potential for acute shortage in the future. More research is necessary for a better understanding of water resource conditions and potential impacts of the proposed repository.

Page 5-102

The discussion of public safety services in the EA should be expanded to address the types of personnel, equipment, training, and procedures required to respond to radiological emergencies. The cost of these items should estimated as well.

The EA rather loosely assumes that fire and police services demands imposed by the project will be accommodated by normal expansion of plans that are commensurate with growth. Detailed information is required on location and size of stations, impacts.

Information is also presented on the provisions of the NWPA of 1982 regarding federal financial assistance. Unfortunately the Act targets the states and Indian tribes as participants and recipients of assistance only. Local governments are not accorded such consideration for some reason. This represents a major oversight of siting policy as the local host communities are likely to be impacted the most by a siting decision. Remedy of this situation could be achieved presumably by the adoption of appropriate procedures in the context of a Consultation and Cooperation Agreement which is to be negotiated with the states selected for site characterization.

The EA notes that the Act requires that the federal government make payments in lieu of real property taxes to state and local governments in the affected area. Clarification of the procedures for measuring and transfering in lieu payments would be useful.

Page 6-11

In reference to the evaluation and conclusion for the qualifying condition on the postclosure site ownership and control guideline, the EA does not note the possible difficulty of acquiring superior water rights over water resources outside the point(s) of extraction on the NTS (which is under DOE control) should this become necessary due to heavy drawdown of ground water resources due to development of a geologic repository.

Page 6-40

In reference to the presence of other nuclear installations and operations, the EA notes that the pertinent regulations (40 CFR Part 190 and Part 191) do not apply to the nuclear weapons testing at NTS.

The reason for this should be discussed.

Page 6-76 through 6-79

In reference to the potential for significant repository-related impacts on community services, housing supply and demand, and the finances of state and local government agencies in the affected area the EA indicates that the area is expected to aborb population changes without significant effects on community services or housing and that government revenues are projected to increase.

This conclusion appears unwarranted. The analysis of community impacts presented in the EA must be viewed as preliminary and subject to revision. The methods used in assessing impacts on services are in most cases crude and involve aggregated analyses, necessitating considerable refinement. Fiscal impacts on communities are evaluated only qualitatively by the EA. As a result, a definitive conclusion on the potential impacts of repository development at Yucca Mountain is not feasible.

Page 6-83 through 6-85

In reference to the potential for the project to significantly degrade the quality, or significantly reduce the quantity, of water from major sources of offsite supplies the EA states that the population related requirements of the repository are small.

This may be true for the site itself, however, other industrial requirements, including dust control, apparently are not included in the calculation of average annual water demand associated with the facility. Nor are secondary requirements of domestic use by project-related inmigrants included in the calculation. Including those demand factors would raise total water requirements considerably. Moreover, as noted in the EA, water supply is short in the vicinity of Yucca Mountain presently and is expected to worsen for the two-county area of Nye and Clark in the future. These factors would suggest that, on the contrary, there is a potential for the project to significantly impact offsite water supplies.

Page 6-88

In reference to adequacy of regional highways the EA states that repository-related transportation requirements will not be superimposed on the local transportation infrastructure and therefore no upgrading or reconstruction will be required.

The information presented in Chapter 5 of the EA indicates that level of service will be degraded on some segments of U.S. Highway 95 as a result of the project. Upgrading may therefore be necessary. The EA does not indicate possible damage to roadways because of heavy truck hauls. This also may result in the need for significant road improvements.

Page 6-88

In reference to capability and willingness of regional carriers to ship nuclear waste materials the EA states that there is no reason to believe carriers that are capable and willing will not be available to ship waste.

The willingness of certain carriers is questionable. Reference has been made to the concerns of railroad industry management over safety and security risk, liability, and cost.

Page 6-89

In reference to plans, procedures, and capabilities for response to radioactive waste transportation accidents the EA states that DOE and the State of Nevada have plans, procedures, and capabilities for responding to radioactive emergencies associated with transporting nuclear waste.

The details of the plans and procedures noted by the EA have not been summarized. It is likely that such plans would have to be augmented considerably at great cost. According the a study on the WIPP repository in New Mexico (Op.Cit.), the cost of developing detailed plans, providing equipment and manpower, and training of state and local personnel who might be required to respond to emergencies would be on the order of $16 million over a 30 year period.

Appendix A

The discussion emphasizes the high reliance on packaging (containers for waste) and on insurance. There is inadequate discussion of the transport process itself. Private insurance covers up to $160 million and presumably is included in shipping costs. Excess of $440 million ($5million per waste generator of which there are 88 civilian indicated) is included as assessments under the law to provide compensation to victims who suffer loss.

There would be considerable benefit from a historical discussion of nuclear accidents, how they happened, severity, and costs.

Lincoln County

and

The City of Caliente

COMMENTS TO THE DEPARTMENT OF ENERGY'S DRAFT ENVIRONMENTAL ASSESSMENT: YUCCA MOUNTAIN SITE, NEVADA RESEARCH AND DEVELOPMENT AREA, NEVADA

SUBMITTED BY:

COUNTY/CITY JOINT COMMITTEE ON IMPACT ALLEVIATION
ON BEHALF OF LINCOLN COUNTY AND
THE CITY OF CALIENTE, NEVADA

March 8, 1985

GENERAL COMMENTS

Lincoln County and the City of Caliente are concerned about possible adverse impacts which may accrue to the area as a result of siting a high level nuclear waste repository at Yucca Mountain. Because the mainline Union Pacific Railroad crosses through Lincoln County and bisects the City of Caliente, these local government entities are concerned that shipments of high level nuclear waste to the Nevada Test Site will result in possible environmental, social, and economic impacts to the County and City.

In general, Lincoln County and the City of Caliente are greatly dismayed that DOE's Draft Environmental Assessment fails to address possible impacts to Lincoln County and the City of Caliente. Working in close cooperation with the Nevada Nuclear Waste Project Office and the U.S. Department of Energy, Lincoln County, and the City of Caliente through their Joint Committee on Impact Alleviation have, during the past 12 months, been active participants in the repository planning program underway by DOE. This participation has included attendance at numerous state and federal briefings, preparation of comments to DOE's Draft Civilian Waste Management Mission Plan, Defense High Level Nuclear Waste Disposal Plan, and Transportation Business Plan among others. The committee, typically represented by its technical consultants, have participated in numerous local government coordination meetings sponsored by the Nevada Nuclear Waste Project Office and attended by DOE and DOE contractor representatives. In October of 1984, Mr. Don Veith, Project Manager for the Nevada Waste Storage Terminal Investigation Project, traveled with members of Science Applications International Corporation to Lincoln County to meet with County Commissioners and Caliente City Councilmen to discuss County and City repository related issues. The DOE representatives were provided with a written and graphic overview of impact issues for the Lincoln County/City of Caliente area. A tour of several areas of concern also occured in an effort to portray possible impacts of shipping high level nuclear wastes through the County to the DOE team. It was made very clear to DOE that the County and City desired that consideration to their issues be given in preparation of the draft EA. During the past 12 months, it has been the perception of the County and City that the Department of Energy recognized Lincoln County and the City of Caliente as areas with valid concerns over possible repository related impacts and that these areas would be at least recognized in the draft EA.

Section 112, Subpart (E)(vi), of the Nuclear Waste Policy Act requires that an assessment of the regional and local impacts of locating the proposed repository at the Nevada Test Site be done. The law does not indicate that only a portion of the impacts be considered. By neglecting to include Lincoln County and the City of Caliente in the analysis, DOE may be in violation of the law. Is DOE implying there will be no impacts to these areas? If so, the following may serve to enlighten DOE to possible effects to Lincoln County and/or the City of Caliente:

1) A small percentage of project related work force, if located in Lincoln County, could have significant impacts on local socioeconomic conditions. For example, Table 5-29 of the draft EA indicates that 0.6 percent of all Nevada Test Site employees typically have located in Alamo, a small farming community in Lincoln County. The methodology in the EA suggests that 0.6 percent of the repository related work force could locate in the Lincoln County community of Alamo. Should this occur, in excess of 150 new persons could desire to locate at Alamo during peak repository employment. Based upon 1980 census figures, 150 new persons would represent a 13 percent increase in Alamo population.

   This compares to approximately 2.9 percent growth rates under similar impact conditions to Nye and Clark Counties. The significant increase in Lincoln County population could severely strain local community services. Given the significance of possible Lincoln County growth effects, why were not these impacts considered in the EA?

2. A major concern to Lincoln County and the City of Caliente is the health risk associated with continuous shipments of high level nuclear waste through Lincoln County and the City of Caliente. As defined in Chapter 5 of the draft EA, the maximally exposed individual is defined as a person who is standing about 100 feet from the railline and exposed to all shipments passing at a speed of approximately 15 miles per hour.

   Within the State of Nevada, the City of Caliente and many of the businesses located immediately adajacent to the Union Pacific Railline may represent the only areas where the maximally exposed individual assumption will be met. In fact, the City of Caliente Municipal Complex is located within 60 feet of the Union Pacific mainline. Yet, despite this situation nowhere in the draft EA is the analysis of possible health risk through radiological exposure to persons in the City of Caliente and Lincoln County presented.

3. Section 5.3.2.1 of the draft EA, concerning radiological effects of nuclear waste transportation, suggests that the greatest contributing factor to radiological exposure under normal operating conditions is associated with transport vehicle stops, particularly those in populated areas. The analysis of health risks contained within the draft EA is based upon a computer model which is specified using a series

of unit risk factors which are based upon nationally aggregated data. In reviewing the transportation appendix to the draft EA, it is clear that the assumptions under which the RADTRAN II risk model is run do not come near to representing the real world conditions which exist in Lincoln County and the City of Caliente. For example, the RADTRAN II model as specified in the transportation appendix assumes that train speeds in rural areas are greater than in urban areas.

Because of the extreme physiographic characteristics which characterize the rail corridor through Lincoln County, rail operating speeds are significantly lower than those assumed in risk analyses contained within the EA. Consequently, it is possible that radiological exposure risks in the City of Caliente are greatly different than those predicted in the RADTRAN II model used in the draft EA. Many assumptions included in the RADTRAN II methodology appear to be misstated when one considers Lincoln County and the City of Caliente. In addition to train speed, stop rates appear far greater in the Lincoln County/City of Caliente area than those assumed in EA risk analyses.

4. As is true for many parts of the nation, Lincoln County and the City of Caliente have, during the past few years, embarked upon an ambitious economic development program. That program has included an inventory of natural, human, and public infrastructure resources which could support economic development activities in Lincoln County/City of Caliente. Presently, a destination resort is being developed in the Rainbow Canyon area immediately south of the City of Caliente. The mainline Union Pacific runs through the resort complex. As public awareness over possible frequent shipments of high level nuclear waste through the City of Caliente and through the Rainbow Canyon Resort become more known, it is possible that private investments in the resort complex may begin to diminish. It is possible that others considering investing in the County and City may be concerned about real or perceived health risks associated with shipments of high level nuclear waste through the area.

In Chapter 6 of the draft EA, DOE, in evaluating various socioeconomic siting guideline criteria, admits that later studies of socioeconomic studies will be done covering a broader geographical area than just Nye and Clark Counties. Presumably, Lincoln County and the City of Caliente would be included in this broader geographical area. Yet, despite the fact that DOE has admittedly not assessed the full range of socioeconomic impacts, Chapter 6 concludes, in several places, that all socioeconomic impacts are mitigable. How can DOE assert that all socioeconomic impacts are mitigable when all socioeconomic impacts have not been identified? Many of DOE's conclusions in Chapter 6 that Yucca Mountain is suitable for site characterization are not founded on the basis of sufficient analyses.

Clearly, Lincoln County and the City of Caliente are recognized by the Nevada Nuclear Waste Project Office as affected local governments with respect to the siting of a high level nuclear waste repository in Nevada. Clearly, the U.S. Department of Energy recognizes the validity of Lincoln County and City of Caliente issues concerning possible impacts as portrayed in their willingness to travel to the area and to discuss impact issues. Clearly, it has been an oversight on the part of the DOE and its subcontractors to ignore these impact issues in the preparation of the draft EA.

Lincoln County, the City of Caliente, and their Joint Committee on Impact Alleviation, respectfully, request that DOE fully consider potential impacts to Lincoln County and the City of Caliente in preparation of the final EA.

In addition, the County and the City request that the public comment period on the draft EA be extended. Such an extension is required to allow a sufficient review of the draft EA's for all five candidate sites, as is necessary to adequately assess DOE's ranking of sites in Chapter 7 of the EA. Because all five sites are concluded to be suitable for site characterization, the ranking process is particularly important. The EA on Yucca Mountain does not contain sufficient information on any of the other four sites so as to allow one to concur first with the conclusion that all five sites are suited for characterization or second, that they should be ranked as they are in Chapter 7.

Given that the EA on Yucca Mountain is in excess of 1,000 pages, one would have to review at least 10 pages per day during the course of the 90 day review period to get through the document. In order to review EA's from the other four sites, as is neessary to adequately consider the rankings presented in Chapter 7, one might have to review almost 40 pages of text per day. Clearly, this is not possible, and clearly DOE has not provided sufficient time for public review of its EA's. A minimum 90 day extension should be provided.

Further, it is requested that DOE meet with County and City prior to publication of a comment response document and the final EA to discuss DOE proposed responses to written comments on the draft EA.

SPECIFIC COMMENTS

Page 5-36

5.2.3

Paragraph two indicates that approximately 50,000 acres, in addition to NTS, will be withdrawn. This is in contrast with Figure 2 which depicts the site encompassing approximately 27,000, acres of which approximately 6,000 would be BLM lands. Does the EA consider impacts to 50,000 or 6,000 acres of withdrawal? A revised Figure 2 depicting entire site is needed.

Page 3-1

Figure 3-1

First paragraph - indicates site is shown on Figure 3-1. Same comment as above.

Page 3-1

First paragraph - indicates that this section describes the "existing environment of Yucca Mountain and the surrounding region including areas that may be affected . . . by possible future development as a repository."

Because of rail transportation, Lincoln County and the City of Caliente may be affected, yet the existing socioeconomic environment for Lincoln County is not included in text (see page 3-63).

Page 3-63

Figure 3-21

The figure is titled "Bicounty area surrounding the Yucca Mountain site". The figure actually depicts three counties: Nye, Clark, and Lincoln, yet Lincoln County is not recognized. Title of figure should be changed to read Tricounty area surrounding . . . ."

Page 3-4

Fourth full paragraph - text does not discuss possible competing land uses on proposed withdrawal lands for rail corridor purposes.

Page 3-60

Section 3.5.2

Indicates that the Union Pacific line passing through Las Vegas is classified as a Class A mainline which meets at least one of three tests. The text does not indicate which of the three tests the Union Pacific line meets. Does the line meet all three tests? If not, which one does it meet?

Page 3-63

Section 3.6 Socioeconomic Conditions

First paragraph - indicates that this section describes existing and expected future baseline social and economic conditions in the region surrounding the Yucca Mountain Site.

Although Figure 3-21 depicts Lincoln County as an area surrounding the Yucca Mountain site, it is not included in this section's discussion of baseline socioeconomic conditions. This is despite the fact that if wastes are shipped by rail to the site from the east, they will be shipped through Lincoln County.

Page 3-62

Second paragraph - indicates that "because of its centralized traffic control system, good maintenance, and frequent sidings, the Salt Lake City to Barstow section of the Union Pacific line should be at the high end of this range" (referring to 25-54 trains daily as determined in WESTPO, 1981). This is a judgemental statement not supported by specific study. A specific evaluation of the Union Pacific line through Nevada is needed before any firm conclusion on line capacity can be drawn. This is particularly necessary as certain sections of the line through Nevada may be shown to require capital improvements in order to bring the entire line up to a sufficiently high traffic capacity, as necessary to service shipments of nuclear waste to NTS.

Page 3-83	Section 3.6.4 Social Conditions

The text states that because transportation routes have not been selected, communities that could be affected by transportation have not yet been identified and consequently, impacts on their social condition not evaluated.

The ommission appears to be in contrast to the transportation impact analysis included in Chapter 5 of the draft EA. In Chapter 5, two scenarios of transportation are evaluated. Those include 100 percent truck and 100 percent rail shipments. The draft EA should include an analysis of the effects of both rail and truck transportation in at least Lincoln, Clark, and Nye Counties. The range of routing alternatives is very narrow, consequently, an impact analysis of transportation effects on social conditions should be included within the scope of this draft EA. Why was not an analysis of transportation effects on social conditions in Caliente included in the draft EA? All rail shipments of nuclear waste from the east coast will necessarily pass through Caliente.

Page 4-2

Fourth paragraph - indicates that the data gathering activities planned for the site characterization program are described in Section 4.1. Page 4-1 (4th paragraph) suggests that the data gathering program planned for site characterization will include nongeologic information. Despite this, a detailed description of data collection plans is only provided for geologic information gathering in Section 4.1. The draft EA needs to be modified to include a detailed description of the scope of data gathering and analysis process to be used to meet all nongeologic information needs described on Page 4-1.

Page 4-34	Section 4.2.2.6 This section fails to address shipments of construction materials to southern Nevada, by rail, during site characterization. Without an assessment of added rail shipments, it is not possible to evaluate potential noise, traffic, and other effects to the Lincoln County/Clark County area. In the same way that rail transportation impacts during repository construction and operation are assessed (Chapter 5), it is suggested that rail transportation impacts during site characterization be evaluated.
Chapter 4	Will site characterization studies and the Environmental Impact Statement include an evaluation of possible impacts to Lincoln County and the City of Caliente? Why were not predecision impacts (i.e., negative public perception) included in the EA? The EA should indicate the answer to these questions in Chapter 4.
Page 5-1	First paragraph - indicates that the evaluation of the regional and local effects of a proposed repository at Yucca Mountain is based upon limited information about the social and economic conditions in the area that might be affected by a repository. Is it possible that Lincoln County and the City of Caliente might be impacted by the construction of a repository operation at Yucca Mountain? If so, why is not an analysis of these possible impacts to Lincoln County and the City of Caliente included in this draft EA? Such an analysis should be included in the Final EA.

Page 5-17 through 19

Tables 5-6 through 5-8

To the extent possible, raw and manufactured materials required for repository, road, and railroad construction should be derived from Nevada sources. For example, limestone could be obtained from the Casleton area of Lincoln County and shipped by rail to the construction area. The EA should discuss possible sources of construction materials and the impacts, both positive and negative, of obtaining materials from alternate sources.

Page 5-71

5.3.1.2 Railroad Impacts

This section states that during the first two years rail use would be zero during construction of rail spur. This section fails to address added rail traffic resulting from shipments of construction materials for the rail spur, road, and repository construction programs. Table 5-7 suggests that 90 to 100 trains annually (at 60 cars each) would be required to ship in highway and rail construction materials. What effect will this added traffic have on rail condition, rail traffic, accident rates, noise, and air quality within those Nevada counties and communities through which the railline passes?

Page 5-71

5.3.1.2 Railroad Impacts

The first part of this section deals with the spur, but then the analysis discusses impacts to mainline Union Pacific. If one considers an increase of one 60-car train every 2.5 days (based upon 90 to 100 trains required to move construction materials during year one and two and 250 operating days per year), this represents a significantly greater increase in traffic than 0.2 percent. Impacts of year one and two rail traffic on railline capacity should be estimated and presented in the final EA.

Page 5-71

5.3.2 Transportation of Nuclear Wastes

This section fails to describe existing local, state, or federal regulations concerning the transport of nuclear waste by rail. What regulations concerning rail transport of nuclear waste will apply to the project? Is there a lack of appropriate regulations currently?

Pages 5-45 and 5-46

The text and Table 5-19 indicate that commuter traffic over the 35 year life of the project will add 27,075 metric tons of carbon monoxide into the air. Because the Las Vegas Basin is cosidered to have a non-attainment status with respect to air quality standards, the EA should indicate specific impacts of added particulates to the Las Vegas Basin. Why was not an alternate route through Lincoln County and Area 51 of the NTS considered as a means to reduce particulate emission impacts to Las Vegas?

Page 5-73

Because of penetrating radiation, which the text indicates is emitted from casks, exposure to persons within 100 feet of train shipments through the City of Caliente will be very frequent. This is particulary true since trains move very slow and/or often stop in the downtown area.

The final EA should address various alternatives which may exist for minimizing radiological exposure associated with rail shipments through Caliente. The final EA should consider minimizing stops through operational guidelines and track upgrading, as well as relocating the tracks out of the populous areas.

Page 5-75	First paragraph - states that the greatest radiological risk from exposure is during stops. Given the rail transportation system proposed by DOE, the population of the City of Caliente will experience the greatest risk of exposure of all Nevada communities. An evaluation of the risk to the population in Caliente and ways to minimize such risks should be included in the final EA.
Page A-16	Section A.8.2 The text indicates that the maximally exposed individual is assumed to be standing in the open within 100 feet of all shipments. To what extent is exposure risk lowered when a person is indoors? To what extent is exposure risk increased when a person is closer than 100 feet? The EA should provide some sensitivity analyses?
Page A-18	Section A.8.4 First paragraph - Specifically, what similarities and uniformities were identified to allow "simplifying assumptions" to be made? What are the specific values of these similarities and uniformities and from what data sources were they derived? Second paragraph - A definition of the population density per kilometer specified for each population zone utilized in the analysis should be provided. The use of population contours derived from 1980 census data is not appropriate. Application of this method may greatly underestimate exposure risk in isolated cities such as Caliente. Without

having benefit of seeing the population contours used in the analysis, it is assumed that Caliente was considered to be rural. As a result, assumed train speeds through Caliente are greatly overstated and radiological exposure risk understated, in relative magnitude. Because Chapter 5 included route specific analyses of exposure risk (Tables 5-38 and 5-39), the analyses should have incorporated actual route population, accident rate history, and stop time data. The EA tends to vacilate in reasoning. Chapter 3 states that because site specific routes are not yet known, they are not analyzed. Chapter 5 analyzes site specific routes, yet does not use site specific data. Very little data would have been required to very accurately portray the various route alternates described in Tables 5-38 and 5-39. The final EA should include a revised analysis of dose levels depicted in Table 5-40 by using actual route population, accident rate histories, stop time, and shipment speed data for route scenarios deptícted in Tables 5-38 and 5-39.

Pages 5-75 and 5-76

On Page 5-75, the text indicates that assessments were performed to characterize radiological impacts that may be incurred within the State of Nevada. This level of analysis is referred to as a regional characterization of impacts, yet on Page 5-76 the text indicates that the RADTRAN II risk analysis method is not well suited for region-specifc analyses. The reason for this appears to be that the RADTRAN II model is based upon nationally aggregated data, not characteristic of Southern Nevada.

Despite this, DOE uses the mis-specified RADTRAN II model to estimate region-specific impact analyses depicted in Tables 5-38, 5-39, and 5-40. Why was not region-specific data utilized in conducting the region-specific analyses?

Page 5-76

Third paragraph - text indicates that results of regional impact assessments (which are actually several very specific routes within Southern Nevada) indicate the following: (1) the differences in assumed routing do not substantialy affect the resultant doses, and (2) the magnitude of the total population dose (1,500 to 5,500 man-rem) for each scenario is low compared with the dose that would be received from natural background sources.

With regard to DOE's finding that the differences in assumed routing do not substantially affect the resultant doses, is it not possible that the reason no significant difference is found is because the only variable in the model was distance shipped with all other variables being held constant in accordance with the nationally aggregated specifications of population zones, vehicle/train speed, stop times, and accident rates? What would happen if each of these factors were specified to reflect route specific conditions and the model rerun?

With regard to the magnitude of the total population dose for each scenario being low compared with the dose that would be received from natural background sources, the issue is not absolute exposure rates (i.e., 1,500 to 5,500 man-rems) but the fact that one route may result in 1,500 man-rem impact versus an alternate at 5,500 man-rem, which represents a 350 percent plus increase in relative exposure risk. Alternate routes do have very significant differences in their relative magnitude of exposure risk. An evaluation of these differences in relative magnitude of risk by routes evaluated in Tables 5-38 and 5-39 should be included in the final EA.

Page 5-81

First paragraph - the federal government has committed to spending approximately fifty million dollars to upgrade and maintain transportation infrastructure in New Mexico associated with the WIPP site. Does DOE assume that there will be no cost for existing highway/railline upgrading and/or construction of new rail or highway in the calculation of transportation costs in this draft EA? If upgrade or new construction costs for transportation infrastructure will be incurred, what are the costs?

The final EA should address the relationship of stop time to transportation corridor factors such as flooding, rock slides, etc. This is particularly true for the Union Pacific line through Lincoln County where flooding and rock slides continuously hamper efficient rail operations, thereby increasing stop time or reducing train speeds. Both factors contribute to increased risk of radiological exposure. What would be the cost necessary to upgrade the railline corridor through Lincoln County to reduce the threat of flood damage or rock slide closures?

Page 5-83

Section 5.3.2.4 Emergency Response

Chapter 5 is a discussion of regional and local effects of locating a repository at the Yucca Mountain site. Section 5.3.2.4 provides a very cursory overview of certain state and federal emergency response capabilities. No detailed evaluation of repository related local, state, or federal emergency response needs compared to current abilities is offered. The final EA should evaluate local capabilities as first responders, available equipment, and available trained personnel. In addition, an evaluation of state and federal equipment and personnel available to respond to a HLW related need should be provided.

A detailed evaluation of required local, state, and federal HLW related emergency response capabilities should be prepared. Such an analysis should consider equipment needs, appropriate response times, trained personnel needs, etc.

A comparison of emergency response capability requirements against current resources would suggest a possible magnitude of repository related impact. Why was not an analysis of this nature included in the draft EA?

Page 5-85

First paragraph - indicates that in 1993, the bicounty area will experience significant increases in demand for mine workers, construction workers, and other skilled workers. It is quite possible that the job opportunities at Yucca Mountain will drain employees from the labor supplies which characterize neighboring counties, creating a net out migration and decline in local economies. How and where have these possible impacts been addressed in the EA? This could be particularly damaging to Lincoln County, which has been historicaly dependent upon its mining sector.

Has any consideration been given to providing access to Yucca Mountain through the northeast side of the test site, which would allow more repository and other test site related workers to reside in Lincoln County? What effect would the Yucca Mountain projects demand for mining related workers have on the viability of Nevada's traditional mining industry?

Page 5-91

Section 5.4.1.6 Tourism

Because Lincoln County has the greatest concentration of state parks of any county in Nevada and because Lincoln County is in many respects a playground for residents of Clark County, it is probable that state parks within Lincoln County will experience repository work force related increased usage. To what extent may these increases occur?

Also, what effect, if any, will shipments of nuclear waste, by rail, have on tourism in the City of Caliente and at Kershaw Ryan State Park and the Rainbow Canyon Resort, all located south of Caliente in the vicinity of the mainline Union Pacific?

Page 5-92

Sections 5.4.2 and 5.4.3

These sections suggest that population increases in sparsely settled areas will likely result in relatively more significant impacts than population increases in urban areas.

Page 5-108	Section 5.4.5
	Second paragraph - indicates that at the onset of construction in 1993, a influx of workers from outside the area would increase demand for community services. In contast to this section, the text on Page 5-86 suggests that immigrating workers might move into the area before the project construction begins. This early immigration may strain community services prior to local government abilities to provide additional infrastructure.
Page 5-110	First paragraph - Lincoln County should be noted as a rural community having potentially signficant impacts.
Page 5-110	Section 5.5
	Last paragraph - a sixth item should be added to the end of the paragraph to read "the effect of the project upon social and economic conditions in other Nevada counties not specifically addressed within this EA.
Chapters 6 and 7	The conclusions reached by DOE in these chapters are based upon analyses which the EA admits to be incomplete and inconclusive. On what real basis can DOE substantiate its conclusions with incomplete analyses?
Page 6-67	Fourth paragraph - why is only the rail spur from the Union Pacific line considered a support facility? If rail transportation is used across the nation, is not the entire railline a support facility? If so, this analysis in Chapter 6 potentially leaves out many significant state or regional protected resource areas. On what basis does DOE define the support facility to be limited as far as rail is concerned to the new spur line?
	This comment could apply to many of the evaluations of adverse environmental impacts included in Chapter 6.

Page 6-72	Conclusion for Disqualifying Condition 1

The Nuclear Waste Policy Act provides that the State of Nevada become the affected area under which repository siting activities are being evaluated. How then, when DOE has only assessed impacts to Clark and Nye Counties, can a conclusion be reached that all impacts within the affected area are mitigable?

Page 6-74	Section 6.2.1.7.2

The text indicates that preliminary studies indicate that the socioeconomic effects predicted for the two counties (Nye and Clark) are indicative of the nature and extent of the total social and economic impact (referring to an undefined "larger geographic area"). What preliminary studies were conducted in Lincoln County and the City of Caliente? Where are the references to these? The City of Caliente is the only community in the area whose downtown is split by the Union Pacific mainline. How does this and other uniquely rural or rail transportation safety/ health risk factors compare to Nye and Clark County? Again, DOE is basing a conclusion on an admittedly incomplete analysis. How can DOE state that all impacts can be mitigated or compensated when they admit that they do not know what all of the impacts are?

Pages 6-93 and 6-94	(2) Proximity to local highways . . .

The condition would not appear to have anything to do with having to superimpose a new spur or access road improvement on existing rail or roadways. On what basis does DOE believe that superimposition is the issue?

Rather, it appears that the issue is the extent to which the existing local highway and rail system can be used without significant upgrading or reconstruction costs. Again, while DOE may spend fifty million dollars upgrading New Mexico's existing highway system associated with the WIPP project, why does DOE think no significant costs for upgrading existing highways or raillines will be required in Nevada? What about flooding and rock slide problems on the Union Pacific line in the Rainbow Canyon area of Lincoln County? Additional costs outside of Nevada for construction of safe harbors for vehicles or sidings for trains could add very significant costs.

Page 6-98

Conclusion

Third paragraph - where in the draft EA is an analysis of flood related problems along the Union Pacific railline in Rainbow Canyon of the Meadow Valley Wash included? Without such an analysis, how can DOE categorically conclude that transportation disruptions would not be routine seasonal occurences? What about winter snow road closure on Interstate 70 in the Rock Mountains? Is this not a possible route to Yucca Mountain? DOE has not, by any stroke of the imagination, performed enough analyses to come anywhere near to reaching the stated conclusion.

The second paragraph of this page indicates that flash flood risks will be reduced to acceptable levels through standard drainage control measures. Does this include mitigation of existing problems on existing highway and raillines to reduce health risks? If so, why are associated costs not included in Chapter 5?

Chapter 7

In order for the public to effectively evaluate the appropriateness of DOE's ranking of sites, the public must be afforded adequate time to review draft EA's for each of the potentially acceptable sites. Were EA's from each of the nine potentially acceptable sites widely available for public review in each state having a potentially acceptable site? Does DOE consider 90 days to be an acceptable length of time to allow interested members of the public to review five to nine EA's, each containing an estimated 600 to 1,000 pages?

The process used by DOE for ranking sites, as described in Chapter 7, is not appropriate from a public review and comprehendability standpoint. Detailed comparisons of baseline conditions and impacts between sites is needed.

Chapter 7

General Comment - what were the individual weights assigned by DOE to each of the ranking factors (i.e., transportation) utilized by DOE in the ranking process? In terms of both the Nuclear Waste Policy Act and 10 CFR, Part 960, what is the basis for the weighting used by DOE in its ranking process of Chapter 7? The final EA should include answers to these questions to allow readers to understand ranking weight priorities and basis.

City of Las Vegas

CITY of LAS VEGAS

March 21, 1985

Mr. Robert R. Loux, Director
Nuclear Waste Project Office
Office of the Governor
Capitol Complex
Carson City, Nevada 89710

Dear Mr. Loux:

Per your request, enclosed are the written comments prepared by the City of Las Vegas on the Department of Energy's Draft Environmental Assessment for Yucca Mountain Site, Nevada.

If the City can be of any further assistance, please contact my office (702-386-6551).

Sincerely,

Jack Thomason, Director
Dept. of Economic and Urban Development

JT:LLB:cmp

Attchment

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COMMENTS

ON

DEPARTMENT OF ENERGY'S

DRAFT ENVIRONMENTAL ASSESSMENT

YUCCA MOUNTAIN SITE

PREPARED BY

CITY OF LAS VEGAS

FOR

STATE OF NEVADA

NUCLEAR WASTE PROJECT OFFICE

Mayor
WILLIAM H. BRIARE

City Council
RON LURIE
AL LEVY
BOB NOLEN
W. WAYNE BUNKER

CITY MANAGER
Ashley Hall

DEPARTMENT OF ECONOMIC AND URBAN DEVELOPMENT
Jack Thomason, Director

March 22, 1985

GENERAL COMMENTS

THE DEPARTMENT OF ENERGY'S DRAFT ENVIRONMENTAL ASSESSMENT ON THE YUCCA MOUNTAIN SITE WAS WRITTEN TO PROVIDE THE JUSTIFICATION FOR YUCCA MOUNTAIN BEING CONSIDERED A "PREFERRED" LOCATION FOR THE NATION'S FIRST HIGH-LEVEL NUCLEAR WASTE REPOSITORY. HOWEVER, AFTER REVIEWING THE DOCUMENT, IT BECOMES OBVIOUS THAT THE DEPARTMENT OF ENERGY HAS FAILED TO ACCOMPLISH THIS GOAL.

THE MOST NOTABLE DEFICIENCY LIES IN THE AREA OF THE TRANSPORTATION OF HIGH-LEVEL NUCLEAR WASTE. THE CITY OF LAS VEGAS, BEING IN CLOSE PROXIMITY TO ALL MAJOR TRANSPORTATION NETWORKS HAS A VESTED INTEREST IN HOW THE DEPARTMENT OF ENERGY RESPONDS TO THE TRANSPORTATION ISSUE. UNFORTUNATELY, THE DEPARTMENT OF ENERGY CONSIDERS TRANSPORTATION TO BE A SECONDARY SUBJECT, AND NOT WORTHY OF THE COMPREHENSIVE STUDY DONE IN OTHER AREAS. FOR INSTANCE, THE RESEARCH AND CONCLUSIONS CONCERNING EMERGENCY RESPONSE AND LIABILITY IN THE SHIPPING OF HIGH-LEVEL NUCLEAR WASTE <u>MUST</u> BE GIVEN FAR GREATER ATTENTION IN THE FINAL ENVIRONMENTAL ASSESSMENT ON THE YUCCA MOUNTAIN SITE. FOR EXAMPLE, THE DRAFT ENVIRONMENTAL ASSESSMENT PROPOSED A TRANSPORTATION SCENARIO OF PROJECTED TRUCK SHIPMENTS THROUGH THE CITY OF NORTH LAS VEGAS, YET THE COST AND RISK ANALYSES ASSOCIATED WITH THE SHIPMENTS ARE COMPLETELY IGNORED. IN FACT, NORTH LAS VEGAS IS BARELY MENTIONED AT ALL IN THE ENVIRONMENTAL ASSESSMENT, DESPITE ITS CRITICAL ROLE IN THE TRANSPORTATION SCENARIOS. A SIMILAR EXAMPLE IS THE CITY OF CALIENTE IN LINCOLN COUNTY. PROJECTED RAIL SHIPMENT OF HIGH-LEVEL NUCLEAR WASTE WILL PASS RIGHT THROUGH CALIENTE, BUT LINCOLN COUNTY IS <u>NEVER</u> MENTIONED IN THE ENTIRE DOCUMENT. FURTHER EVIDENCE OF THE DRAFT ENVIRONMENT ASSESMENT'S LACKLUSTER ATTITUDE TOWARDS TRANSPORTATION, IS THE RADTRAN II MODEL OF RISK ANALYSES. WITH RADTRAN, NATIONAL AGGREGATE DATA IS USED FOR SITE SPECIFIC FINDINGS AND APPROACHES, WHICH IS TOTALLY UNACCEPTABLE.

A SECOND SIGNIFICANT FLAW IN THE DRAFT ENVIRONMENTAL ASSESSMENT IS THE QUALITY OF ASSUMPTIONS USED IN THE DOCUMENT. FOR INSTANCE, THE EMPLOYMENT MULTIPLIER USED FOR BOTH CLARK AND NYE COUNTIES TO STUDY POTENTIAL IMPACTS IS 1.54. HOWEVER, THE DEMOGRAPHICS OF THE TWO COUNTIES DIFFER GREATLY AND MUST BE RESEARCHED SEPARATELY TO ASSURE VIABLE CONCLUSIONS. ANOTHER EXAMPLE IS THE ASSUMPTION THAT THE PROPOSED REPOSITORY AT YUCCA MOUNTAIN WOULD ONLY IMPACT CLARK AND NYE COUNTIES, ALMOST TOTALLY IGNORING OTHER COUNTIES IN THE STATE THAT WILL IN FACT BE "AFFECTED" AREAS.

LIKEWISE, MANY "UNCERTAINTIES" CLOUD THE YUCCA MOUNTAIN DRAFT ENVIRONMENTAL ASSESSMENT. IN THE CHAPTER ON POTENTIAL SOCIO-ECONOMIC IMPACTS OF A REPOSITORY, FOR EXAMPLE, THE DRAFT ENVIRONMENTAL ASSESSMENT OFTEN FOUND THE NEED "FOR FURTHER STUDY." A CLEAR CASE OF THIS IS THE DRAFT ENVIRONMENTAL ASSESSMENT'S CONCLUSIONS CONCERNING THE POTENTIAL IMPACT OF A HIGH-LEVEL NUCLEAR WASTE REPOSITORY ON TOURISM. AT FIRST IT IS LISTED AS "NONE" AND THE REASONING IS THAT THE HISTORY OF NUCLEAR WEAPONS TESTING AT THE NEVADA TEST SITE APPARENTLY HAS HAD NO EFFECT ON TOURISM. THEN THE DRAFT ENVIRONMENTAL ASSESSMENT STATES "NEVERTHELESS, RESEARCH ON THE SUBJECT TO DATE IS INCONCLUSIVE AND WILL BE CONTINUED." BEFORE IT CAN BE TAKEN SERIOUSLY, THE ENVIRONMENTAL ASSESSMENT MUST ADDRESS THESE TYPES OF QUESTIONS IN A DETAILED AND COMPREHENSIVE WAY. FURTHERMORE, THE FACT THAT TOURISM IS THE FOUNDATION OF THE NEVADA ECONOMY DICTATES THAT THE DEPARTMENT OF ENERGY EXPAND ITS RESEARCH CONSIDERABLY ON TOURISM IN THE FINAL ENVIRONMENTAL ASSESSMENT.

IN CONCLUSION, AT STAKE HERE IS WHETHER THE DEPARTMENT OF ENERGY HAS WILLFULLY IGNORED CERTAIN SENSITIVE AREAS IN THEIR RESEARCH. THE DRAFT ENVIRONMENTAL

ASSESSMENT ON YUCCA MOUNTAIN SITE GIVES THE IMPRESSION THAT COMPREHENSIVE RESEARCH WAS DONE ONLY IN AREAS WHERE CONCLUSIONS WOULD BE FAVORABLE TO LOCATING A REPOSITORY IN NEVADA. AREAS OF CONCERN THAT MAY CAST DOUBT ON A POTENTIAL REPOSITORY SEEMED TO BE GLOSSED OVER WITH FINDINGS THAT ARE "SUBJECT TO FURTHER STUDY." THE DEPARTMENT OF ENERGY MUST REVISE ITS ATTITUDE TOWARD CERTAIN SUBJECTS, SUCH AS THE TRANSPORTATION ISSUE, AND PROVIDE THE "REAL JUSTIFICATION" AS TO WHY YUCCA MOUNTAIN WOULD BE A PREFERRED LOCATION FOR THE NATION'S FIRST HIGH-LEVEL NUCLEAR WASTE REPOSITORY. THE DEPARTMENT OF ENERGY MUST BE TOTALLY OBJECTIVE IN ITS EVALUATIONS OF YUCCA MOUNTAIN, VOID OF THE SUBJECTIVE AND QUESTIONABLE RESEARCH METHODOLOGY AND DATA THAT IS FOUND IN THEIR PRESENT DOCUMENT.

11:COMMENTS

SPECIFIC COMMENTS

CHAPTER 5, PAGE 11, 5.1.1.4 OTHER CONSTRUCTION

THE TRANSPORTATION INFRASTRUCTURE WITHIN SOUTHERN NEVADA NEEDS TO BE EXAMINED BY THE DEPARTMENT OF ENERGY FOR POSSIBLE UPGRADE AND IMPROVEMENT, ESPECIALLY WITH THE VAST NUMBER OF PROJECTED HIGH-LEVEL NUCLEAR WASTE SHIPMENTS THROUGH THE AREA.

CHAPTER 5, PAGE 72, 5.3.2 TRANSPORTATION OF NUCLEAR WASTE

"BASICALLY, THE OVERALL GOAL IS TO REDUCE RISK BY REDUCING THE AMOUNT OF TIME THE RADIOACTIVE MATERIAL IS IN TRANSIT." WITH THE MAJORITY OF NUCLEAR WASTE BEING PRODUCED IN THE EASTERN PORTION OF THE UNITED STATES, HOW CAN THE DEPARTMENT OF ENERGY JUSTIFY THEIR "OVERALL GOAL" BY SHIPPING HIGH-LEVEL NUCLEAR WASTE THOUSANDS OF MILES ACROSS THE COUNTRY?

CHAPTER 5, PAGE 76, 5.3.2.1 TRANSPORTATION OF NUCLEAR WASTE

"ALSO, THE RADTRAN II RISK ANALYSIS METHOD, UPON WHICH THESE REGIONAL IMPACTS ARE BASED, IS NOT WELL-SUITED FOR FINE-SCALE OR REGION-SPECIFIC ANALYSES." IT IS INAPPROPRIATE TO USE NATIONAL AGGREGATE DATA IN PREDICTING SITE-SPECIFIC RISK ANALYSES.

CHAPTER 5, PAGE 84, 5.4 EXPECTED EFFECTS ON SOCIO-ECONOMIC CONDITIONS

THE DEPARTMENT OF ENERGY STATES "ALL FACTORS THAT AFFECT SOCIO-ECONOMIC IMPACT ESTIMATES WOULD BE THE SUBJECT OF MORE DETAILED REVIEW." THIS IMPLIES THAT THE DRAFT ENVIRONMENTAL ASSESSMENT ON YUCCA MOUNTAIN WASN'T THE APPROPRIATE DOCUMENT FOR "ALL FACTORS" TO BE IDENTIFIED, WHICH MAKES NO SENSE.

CHAPTER 5, PAGE 91, 5.4.1.6 TOURISM

INITIALLY, THE DRAFT ENVIRONMENTAL ASSESSMENT STATES WITH REGARD TO TOURISM, THAT "RESEARCH TO DATE CONCERNING THE POTENTIAL EFFECT OF REPOSITORY OPERATION ON TOURISM IS INCONCLUSIVE: THEREFORE, FURTHER INVESTIGATION HAS BEEN PLANNED." FURTHER ON, THE DEPARTMENT OF ENERGY STATES "...THE PRESENCE OF NUCLEAR WASTE WEAPONS TESTING AT THE NEVADA TEST SITE DOES NOT APPEAR TO HAVE HAD A SIGNIFICANT EFFECT ON TOURISM AND THIS SUGGESTS THAT THE REPOSITORY WOULD NOT CHANGE THE TOTAL AESTHETIC APPEAL OF THE LAS VEGAS AREA." IF SUBJECTIVE ANALYSIS ("THIS SUGGESTS") IS TO BE INCLUDED IN AN ENVIRONMENTAL ASSESSMENT, THE DEPARTMENT OF ENERGY COULD AT LEAST DISTINGUISH BETWEEN CONTROLLED ISOLATED NUCLEAR WEAPONS TESTING AND THE THOUSANDS OF HIGH-LEVEL NUCLEAR WASTE SHIPMENTS THAT WILL BE PASSING THROUGH SOUTHERN NEVADA. THERE IS A REAL DIFFERENCE THAT SEEMS TO HAVE BEEN IGNORED IN FAVOR OF SOME UNNECESSARY REPOSITORY PROPAGANDA.

CHAPTER 6, PAGE 63, 6.2.1.6.2 ASSUMPTIONS AND DATA UNCERTAINTIES

"THE UNCERTAINTIES WILL BE MINIMIZED THROUGH ONGOING INVESTIGATIONS, WHOSE RESULTS WILL BE DESCRIBED IN AN ENVIRONMENTAL IMPACT STATEMENT IF YUCCA MOUNTAIN IS SELECTED AS A REPOSITORY SITE." WHAT DOES THE DEPARTMENT OF ENERGY MEAN BY ONGOING INVESTIGATIONS? ARE THESE INVESTIGATIONS ALSO GOING TO EVENTUALLY LEAD TO FINDINGS, "SUBJECT TO FURTHER STUDY?" IF SO, WHEN ARE THE REAL FINDINGS PROVIDED?

CHAPTER 6, PAGE 86, 6.2.1.8.1 TRANSPORTATION INTRODUCTION

(3)iv "...WITHOUT CAUSING UNACCEPTABLE RISK TO THE PUBLIC OR UNACCEPTABLE ENVIRONMENTAL IMPACTS..." THE TERM UNACCEPTABLE NEEDS TO BE DEFINED TO A GREATER DEGREE. AS IT STANDS NOW, THE DEPARTMENT OF ENERGY CAN USE "UNACCEPTABLE" TO MEAN WHATEVER IT WANTS.

CHAPTER 6, PAGE 88, TABLE 6-12 (2) DOE FINDINGS

THE DEPARTMENT OF ENERGY CONCLUDES THAT "TRANSPORTATION REQUIREMENTS WILL NOT BE SUPERIMPOSED ON THE LOCAL TRANSPORTATION INFRASTRUCTURE AND THEREFORE NO UPGRADING OR RECONSTRUCTION WILL BE REQUIRED." IT IS HIGHLY DEBATABLE THAT THE SOUTHERN NEVADA TRANSPORTATION INFRASTRUCTURE CAN ADEQUATELY HANDLE THE MASS NUMBERS OF RAIL/TRUCK SHIPMENTS TO A REPOSITORY. SITE-SPECIFIC RESEARCH (HOOVER DAM, CRAIG ROAD, BOULDER HIGHWAY) NEEDS TO BE DONE BEFORE SUCH A GENERAL STATEMENT CAN BE MADE CONCERNING THE ADEQUACY OF AN INFRASTRUCTURE.

NOTE: OVERALL, TRANSPORTATION ANALYSIS IS DIRECTED TO THE YUCCA MOUNTAIN AREA AND OFTEN FAILS TO INCLUDE ALL THE POTENTIALLY "AFFECTED" AREAS OUTSIDE THE IMMEDIATE REPOSITORY LOCATION.

11:SPECCOM

City of North Las Vegas

JAMES K. SEASTRAND
Mayor

MICHAEL DYAL
City Manager

Councilmen

THERON H. GOYNES
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RECEIVED
MAR 15 1985
NUCLEAR WASTE PROJECT OFFICE

March 13, 1985

Mr. Robert R. Loux, Director
Nuclear Waste Project Office
Office of the Governor
Capitol Complex
Carson City, Nevada 89710

Dear Sir:

Enclosed please find copies of general and specific comments relative to the review of the draft Environmental Assessment for the Yucca Mountain Site.

Please be advised that the enclosed comments should not be assumed to be all inclusive. Given the length of the Environmental Assessment document, the number of references and the manpower available for review, there may be concerns that have been unintentionally overlooked. The City would like to reserve the right to comment on pertinent issues in the future.

Should you have any questions, need additional information or clarification, please let me know.

Sincerely,

R. Jane Poulos

R. Jane Poulos, Director
Community Planning and Development

RJP/od
Enclosure

ENVIRONMENTAL ASSESSMENT _ YUCCA MOUNTAIN
GENERAL COMMENTS

THERE ARE AT LEAST FOUR MAJOR PROBLEMS WHICH PRESENT THEMSELVES IN THE ATTEMPT TO EVALUATE THE ENVIRONMENTAL ASSESSMENT FOR YUCCA MOUNTAIN: 1) an incomplete or inaccurate definition of basic terms 2) a mixture of demographic characterizations that is incomplete and insufficient 3) generalizations and inferences drawn from incomplete data, and 4) when definitions are made clear and it is stated that the purpose of this section will be to analyze a specific type of impact, then those issues are not directly or comprehensively addressed, that is, they say they're going to analyze an issue and then they do not.

1. INCOMPLETE OR INACCURATE DEFINITION OF BASIC TERMS

The primary and underlying problem in evaluating this draft environmental assessment is that a clear definition of terms is not provided. Definitions must mean the same thing to those who develop them, to those who use them and to those who challenge them. The glossary of terms at the end of the assessment is indicative of the general attitude toward "socioeconomic" characteristics. Trouble is taken to define such terms as 'risk, 'rock', 'site', and 'very unlikely releases', but there is no definition of 'socioeconomic', 'social impact','economic impact', or any of the other terms used in assessing 'the regional and local effects of locating a repository at the site'.

In order to project or predict possible impacts on a region and localities, a baseline must be established which identifies how things are in a community at a specific point or at several points of time. One way to establish such a baseline would be to evaluate social, cultural, demographic and economic characteristics based on the Census in 1960, 1970 and 1980. Instead, a mixture of characteristics from varied years in the 1980's has been used which may or may not be valid.

Two of the glaring omissions in establishing a regional baseline include air quality and transportation. The Las Vegas Valley is a non-attainment area in terms meeting the minimum standards of air quality set by the Environmental Protection Agency. The environmental assessment addresses in depth air quality in terms of Yucca Mountain and fugitive particulates during construction and the issue of commuter traffic/waste transport only minimally. What kinds of impacts will be contributed over time by the transport of thousands of trucks and hundreds of trains which travel through the Valley to get to the site? The Las Vegas Valley also has an abysmally poor mass transportation system which contributes significantly to the air quality problems. Mass transportation and air quality are inextricably joined together and these two problems represent the most pressing issues of survival and quality of life to the residents of the Las Vegas Valley.

2. MIXTURE OF DEMOGRAPHIC CHARACTERISTICS WHICH ARE INCOMPLETE AND INSUFFICIENT
3. GENERALIZATIONS AND INFERENCES DRAWN FROM INCOMPLETE DATA.

A third glaring omission is the total avoidance of possible negative impacts on the economy. The environmental assessment reports that over 60% of the jobs in the State are directly or indirectly related to gaming and tourism. Yet they do not address possible impacts of tourists who may never come here after hearing that Nevada is to be the site of the first nuclear waste repository. Instead, the questionable conclusion is drawn that "the economy of Nye and Clark Counties is espected to experience beneficial effects."... Although the State Legislature has proposed bills to encourage the purchase of materials and supplies within Nevada, there is no provision for encouraging or requiring to any extent possible, the contractors to hire and or buy locally. The environmental assessment , likewise, makes no specific commitments, just inferences. The value of inference can be validated by checking with the City of Carlsbad in terms of how many local contracts or purchases were let in conjunction with the construction of the Waste Isolation Pilot Project, how many local workers were hired and any effect the project may have had on tourism.

The characterization of "Clark County" as a region, practically ignores the identities of local government and communities in the Valley. Henderson, North Las Vegas, Las Vegas, Boulder City and both urban and rural areas of unincorporated Clark County....all have their own distinct identities. One may attempt to characterize the whole by examining the several parts, but you can come up with some misleading conclusions by ignoring the parts that go together to make up the whole. An example can be found on Page 3-70, Paragraph 3.6.3.1, Housing. The social scientist examines housing statistics from four different sources, from three different years. All of the years and sources are not documented in the same fashion that the Census is documented (and even it allows for specified degress of error). All of the sources cited are based on predictive techniques used by each of the entites. Table 3-17 is cited as the source of information offered at the end of the housing section that concludes "only two out of five households have children under 18 years of age."

A close examination of the table cited is perplexing. There is no data in the table (3-17) nor, for that matter, anywhere else in this document, which provides information on the number of households or on age characteristics for the residents of the Standard Metropolitian Statistical Area (the greater Las Vegas Valley). As a matter of record, according to the 1980 Census for the SMSA, of the 173,891 households, 119,068 (or more than 68%) are family households.

Regardless, the social scientist somehow determined from Table 3-17, that two out of five households have children under 18 years of age, then drew the conclusion that "Las Vegas is primarily an adult community". (Page 3-70). The first problem with this statatement is that "Las Vegas" is a city with a 1980 population of 164,674, only representative of approximately 35% of the Clark County population. The second problem with this statement is that even if it did have a higher-than-national average of non-family households, it could still be demonstrated, by examining related data of the individual cities located in the valley, that there may be patterns of settlement for non-family households and family households within the Valley that are significantly different.

The point is that the scientist who seeks to characterize human groups in a large metropolitian area cannot look at raw statistics (assuming that there are statistics provided), and jump to conclusions about major characteristics of that area. In order to understand the whole with some sensible and logical approximation of reality, the individual parts need to be examined.

The individual identity of the City of North Las Vegas, with a 1980 population of 42,739, is seriously impinged in the review of the environmental assessment, in that the City of North Las Vegas does not appear on <u>any</u> of the maps of the area. The fact that a city of over 42,000 people was overlooked, again calls into question the kind of confidence the public can have in the balance of the information presented in this document which purports to be thorough, accurate and scientifically responsible.

Additionally, the statement is made in the "Draft Environmental Assessment Overview", December, 1984, Page 14, Section 6, that Yucca Mountain was evaluated for its suitability for site characterization based mainly on the "siting guidelines" (which were not used) and in part on the "expected effects" of the site characterization and repository development outlined in the Overview. There is some question as to whether concentrated efforts were made to obtain and use readily available information.

4. <u>CLEAR DEFINITIONS BUT INFERENCES AND CONCLUSIONS BASED ON INSUFFICIENT DOCUMENTATION</u>

This last analysis will be of one segment of the assessment in which the terms are defined and the direction of the assessment is evident. "Culture, as used in the following discussion, is defined as the enduring and deeply felt set of attitudes and beliefs held by an identifiable group of people . . . "The rich diversity of cultures and lifestyles exhibited in Nye and Clark Counties is outlined in the following section." After taking the trouble to define the terms and state what will be outlined, the entire issue is ignored with broad generalizations such as ". . . only 18 percent of Clark County residents were born in Nevada, resulting in a marked cultural diversity." (Page 3-88) This is a prime example of a generalization drawn from insufficient documentation. One hopes that this example of scientifically inadequate documentation and extrapolation does not carry over into the other scientific endeavors associated with this project. After stating that "deeply felt attitudes and beliefs" would be addressed, it is never mentioned again other than to quote the sublime conclusions of Adams (1978) and Gottlieb and Wiley (1980) that "Regardless of background, all citizens must reach some accommodation between gaming and other cultural values."

This type of statement about gaming reflects the cultural bias of the investigators rather than the reality of the attitudes and beliefs of those citizens who live in a community where gaming is legal, socially acceptable and almost excessively regulated. The underlying premise that gaming is somehow inconsistent with other American cultural values totally ignores what may be considered a national preoccupation with gaming (such as football, baseball and basketball pools, not to mention the highly visible "game" shows). One might even suggest that gaming, in terms of the Superbowl, is an overwhelming acceptable value, since "mass" inauguration ceremonies for the President of the United States were postponed until after the Superbowl game.

The social scientist participating in this information gathering process who concludes that gaming is an area of American culture which requires "accommodation" to other cultural values is representative of the grossest types of errors which have been committed in the entire Environmental Assessment. Conclusions which are based on assumptions, personal bias, subjective evaluation, insufficient documentation, inferences and innuendos and the lack of standard, acceptable methods of scientific inquiry can hardly give the public assurance that any of the conclusions contained within the entire document are valid.

MISCELLANEOUS COMMENTS

P. 5-63 Table 5-29, cites ZIP codes as the resource for determining settlement pattern. In many instances, the zip code boundaries are inconsistent with jurisdictional boundaries.

P. 5-70 Table 5-33. References Figure 5-8 which is the surface facility for a two-stage repository. Should the correct reference be Figure 5-9? It should be noted that for those incidents occurring at SR156 to northern city limits of Las Vegas, the City of North Las Vegas may be the first responders due to proximity. (That would be evident if North Las Vegas was indicated on maps and included in the draft Environmental Assessment.)

6.3.1 What are acceptable levels of radionuclide release specified in Section 960.4-1.?

Page 16 - Overview - states that it is unlikely that radioactive releases from the repository could affect large numbers of people. What kind of affect? Physical? Mental(fear)? And what is large? Does that include or disregard employees?

P. 4-32 4.2.2.3. Effects on community services are dismissed in three sentences. The inference is made that because a problem exists, adding to it is acceptable.

P. 3-87 3.6.4.1.2. Statistics should be delineated to reflect number of tourists as residents when comparing with national average.

TRANSPORTATION COMMENTS:

1. The DOT, DOE, the NRC and other agencies have various degrees of involvement, but no where do we find out which agency will assume full responsibility.

2. DOT/RSPA/MTB-84/22 "Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials" requires carriers to file route plans, provide specialized driver training and to comply with security requirements of the NRC (or equivalent requirements of DOT) when appropriate. There are no guaranties in the Draft Environmental Assessment that these regulations will be applied to high-level nuclear waste transportation, nor do we know which set of requirements will be used.

3. This same publication, on page 5, states that the packages must be shielded to reduce radiation emissions during transportation to "safe levels as specified in DOT regulations". What, exactly, is a "safe level" of emission?

4. Draft Environmental Assessment, pg. 1-10 1.2.3. Sites in Basalt and Tuff - the reference to ..."advantages of locating a repository on land already withdrawn and committed to long-term institutional control" is misleading. It infers that the Yucca Mountain site is within the NTS - not a part of BLM controlled land. BLM land is <u>not</u> withdrawn from public use - it is available for public use. According to DOE's own maps, the bulk of the proposed site is on BLM land and would necessitate withdrawal of an additional 51,000 acres.

5. Pg. 2-11, 2.2 - Identification of Yucca Mountain as a potentially acceptable site - Testing and site screening on Yucca Mountain was started in 1978. The analysis was <u>not done</u> in the manner prescribed for site screening, although DOE states the process was compatible. How can DOE evaluate, nominate or recommend according to the guidelines in 10 CFR Part 960.3 which require DOE to implement a 7-step decision process, when DOE did not perform the required site screening methods?

6. 3-56 3.5.1 Highway Infrastructure and Current Use
5-12 5.1.1.4.1 Highway - Access to the Yucca Mountain Site would be by a new access road. Particularly during the construction phase, we would like assurances that this road (and the future rail spur) would be the only means of access to the site. The reasoning is that construction vehicles from the Las Vegas area should be forced to use the access road and not enter at Mercury and cross to the site from any other road. We propose installation of truck scales at the entrance to the new road in order to "catch" and fine overweight vehicles. It is common practice for contractors

and truckers to maximize their profit - at the expense of the local and state roadways, in fact DOE is encouraging the use of overweight vehicles. The fines could be used to pay for the cost of a 24-hour, 7-day scale operation, and for other monitoring activities, or as additional compensation on a prorated basis to the entities effected.

7. 3-57 Figure 3-20 - Although DOE does not recognize the existence of North Las Vegas as a City, we certainly do--and resent the exclusion of our City on this (and other) map(s). This figure shows Dike Siding. Exactly where is Dike Siding, and what sort of activity is planned? Will there be a marshaling yard? Will "cargo" be transferred or handled in any way at Dike Siding? Will the railroad cars sit there for any length of time? More information is required about the activities planned for Dike Siding.

8. 5-72 5.3.2.1 Radiological Effects of Nuclear Waste Transportation - This section states that "HLW mixture for which the impacts are assessed consist, in part, of spent fuel that has been out of the reactor for a 10-year decay period" (used in RADTRAN II). However, A.6.2 REGULATIONS indicate the spent fuel shipped to a repository will have been out of the reactor at least 5 years. If the 10 year old fuel was used as a basis for the calculations in RADTRAN II as it appears, and if the proposed regulations specify "at least 5 years", one would expect the assumptions in the RADTRAN II model to be erroneous since the basic assumption would then be wrong. What is the impact on the spent fuel of reducing the holding time from 10 to 5 years?

9. 5-73 5-75 This section also states that the greatest radiological risk of exposure is from stops during shipment. A stop is estimated at .0177 hours per mile. How long does an average driver stop for meals or where does he stop to sleep? The Draft Environmental Assessment mentions no regulations for isolating a truck during a rest, meal, or sleep stop. Where does DOE propose the truck "stop" when the NTS is closed for a test and deliveries cannot be made. (Often due to weather, a test can be delayed up to 24 to 48 hours.)

10. Nowhere in the Draft Environmental Assessment is there a clear definition of what (how many m rems) is a dangerous dose. RADTRAN II uses "whole body". What <u>exactly</u> is a dose that would require medical attention?

11. A-3 A.4 Regulations Related to Normal Transportation - This section states that exposure limits are prescribed for both heat and radiation. The surface temperature of packages "may not exceed" 180° F. Will DOE require air conditioned trailers? According to the Nevada Department of Transportation, Motor Carrier Division, surface temperatures of asphalt during the summer can reach over 140° F. With an

outside temperature of 115° F. and a road surface temperature of 140° F., what will the temperature reach inside a closed trailer? To my knowledge, no one including DOE knows the answer. What will happen if the temperature does exceed 180° F.?

12. A-6 A.5 Regulations Related to Transportation Accidents - Under the specific tests listed in this section, number 2 is a free drop of 40 inches onto a specified-size puncture probe. Why 40 inches? For a normal tractor-trailer rig, the loading level of the trailer is variable between 48" to 54" for heavy duty trailers (see attached). Why is the packaging not tested from a useful height? And, what is a "specified-size puncture probe"? Does that mean a nail or rebar, or something larger?

13. A-7 A.6.2 Regulations - Who monitors the spent fuel when it is removed from the reactors to determine that it is 5 years old (or 10 years old) and ready to ship?

14. A-13 A.7.4.2 Heavyweight Truck Casks - In this section, DOE appears to be actively encouraging the trucking industry to haul overweight loads! In fact, DOE has commissioned a study on how to break the law, and to hell with the "additional wear and tear" on the roadbeds and other impacts.

    Statements such as those in A.7.4.2 do not lead to confidence in the DOE and certainly lead one to suspect that this is not the only area where DOE will make its own rules to suit itself!

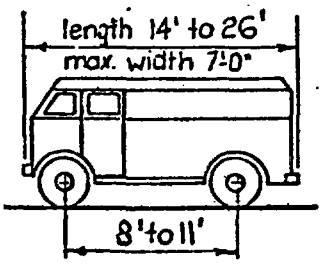
15. We also have a great deal of concern with having a private trucking company (low bidder) transporting the high-level nuclear waste. With all the existing regulations - federal, state and local, there are still many problems with transportation of hazardous materials, i.e., improper plackarding, and paperwork. For example, in a recent check in Arizona, 100 plackarded trucks were checked. Fifty of the trucks had serious problems. We must have reassurances that proper monitoring and inspection is performed on the shipments. No special provisions for monitoring have been addressed in this Draft Environmental Assessment.

TRANSPORTATION POSITION PAPERS:

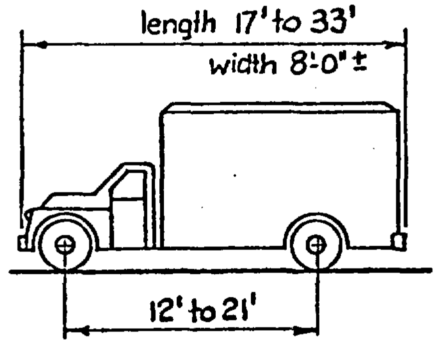
16. "Prenotification for Spent Fuel Shipments to Repositories" November, 1984

    In this paper DOE "stands ready to support and assist in emergency response activities." The paper further states that DOE believes this support provides an appropriate level of Federal assistance. On the contrary, DOE should be made responsible, and should fully fund emergency response. It should not be a burden upon the State or a local entity to

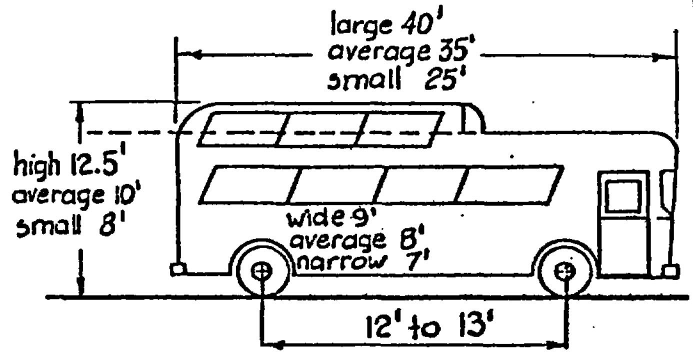
PARKING – TRUCKS AND BUSES



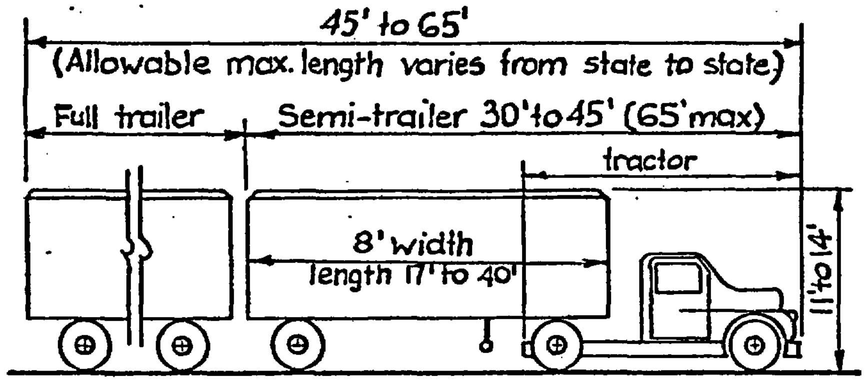
DELIVERY TRUCK



VAN TRUCK



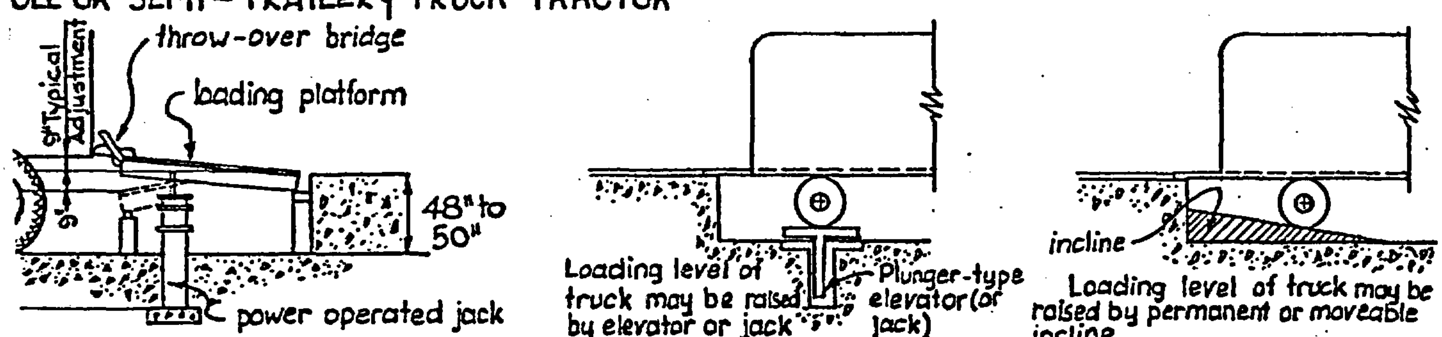
MOTOR BUS



Turning radius of trailer depends on radius of tractor (24' - 43') See page 12-22

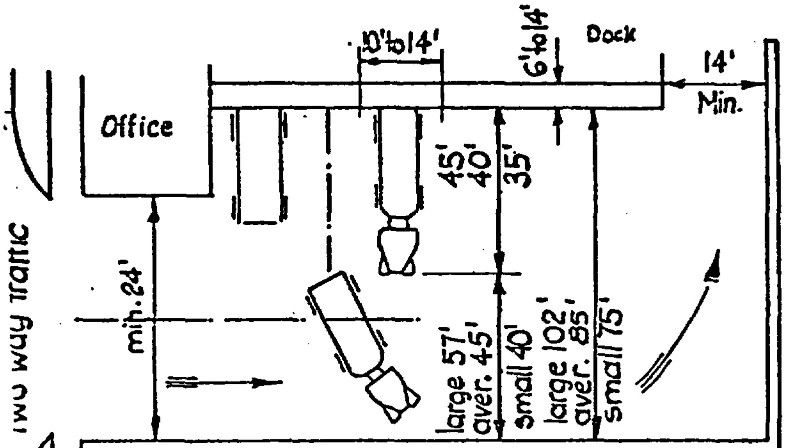
ULL OR SEMI-TRAILER & TRUCK TRACTOR

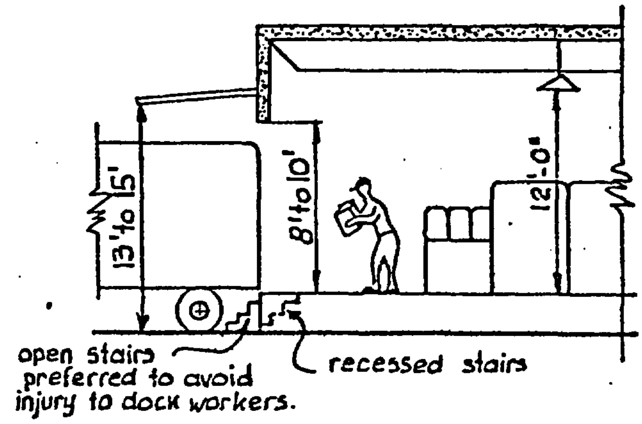
Note: For turning clearances for inside driveways see p 12-24.



Loading levels of trailer are variable from 44" to 50" (48" to 54" for heavy-duty units.) For van-type trucks 42" to 46". For delivery trucks 25" to 31".

LOADING DOCK LEVELING DEVICES



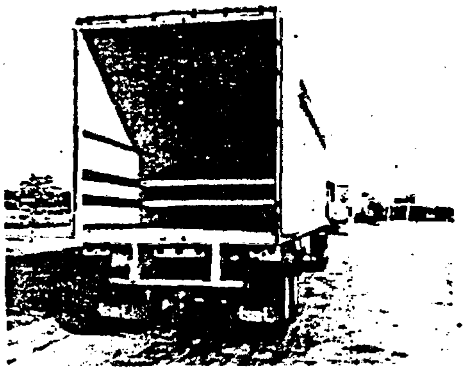


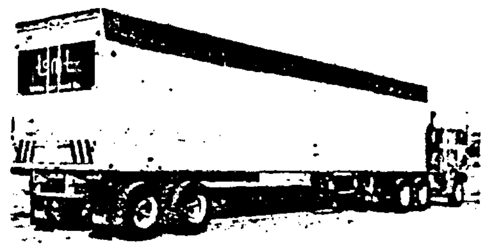
TRUCK APRON WIDTH

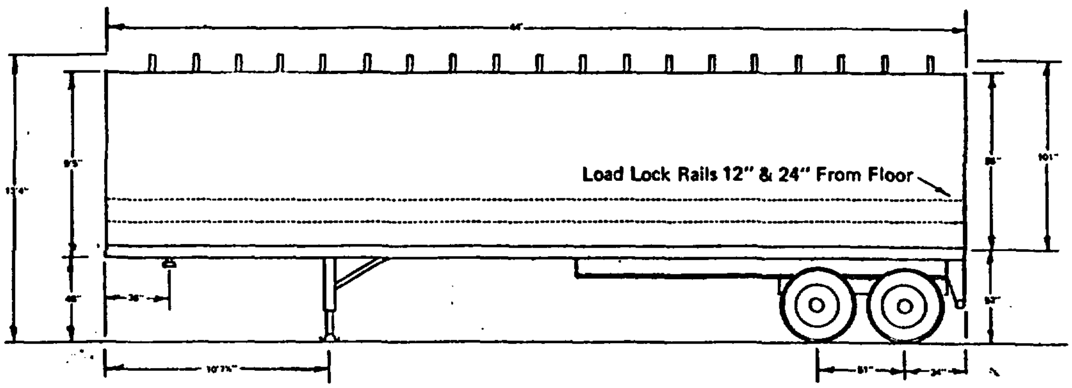
MOTOR CARRIER DOCK – TYPICAL

Adopted from "Architectural Graphic Stds" Ramsey & Sleeper

TRI-STATE MOTOR TRANSIT CO.
SHIELDED VAN

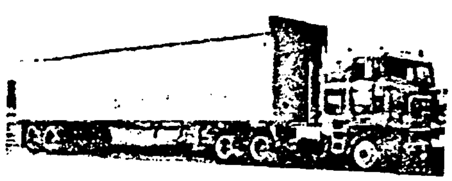


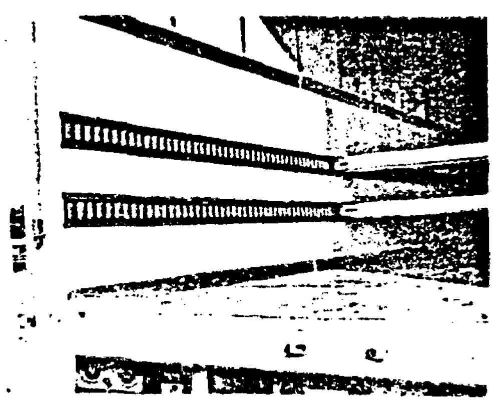




NOTE: 1. Steel tarp bows swing away
2. Tarp bow at door removable

Type: 44' Open Top
Suspension: Air
Empty Wt.: 27,000 lbs.
Tie-Down: Ancra "E" Series Retention System
Shielding: ½" Lead 4' High on sides and front
Floor: ⅛" Steel Plate





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have to be financially encumbered in any way as a result of having a repository located within our state or, for having HLW transported through our state.

17. "Liability for Incidents Connected with Spent Fuel shipments to Repositories" November, 1984

    This paper states DOE has executed approximately 70 contracts wherein DPE agrees to assume ownership of the spent fuel. There are over 80 reactors - what is DOE doing about the rectors not under contract? Provisions must be made either in the Price-Anderson Act or other means to make money immediately available in case of an accident. If, as stated in the position paper, we must wait until liability is determined before the $605 million is "made readily available", we could wait years!

18. Transportation has proven to be a very important issue. Due to the high costs of transporting nuclear waste from a reactor in Florida to Yucca Mountain, it would have been logical to include the transportation cost issue as one of the ranking factors.

19. During the approximately 5 year long construction period, which includes heavy truck traffic from the Las Vegas area to the site, there will be impacts to the Valley's air quality. Areas of Las Vegas are presently unable to meet air quality standards. DOE's Draft Environmental Assessment has not adequately addressed construction impacts to the Las Vegas Valley.

20. The attached map from NUREG-0725, Rev 4 lists NRC approved routes for transporting spent fuel. The State of Nevada has not yet designated any alternate or preferred routes - Using NRC's map - there is no way to get the the NTS. Has DOE prepared their own "approved routes"?

21. Federal Register, Volume 50, No. 36, February 22, 1985 issue features 4 + pages of exemptions to the Department of Transportation's Hazardous Materials Regulations (49 CFR Part 107, Subpart B). What assurances are there that exemptions will not be granted to regulations governing the transportation of high-level nuclear waste? Or will 49 CFR Part 107 govern (complete with its methods for circumvention)?

22. 5-62 - What is determined to be the effect of "increased truck traffic"? Does the design and the condition of the present roadway system maximize or minimize the transportation risk? This should be assessed to determine whether or not improvements are warranted.

23. P. 14 - Overview, Section 5 - Access routes will bypass local towns and communities, providing direct access to

regional/national transportation networks. Some of these roads (regional/national) go through local towns and communities!

24. 5-72 - Section 5.3.2.1 states that transportation accidents severe enough to release radioactive materials from a shipping container are extremely unlikely. Yet:

25. 5-50 - Section 5.2.9.2.3 cites five operational accidents which would involve potential releases, four of which involve a transportation accident. What are the facts? Based on what data?

EMERGENCY MANAGEMENT:

North Las Vegas wants to be assured that our City will be furnished state of the art emergency response training and equipment and that adequate monitoring and inspection is being performed.

1. DOE must agree to assume full responsibility for costs and damages related to the HLW program.

2. Local entities are, according to DOE, supposed to have the capabilities of a 15 minute response time to an accident. DOE says they provide assistance. No local entity in Southern Nevada has anywhere near a 15 minute response capability.

3. North Las Vegas will require special medical facilities capable of dealing with radiation poisoning and decontamination.

3a. North Las Vegas will require additional training, equipment and manpower to handle incidents involving nuclear waste.

4. In the event of an incident where an area is evacuated, DOE must be willing to pay the costs of the evacuation, even in the event of a false alarm. Certainly our City cannot afford to absorb any costs associated with nuclear waste incidents. We will be dependent upon the DOE for full monetary support.

5. North Las Vegas feels that we must in Southern Nevada have the capability to respond at the level in NUREG/CR-2225 "An Unconstrained Overview of the Critical Elements in a Model State System for Emergency Response to Radiological Transportation Incidents" (estimated at in excess of $5,000,000).

6. FEMA's current Fiscal year Budget is not adequate to fund the level of training programs, and equipment grants required to deal with HLW. DOE should assume the responsibility itself, or should support a hefty increase in FEMA's budgetary allocation to cover the costs.

7. There appear to be 12 government agencies that have involvement appropriate to a radiological emergency. The 12 agencies are:

   Department of Commerce (DOC)
   Department of Defense (DOD)
   Department of Energy (DOE)
   Department of Health and Human Services (HHS)
   Department of Housing and Urban Development (HUD)
   Department of the Interior (DOI)
   Department of Transportation (DOT)
   Environmental Protection Agency (EPA)
   Federal Emergency Management Agency (FEMA)
   National Communications Systems (NCS)
   Nuclear Regulatory Commission (NRC)
   U.S. Department of Agriculture (USDA)

Some <u>one</u> agency should be in charge. Dealing with any federal agency is a nightmare of red tape and paperwork. Twelve separate agencies is insane!

City of Henderson

CITY OF HENDERSON

CITY HALL 243 WATER STREET 702/565-8921
HENDERSON, NEVADA 89015

Gateway to Lake Mead Resorts

March 15, 1985

Mr. Robert R. Loux, Director
Nuclear Waste Project Office
Capitol Complex
Carson City, Nevada 89710

Dear Mr. Loux:

Although our staff has not been able to accomplish a complete analysis of the Yucca Mountain Draft Environmental Assessment within the limited time allotted by the Department of Energy, we wish to submit our findings to date. Please include the following comments with your own in your correspondence with the Department of Energy.

Highway transportation of nuclear waste is of prime interest to our community, as Henderson is located between Las Vegas and Hoover Dam on U.S. 95, the proposed truck route from the south to the Yucca Mountain site. We feel that, not only is the Draft Environmental Assessment treatment of transportation issues far from adequate, but the data presented is contradictory and self-defeating.

Transportation - Appendix A

A.3 Participants in the Shipping Process. "The shipper is instrumental in insuring the safety of the shipment. The carrier must. . . . provide any training that may be required. . ."

During a visit to G.A. Industries in LaJolla, California, several weeks ago I observed a cask-loaded trailer parked with the landing gear seated improperly and an illegible placard. The shipper, Tri-State, is apparently a major nuclear waste carrier.

We feel that more attention must be given the issue of carrier training and safety, both in the final Environmental Assessment and in actual practice.

A.8 Risk Analysis. The discussion of the uncertainties of existing computational tools is underscored by the model's proposed plan to route truck traffic over Hoover Dam. The use of "National scale . . . aggregate input" is totally inadequate if it fails to recognize the steep-grade switch-back configuration of the two-lane road leading to and from Hoover Dam, and the mile-long traffic jams of tourists during the hottest months of the year. The cavalier use of this level of data provides a poor basis for "comparing potential sites." We feel that the gravity of the problem deserves decisions based on much higher quality information.

A.10.3 Routing The discussion of routing implies that States will be afforded a great deal more control than is supported by other literature. The draft Environmental Assessment states that carriers will be instructed to use approved State-preferred routes. However, a paper by the State of Wisconsin, Nov. 7, 1984, states that U.S. Department of Transportation regulations, which govern the selection of routes, do not specifically authorize U.S.D.O.T. to approve or disapprove suggested State alternatives. Within these general restrictions (use of the interstate system or State-designated alternatives) the carrier makes the actual decision on which route will be used for a specific shipment by truck. The final Environmental Assessment must do a much more thorough job of clarifying the State's position in route selection and route control, and if the State is to be at the mercy of the carrier, that information must not be misrepresented or omitted.

A.10.4 Insurance Coverage for Transportation Accidents. The draft Environmental Assessment makes no reference to methods of determining coverage of difficult-to-measure impacts such as compensation for reduced property values surrounding an accident site as a result of a change in public perception of the safety of living near the route.

We feel that this whole area of insurance has been inadequately addressed. At a recent meeting with the Western Interstate Energy Board and Department of Energy, when asked why D.O.E. would not assume full responsibility, Keith Klien, a D.O.E. representative, stated, ' We can't treat this like a blank check because, obviously, we may be discussing a lot of money!

The D.O.E. claims that they will assume "proper" responsibility. Their interpretation of proper responsibility may conflict with ours, and we are unwilling to wait until there is a claim to find out. This entire subject needs extensive discussion and clarification in the final Environmental Assessment.

A.7.4.2. Heavyweight Truck Casks. The draft Environmental Assessment has devoted only four sentences to overweight truck casks, yet this may be one of the most immediately identifiable negative impacts on communities located along the truck routes.

Henderson has a small population to support a large land jurisdiction and corresponding infrastructure, including roads. As a result, overloaded vehicles and their resultant road destruction have hurt us immeasurably. The idea of the D.O.E. magnifying the problem is intolerable. The final Environmental Assessment must address this subject thoroughly, including specifics on upgrading the routes prior to use, stating methods of identifying areas damaged by overloaded vehicles during transport, and providing for ongoing repairs during the life of the project.

A.6.2. Regulations (and 5.4.1.6. Tourism) The draft Environmental Assessment states that D.O.E. has implemented safeguards under D.O.T. Regulation 49 CFR 173.22(c)(2), including "one unarmed escort in vehicle or two escorts in separate vehicles to maintain surveillance." Yet D.O.T.'s inconsistency rulings (IR-8, 11-15) declared such escort requirements inconsistent.

This subject must be clarified in the final Environmental Assessment.

A.10.2. Emergency Response. Our emergency response personnel indicate that the draft Environmental Assessment has understated and misrepresented the procedures which first responders may perform, depending upon the severity of an accident, and the availability of detection and protective equipment.

The proposed route through our community is used by a significant portion of the tourists to the Las Vegas area. It is used as a primary commuter route for the southeast area of the Valley. It abuts residential and tourist uses, and experiences cross winds of varying degrees year-round. An accident near "Old Vegas", an amusement facility on South U.S.95, could result in more than the limited involvement implied in the draft Environmental Assessment. An accident with a leak could easily require evacuation of tourists and nearby residents, as well as blocking traffic in all directions at a freeway interchange.

Our Fire Chief states that our detection equipment is not as good as it should be, yet we are expected to use that equipment to fulfill our role as primary responder.

We feel that the final Environmental Assessment must do a much better job of addressing emergency response.

CHAPTER 5, REGIONAL AND LOCAL EFFECTS OF LOCATING A REPOSITORY AT THE SITE

5.4.1.6. Tourism. We have a serious problem with the analogy of the Las Vegas hotel fires, and Three Mile Island in discussing the impacts on tourism. We certainly cannot agree that the area around Three Mile Island compares in any way whatsoever with the Las Vegas Valley's warm, dry climate and gaming/resort image.

The reference to the Las Vegas hotel fires is equally inaccurate without a discussion of the extensive and very costly fire protection retrofit program undergone by the entire State, the corresponding State enforcement legislation, and the expensive massive media campaign to re-attract the tourist population following the fires.

Our City's letterhead says, "Gateway to Lake Mead Resorts". Also, we have several casinos and other non-gaming tourist attractions. Tourism is an important part of our local economy, and we are not satisfied with the draft Environmental Assessment's lack of attention to the subject.

We want to know what measures will be taken to determine damages and compensate our tourism-dependent population in the event of an accident along the truck route, or if tourism is affected simply because of the proximity of the route or the site, itself.

5.1.1.6. Material and Resource Requirements. No mention is made of local availability of construction materials (for example, the half-million cubic yards of concrete used on the project) and the effect of withdrawal of those materials upon local demand and price. Henderson is far enough away from the repository site to be effectively deprived of industrial side benefits from the project, but still within the market area of the project's materials suppliers. This means that those who gain no benefit from the siting will have to pay higher costs for homes and amenities due to competition for materials.

The final Environmental Assessment must address this matter and provide solutions.

In summary, almost every area of the draft Environmental Assessment which we have had time to review has been inaccurate or inadequate. Under separate cover, we have asked for additional time to comment on the document, and whether that extension is granted or not, we will continue to review the draft and submit our findings to your office.

If you have any questions about our comments, please contact us immediately. Thank you for your assistance in this matter.

Sincerely,

Robert D. Wilson
Senior Planner

RW:sa

STATE OF NEVADA COMMENTS

ON THE

U. S. Department of Energy Draft Environmental Assessment for the Proposed High-Level Nuclear Waste Site at Yucca Mountain

Richard H. Bryan
Governor

COMPILED BY

THE NUCLEAR WASTE PROJECT OFFICE
OFFICE OF THE GOVERNOR

MARCH, 1985

VOLUME II

STATE OF NEVADA COMMENTS

ON THE

U.S. DEPARTMENT OF ENERGY DRAFT ENVIRONMENTAL ASSESSMENT

FOR THE PROPOSED HIGH-LEVEL NUCLEAR WASTE SITE

AT YUCCA MOUNTAIN

PREPARED BY

THE NUCLEAR WASTE PROJECT OFFICE

OFFICE OF THE GOVERNOR

MARCH 1985

VOLUME II

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Nevada Bureau of Mines and Geology

Comments by John Schilling

UNIVERSITY OF NEVADA RENO

Nevada Bureau of Mines and Geology
University of Nevada Reno
Reno, Nevada 89557-0088
(702) 784-6691

1 Mar 85

M E M O R A N D U M

TO: Robert Loux

FROM: John Schilling JS.

SUBJECT: Summary of Review of the YUCCA MOUNTAIN DRAFT ENVIRONMENTAL ASSESSMENT

Attached please find my page by page review of the Yucca Mt. EA. The EA is much better than I had expected, and has been greatly improved from the "preliminary draft".

However, I feel that there are four possible geologic problems that need further study. Each has been inadequately studied. They are:

1. "Young" faulting. (Needs more study over a larger area, centered on Yucca Mt., and including low-sun-angle photography, and more trenching. Additional such faulting probably exists, and must be delineated. The study should at least be equivalent to John Bell's study of the Reno 1 x 2° sheet, and should be done by him or someone else that is not connected with DOE or USGS.)

2. "Young" volcanism. (A more-in-depth study is needed, one that considers both basaltic and felsitic eruptions, that dates all young "volcanic" features including feeder dikes and diatremes, and that considers all regional structures, especially those that intersect at Yucca Mt. The potential for near-term activity has not been ruled out, and should be studied in more detail. Any study should be done by someone not connected with DOE or USGS.)

3. Mineral Potential. (No one has done a study of the mineral potential at and near Yucca Mt. This should be an on-the-ground examination of mineralization and alteration, and geochemical sampling at the surface, in drill holes, and workings. The sampling should include both valuable elements and "indicator" elements. The presence of the edge of a caldera [see discussion of pages 3-23 & 24] along the west flank of Yucca Mt. strongly suggests the possibility of mineral potential. The study should be equivalent to the type of study Joe Tingley does in inventorying potential elsewhere in the State.)

4. Deep-circulating springs. (All springs close to Yucca Mt. should be examined using water chemistry, temperatures, etc. to determine if they are deep-circulating, and thus interrupt and greatly shorten the groundwater flow-paths.)

JS:smw

1 Mar 85

M E M O R A N D U M

TO: Robert Loux, Director, Governor's Nuclear Waste Project Office

FROM: John Schilling, Director/State Geologist, Nevada Bureau of Mines and Geology (NBMG) JS

SUBJECT: Review of the DRAFT ENVIRONMENTAL ASSESSMENT, YUCCA MOUNTAIN, NEVADA, (high-level nuclear-waste repository) SITE

A page by page review of the geologic and mineral-resources considerations in DOE's Yucca Mountain EA follows. This review does not cover geohydrological or earthquake/faulting considerations in any detail, as they are being reviewed in detail by others (John Bell, Engineering Geologist, NBMG, will also review the geologic considerations, especially those related to earthquake/faulting). Other, non-geologic errors of fact are also pointed out.

It appears that the process of evaluation has been done backwards --- possible sites have been selected for nongeologic reasons, then efforts made to make the geologic settings (for example: rock type) appear favorable. Additional, more detailed studies need to be made by organizations other than DOE or the U.S. Geological Survey to cross-check the accuracy, completeness, and conclusions of existing studies. The page by page review that follows, will cite specific subjects that need additional study.

page 2-3

line 1 The Great Basin is not all desert (the mountains often have substantial rainfall and are forested).

line 4 a. Water is not scarce (surface water is).

b. Scarce water is not the limiting factor (lack of jobs is).

c. "few people" is misleading --- is a strange way to characterize 1 million persons (why not say: population density is low over much of the area).

paragraph 3 Nevada is not in the "crystalline shield" (the shield is a hugh area where outcrops are nearly all crystalline rocks, and does not include areas such as Nevada where very few crystalline rocks outcrop).

paragraph 4 Volcanism did not stop 10 million years ago, but has continued up to the present. (The Yucca Mt. area is a potentially volcanically active area -- the possibility of near-term volcanic activity is far from absent.) Cinder cones within a few miles of Yucca Mt. are much younger than 10 million years. And just because there is no volcanic activity today does not mean that the area is not volcanically active --- periods of volcanic activity contain many intervals with no activity. This statement implies that volcanic activity will be no problem at Yucca Mt. --- this may not be true. MORE EXHAUSTIVE STUDIES ARE NEEDED before this potential problem can be resolved.

Further future volcanism other than the basaltic-type is essentially ignored -- "rhyolitic" eruptions could occur (they are more violent and cover much bigger areas).

page 2-5

paragraph 1a — Tectonic activity has not "waned" in the last 10 million years (there is considerable evidence that it may be as great today as it ever was). Earthquakes, both breaks in the facilities, and severe shaking, could occur. Studies made do not rule out this probability. ADDITIONAL STUDIES OF "YOUNG" FAULTING MUST BE MADE TO DETERMINE WHETHER THIS IS A MAJOR PROBLEM.

paragraph 1b — (See p. 2-3, paragraph 4 for discussion of volcanic activity).

paragraph 2 — There is nothing to indicate that the geologic processes mentioned have stopped, are not going on today, will not continue in the future. Yucca Mt. is in a highly geologically-active area.

paragraph 3 — A more accurate statement would be: "The southern Great Basin is characterized by deep groundwater in the mountains and shallow groundwater and springs in tbe basins". Considerable recharge occurs in the lowest areas, the playas, where the water flows during flash flood (recharge is not mostly in the higher areas; most precipitation moves laterally on the surface, often miles).

paragraph 4

last line — "Bedded-tuffs" contain numerous cooling-cracks that "store and transmitt water", these are often more important than interstitial pores.

paragraph 5 — Some springs nearer Yucca Mt. may have deep circulation (hot-spring in nature but not hot at the surface) that greatly shorten the flow path by intercepting the deep aquifers. No studies have been made to determine if this is an important factor -- it certainly could be.

last line — Not fair to call this a "small" flow system -- is only small compared to the very large systems in the area.

<u>page 2-47</u> — GEOHYDROLOGY - <u>see</u> p. 2-5, paragraph 5 (travel time may be greatly shortened by deep-circulating springs that short-circuit the flow-paths).

EROSION - "Less than 200 meters" cover over facility is an absolutely abitrary number, is at best a wild guess as to possible erosion rates.

TECTONICS - <u>see</u> p. 2-5, paragraph 1a (shaking and faulting is possible, and could cause loss of waste isolation).

<u>page 2-48</u> — NATURAL RESOURCES - "creating significant pathways" (if this is bad, shafts and drill holes done by DOE are "creating significant pathways".)

page 3-14

paragraph 2 Fleck and Carr reason that major motion ceased 10 million years ago, not that all or even most motion did or that tension does not still exist, waiting to be released. The Las Vegas shear zone has not been "inactive for millions of years". Extensional forces continue until the present as witnessed by the extensional forces causing the hugh cracks in the Yucca Flat playa and several young fault scarps on the Test Site. Surface displacement triggered by nuclear explosions also indicate that tension does still exist.

paragraph 4 Yucca Mt. is criss-crossed by numerous faults and fractures. Studies of these features are not detailed enough to determine whether some of these might be active in the future or whether they might break the integrity of the site. ADDITONAL STUDIES, INCLUDING LOW-ANGLE PHOTOGRAPHY, SURFACE MAPPING, AND TRENCHING ARE NEEDED.

page 3-17 note numerous faults.

page 3-18 note numerous faults.

page 3-19

last paragraph Yucca Mountain is not "in an area of relatively low historical seismicity", and it is in the Southern Nevada E-W Seismic Zone, not "south" of it.

page 3-20 Somewhere on this figure should be an explanation of what the dots are.

South boundary of the Southern Nevada E-W Seismic Zone (dash-line) should obviously be placed further south, and should include the Yucca Mt. site. This is clearly indicate by the "dots".

page 3-24 Energy resources: No drill holes are deep enough to ruled out high-enough temperatures at depth. Frequently in geothermal exploration-drilling the gradient is not linear, and much-higher temperatures are suddenly encountered.

page 3-23 & 3-24 Metals: This entire section is very poor, partly because it is based almost entirely on a very incomplete study (Bell and Larson, 1982). This study was done mainly in the library, little on-the-ground examination was done, and no geochemical sampling. It is not adequate either as a historical record or as a discussion of future potential. A MORE DETAILED STUDY, INCLUDING GEOCHEMICAL SAMPLING, MUST BE MADE.

Like many calderas in Nevada, the Crater Flat Caldera has ore deposits (and thus mineral potential) around its margin. There is known mineralization, prospects, and mines around the ~~east~~ west and north flanks of the Crater Flat Caldera (Smith and others, 1983, and Kral, 1951), and geochemical sampling (Tingley, 1984) indicates that these flanks have considerable mineral potential. The eastern flank of the Caldera, along the west flank of Yucca Mt., is obscured by alluvium (valley-fill), and the southern margin of the Caldera is buried under deep valley-fill. However, these flanks can be expected to have as much mineral-potential as do the other margins. Any ore deposits along the southern margin probably are buried too-deeply to be mined economically, but this may not be true at Yucca Mt. A GEOCHEMICAL SURVEY OF THE SURFACE, DRILL HOLES, AND WORKINGS IS NEEDED TO DETERMINE POTENTIAL. AND SEVERAL, DEEP HOLES PROBABLY ALSO SHOULD BE DRILLED AND SAMPLED.

AND ADDITIONAL REFERENCES SHOULD BE EXAMINED, USED TO IMPROVE THIS SECTION, AND ADDED TO THE REFERENCE LIST (pages 3-93 to 3-106):

Tingley, J. V. (1984) Trace element associations in mineral deposits --- Bare Mountain mining district, southern Nye County, Nevada: Nevada Bureau of Mines and Geology Report 39.

Quade, J., and Tingley, J. V. (1983) A mineral inventory of the Nevada Test Site, and portions of the Nellis Bombing and Gunnery Range, southern Nye County, Nevada: DOE/NV/10295-1.

Smith, P., and Tingley, J. V. (1983) Results of geochemical sampling within Esmeralda-Stateline resources area, Esmeralda, Clark, and southern Nye County: Nevada Bureau of Mines and Geology open-file report 83-12.

Smith, P. and others (1983) A mineral inventory of the Esmeralda -Stateline Resource Area: Nevada Bureau of Mines and Geology open-file report 83-11.

Kral, V. (1951) Mineral resources of Nye County: Nevada Bureau of Mines and Geology Bulletin 50.

paragraph 2

first line "mining operations" is misleading --- should say "exploration, development, and mining".

Historically, Nevada's metallic industry did <u>not</u> "center around the mining of precious metals at ... Comstock ... Tonopah and Goldfield" --- lead at Eureka, copper at Battle Mt., Yerington, and Ely were just as important, either dollar-wise or as tonnage mined.

Reserves of gold at the Sterling Mine are over 10,000 lbs (120,000 oz, or $36 million) --- 5 times the reserves given. The mine obviously is not "small", and if gold prices rise reserves will increase.

paragraph 3 "Land around these districts was withdrawn". This is true. And existing claim holders were allowed to continue to hold claims and were given access to them. A claim map of the Test Site indicates many additional points of mineral potential, and should be included as an additional figure in the EA.

The Wahmonie district did produce gold. Sampling has shown the presence of tellurium.

page 3-24 Should mention: Largest fluorite mine in Nevada is in Bare Mt. mining district; this mine is large enough to alone make Nevada number 3 among the states in fluorspar production.

page 4-2 SITE-CHARACTERIZATION ACTIVITIES: THESE STUDIES SHOULD BE DONE BY, OR MONITERED BY, CONTRACTERS TO THE STATE OF NEVADA IN ORDER TO CROSS-CHECK DOE AND USGS STUDIES. Contractors whose existence depends on DOE support can hardly be expected to turn out unbiased reports; state agencies who are not dependent on such support should be able to be more even-handed.

page 4-3 TRACE-ELEMENT SAMPLING OF ALL DRILL HOLES AND THE SURFACE SHOULD BE REQUIRED TO ESTABLISH THE MINERAL POTENTIAL.

page 4-4 There should be a section called "Geochemical Surveys" (see page 4-3).

page 4-16 TRACE-ELEMENT SAMPLING OF THE SHAFT AND OTHER WORKINGS SHOULD BE DONE.

page 4-21 Studies of tectonics, seismicity, and volcanism: see comments p. 2-3, paragraph 4; p. 2-5, paragraph 1a; p. 3-14, paragraph 4; p. 3-23 & 3-24; p. 4-2; p. 4-3.

page 6-114 condition (1): see p. 2-5, paragraph 5.

page 6-115 condition (4i): hydraulic conductivity may be "low", but because of the numerous cracks (joints, fractures, fault) the actual "conductivity" may be very high.

page 6-116 condition (4iii): Tuffs at Yucca Mt. contain many tectonic-caused fractures, along which water could move in a matter of days. (At the Climax granite body, Nevada Test Site, after a rain, water moves from the surface to "mine" openings thousands of feet below in several days.

page 6-220 (2) see comments by John Bell.

page 6-225 Table 6-32 should not be misused to indicate 4 periods of volcanism. The Red Cone is a 5th period, and if all features in the Western Rift and at Lathrop Wells were dated there probably would be a further spread in dates. ALL FEATURES MUST BE DATED BEFORE ANY CONCLUSIONS CAN BE MADE ABOUT VOLCANIC ACTIVITY.

page 6-226 to 6-234 See remarks by Alan Ryall, Director, Seismological Lab, UNR, and by John Bell, NBMG.

page 6-236

paragraph 3 Garside and Schilling (1983) does not evaluate hot springs, only lists data about them.

paragraph 5 Not true that there is "no potential for any commercially attractive geothermal resources" --- the statement is too positive. It should read "INSUFFICIENT INFORMATION IS AVAILABLE TO DETERMINE GEOTHERMAL-RESOURCE POTENTIAL." Additional deeper drilling would have to be done to postively rule out any potential. It is true that the very limited data does suggest little or no potential.

page 6-241 It's not true that mineral-resources "critical to foreseeable national needs" have not "been identified". Apparently a "mineralized vein" has been encountered in one of the drill holes (verbal communication, Nevada Dept. of Minerals). AND A GEOCHEMICAL SURVEY NEEDS TO BE MADE covering not only "valuable" elements but also indicator metals (i.e. arsenic, mercury, etc.).

page 6-245

paragraph 2 "A thorough examination of the resource potential of Yucca Mt. has not been made". Bell and Larsen (1982) is hardly "thorough".

Please put the reference citation to the resource-potential survey in the 1st sentence --- can't evaluate otherwise.

A THOROUGH RESOURCE-POTENTIAL STUDY NEEDS TO BE MADE OF YUCCA MT. (including a geochemical survey).

<u>page 6-259</u> Table 6-36(2) Not true that "minimal artificial means are required to support similar tuffs at the NTS." (Actually extensive roof bolting and screening is used, and even caving does occur.

<u>page 6-279</u>

paragraph 4 This paragraph is very misleading, the fractures do form an aquifer after rain-storms. Any one having worked in mines knows that travel-times from surface to the working would be a matter of hours, and can rapidly reach rain-storm proportions. This is true in some of the tunnels at NTS (see also p. 6-116).

<u>page 7-106</u> The ranking seems rather arbitary. As is pointed out: "all stites appear suitable", and if small differences were weighed differently the order would change.

<u>page 7-111</u> My evaluation is that Yucca Mt. is not quite as favorable as this page indicates, <u>and</u> that the other sites are more favorable --- that the "difference between the two ranks is not substantial."

<u>page 7-132</u>

last paragraph <u>This should be emphasized more.</u> The proceeding pages seem to indicate that Yucca Mt. is far and away the most favorable site.

Nevada Bureau of Mines and Geology

Comments by John Bell

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4 Mar 85

Robert R. Loux, Manager
Nuclear Waste Project Office
Office of the Governor
Capitol Building
Carson City, NV 89710

Dear Bob:

Under the terms of the agreement between your office and the Nevada Bureau of Mines and Geology, I have reviewed the Draft Environmental Assessment, Yucca Moutain Site, Nevada Research and Development area, Nevada. At John Schilling's request, I have restricted my review to the issue of tectonics; it is my understanding that he is reviewing the other geologic issues.

Overall, I would categorize the EA (tectonics) as incomplete, inadequate, and, in some instances, incongruous. On the surface, the EA appears to assess all pertinent aspects. Upon a comprehensive review of the supporting literature, however, it is apparent that the EA has not objectively assessed all available evidence. In fact, some of the conclusions drawn in the EA are in direct conflict with the available data. The selective use of data in the EA also significantly detracts from the adequacy and credibility of the conclusions.

My review indicates, based on DOE guidelines for conservative interpretations, that the following assessment is most "clearly supported" by the available data. With regard to post-closure tectonics conditions, the favorable condition is not present, five of six potentially adverse conditions are present, and the disqualifying condition is possibly present. With regard to pre-closure tectonics conditions, the favorable condition is not present, two of three potentially adverse conditions are present, and the disqualifying condition is possibly present.

The Yucca Mountain site may well be technically (tectonically) acceptable for the proposed repository, but the available data do not clearly support that conclusion at this time.

If you are tabulating level-of-effort by reviewers, I would estimate my effort as about 20 man-days. If I can answer any questions, please contact me.

Sincerely,

J. W. Bell

John W. Bell
Engineering Geologist

JWB:smw

enc.

REVIEW OF DRAFT ENVIRONMENTAL ASSESSMENT
YUCCA MOUNTAIN
TECTONICS

John W. Bell

Nevada Bureau of Mines and Geology
University of Nevada Reno

INTRODUCTION

This review focuses primarily on the issue of Tectonics in relation to the suitability of the proposed Yucca Mountain site for a nuclear waste repository. It incorporates the evidence presented in the Environmental Assessment (EA) with other existing data or generally accepted, state-of-the art concepts to formulate a best estimate of what the state-of-knowledge is at the Yucca Mountain site. Conclusions are drawn concerning the adequacy and validity of the EA with respect to the requirements defined by 10CFR60 (Disposal of High Level Radioactive Wastes in Geologic Repositories, dated 1983) and U.S. Department of Energy General Guidelines for Recommendation of Sites for Nuclear Waste Repositories, dated November, 1983.

This review is presented in several parts. First, the post-closure and pre-closure guidelines (Chapter 6) will be evaluated following the format contained in the EA. Secondly, specific conflicts in the technical data will be described on a page-by-page basis in the EA. Thirdly, a synopsis of the review will outline the inadequacies of the EA and present recommendations for necessary future work. In addition, an appendix contains a technical review of supporting literature cited in the EA.

TECHNICAL GUIDELINES - TECTONICS
Post-closure Favorable Condition (Section 6.3.1.7.3)

The favorable condition which should be present is:

"The nature and rates of igneous activity and tectonic processes (such as uplift, subsidence, faulting or folding), if any, operating within the geologic setting during the Quaternary Period would, if continued into the future, have less than one chance in 10,000 over the first 10,000 years after closure of leading to releases of radionuclides to the accessible environment."

I do not agree with the DOE finding that "the evidence indicates that this favorable condition is present at Yucca Mountain."

The principal assumption that the geologic hisotry of the last 1-2 m.y. allows the prediction of future events must be tempered by the fact that, at least with regard to tectonics, the history is not completely understood at the present time. The evidence suggests that the nature and rates of igneous and tectonic activity may in fact be episodic or cyclic (EA, pg. 6-227). This observation is acknowledged in most of the current literature related to seismotectonics of the Basin and Range Province (Carr, 1984; Rogers and others, 1983; U. S. Geological Survey, 1984; Wallace, 1978). Consequently, the principle of "uniformitarianism" is applicable only if these episodes or cycles are reasonably well understood, especially if they are to be used to gauge activity over the next 10,000 years.

The EA evaluation of the favorable condition does not indicate the probability of tectonic activity at Yucca Mountain. Based on the work of Rogers and others (1983, p. 27) and U. S. Geological Survey (1984, p. 72), it could be reasonably inferred that since "there is a potential for significant seismicity on faults at or near Yucca Mountain despite geologic evidence of general long-term tectonic stability in the last 10 m.y." (EA, p. 6-227), there is also a high probability that significant tectonic activity could occur at least once at Yucca Mountain in the next 10,000 years. If the data of Carr are used (EA, p. 6-232) the recurrence rate of 2.5×10^{-5} events/yr/1000 km^2 is equivalent to a rerupture time of 40,000 years/1000 km^2. This rerupture time is the average time between surface faulting events randomly occurring within a 17 km radius (1000 km^2) of the site. Since the faulting events will not be randomly distributed, but rather will be confined to tectonic structures, it is likely that the north-northeast-trending structures of Yucca Mountain will be preferred sites of activity and exhibit rerupture rates significantly higher than the surrounding area, possibly greater than 1 event per 10,000 years. If the average displacement rate on the Windy Wash fault is used (0.11 m/1000 yrs; Carr, 1984, p. 92), 1.1 m of displacement would occur on this fault during the next 10,000 years. This is comparable to a single earthquake of magnitude 6.5-7 with normal displacement (Bonilla and others, 1984).

The probability calculations for volcanic eruptions are also incomplete. The very low rates of projected volcanic activity are based only on basaltic eruptions. According to Crowe and others (1984, p. 86) new work has raised questions about the effects of hydrovolcanic activity at Yucca Mountain, a possibility not considered in previous volcanic-consequence analyses.

Estimates of low ground-water flux and long travel time (>20,000 yrs) are based on present geohydrological conditions and on incomplete, unsubstantiated evidence (see Desert Research Institute review comments). These estimates do not account for anticipated climatic changes which could significantly increase precipitation and raise the elevation of the water table (EA, p. 6-131), nor do they account for future tectonic events which produce new fracture or fault systems which would allow more rapid access to the environment. The argument that faulting will not lead to radionuclide release on the basis of low ground-water travel time is incomplete and presently untenable.

In summary, I disagree with the DOE finding concerning the favorable condition. The existing evidence does <u>not</u> indicate that this condition is present. The data base is very poor, as evidenced by the absence of a probability estimate for tectonism. A favorable interpretation of existing data available in the EA and supporting literature is that there is, in fact, a significant potential for tectonic activity at Yucca Mountain during the next 10,000 years.

<u>Post-Closure Potentially Adverse Conditions (Section 6.3.1.7.4)</u>

<u>Condition (1)</u>: "Evidence of active folding, faulting, diapirism, uplift, subsidence or other tectonic processes or igneous activity within the geologic setting during the Quaternary Period."

I agree that this potentially adverse condition is present. I disagree, however, with the supporting evidence. In particular, I disagree with the finding that there is no unequivocal evidence for surface faulting in the geologic setting within the last 40,000 years. The study of Swadley and others (1984) is incomplete (a review of the report is contained in the Appendix), and should not be used as a basis for inferring that all faults in the Yucca Mountain area are more than 40,000 years old. To the contrary, some field evidence indicates that the Paintbrush Canyon, Bow Ridge and Solitario Canyon faults have had demonstrable movement within the last 40,000 years. (This is discussed at greater length in a following section.)

Condition (2): "Historical earthquakes within the geologic setting of such magnitude and intensity that, if they recurred, could affect waste containment or isolation."

I agree that this potentially adverse condition is not present. This finding, however, is based on a poorly documented seismic record within the geologic setting - a record which is far too short (less than a few years at Yucca Mountain) - to allow extrapolation over the next 10,000 years.

Condition (3): "Indications, based on correlations of earthquakes with tectonic processes and features, that either the frequency of occurrence or the magnitude of earthquakes within the geologic setting may increase."

I agree that this potentially adverse condition is present. The EA (p. 6-226 - 6-227) summarizes the present state-of-knowledge concerning earthquakes and tectonic processes fairly well. The primary lines of evidence are:

1. North-northeast-trending faults, such as those at Yucca Mountain, appear to be preferred sites for future movement in the present stress field (Carr, 1974, 1984; Rogers and others, 1983; U. S. Geological Survey, 1984).

2. In situ stress measurements conducted at Yucca Mountain indicate that faults may be presently stressed to near the rupture point (U. S. Geological Survey, 1984, p. 59). Healy and others (1984, p. 14) conclude "the

stress field as measured in USW-G1 is close to that at which failure might be expected along normal faults present in the area." (Drill hole USW-G1 is located at the proposed repository site at Yucca Mountain and is more than 1300 m deep.)

3. Tectonic strain release, in the form of earthquakes and surface rupturing, has occurred as the result underground nuclear testing at Yucca Flat and on Pahute Mesa (Carr, 1974; Hamilton and Healy, 1969). Earthquakes induced by these tests still continue to occur (Rogers and others, 1983). The controlling faults are north-northeast-trending, supporting the interpretation that faults of this orientation are close to the stress threshold for rupturing. Although this explosion-induced activity was originally believed to be restricted to within a radius of about 15 km of the test, there is now evidence of a statistical relation between the underground tests and the frequency of earthquakes in the region (Carr, 1984, p. 40).

4. The age of surface faulting at Yucca Mountain is not thoroughly documented; it has not been demonstrated (Swadley and others, 1984) that the Quaternary faults within the geologic setting are not capable faults as defined by the Nuclear Regulatory Commission (10CFR100).

Condition (4): "More-frequent occurrences of earthquakes or earthquakes of higher magnitude than are representative of the region in which the geologic setting is located."

I disagree with the DOE finding that this potentially adverse condition is not present.

The instrumental seismic record is only a few years long, and although it indicates that Yucca Mountain is relatively seismically quiet, it is far too short a record to allow extrapolation. Regional seismic data in fact show that Yucca Mountain lies within a fairly active seismic zone, the East-West Seismic Zone (Rogers and others, 1983). In addition, Yucca Mountain lies in an area of moderate seismic energy release according to Carr (1984, p. 48). Studies by Algermissen and others (1983, plate 3) also show Yucca Mountain to be within a zone of fairly high tectonic flux especially if it is structurally related to Pahute Musa. Rogers and others (1983, p. 22) also point out that seismic monitoring of the Southern Great Basin indicates that the southern part of the Nevada Test Site is more active than the rest of the region and may have a higher "b-value".

In summary, although Yucca Mountain appears to presently be seismically quiet, the instrumental record is too short to allow an assessment to be made. Regional data in fact suggest that Yucca Mountain may be within a region of relatively high seismic energy release.

Condition (5): "Potential for natural phenomena such as landslides, subsidence, or volcanic activity of such magnitudes that they would create large-scale surface-water impoundments that could change the regional ground-water flow system."

I do not agree that the evidence indicates that this potentially adverse condition is not present.

Section 6.3.1.1.3 of the EA states (p. 6-122) that hydrologic processes are to be evaluated for the next 100,000 years, and it has not been demonstrated that the above natural phenomena have a low probability of occurrence during this time frame. In particular, the evidence for disruption of the ground-water flow system by volcanic activity is incomplete. Only basaltic eruptions were considered by Crowe and others (1982). Crowe and others (1984) now suggest that their original assessment was incomplete and should include an evaluation of hydrovolcanic activity.

Condition (6): "Potential for tectonic deformations - such as uplift, subsidence, folding, or faulting - that could adversely affect the regional ground-water flow system."

I do not agree that the evidence indicates that this potentially adverse condition is not present.

The potential for tectonic activity disrupting the ground-water flow system should be based on a 100,000 year time period (Section 6.3.1.1.3). None of the cited studies assess the probability of occurrence during this time frame.

The rates of late Cenozoic vertical displacements (Table 6-33) are listed only for specific range-bounding faults and do not reflect regional trends. The listed rates are low, but cumulative regional effects may be significantly higher, especially if coupled with tilting or warping. Carr (1984) indicates that regional warping of Quaternary deposits is present, but no estimated rates of deformation are given. Regional tectonic tilting in southern Nevada has also been recognized by Longwell (1960). No data are presented on the numerous regional leveling surveys conducted by the National Geodetic Survey, which also could document the amount and rate of modern tectonic tilting.

No assessment of potential tilting in relation to the hydraulic gradient is presented. The hydraulic gradient of 3.5 m/10.3 km (EA, p. 6-137) should at least be evaluated with regard to anticipated effects from regional tectonic events.

Post-Closure Disqualifying Condition (Section 6.3.1.7.5)

"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."

I do not agree that the "existing information does not support the finding that the site is not likely to meet the qualifying condition."

The evidence suggests, to the contrary, that the data base is incomplete and often conflicting, and that a reasonable interpretation of the available information is that a large earthquake accompanied by surface faulting could occur near or within the repository during the life-time of the facility. The evidence supporting this interpretation consists of the following:

1. The seismicity record at Yucca Mountain is far too short (a few years) to

allow its extrapolation over the next 10,000 years. Regional studies (Algermissen and others, 1983; Carr, 1984; Rogers and others, 1983) show that Yucca Mountain lies within an area of relatively high seismic activity and therefore should be considered as seismically active (U. S. Geological Survey, 1984, p. 78).

2. Seismic data suggest that north-northeast-trending faults are susceptible to slip in the current stress field (Rogers and others, 1983). Stress measurements taken at the repository site suggest that the stress field is close to that at which fault failure might be expected (Healy and others, 1984). Explosion-induced tectonic strain release on north-northeast-trending faults suggests that the Yucca Mountain faults may also be tectonically stressed to near the rupture point (Rogers and others, 1983). Taken together, this data suggest that the potential for significant seismicity and renewed movement on faults exists and should be considered (Rogers and others, 1983, p. 27; U. S. Geological Survey, 1984, p. 72).

3. Lack of surface (fault) rupture is not sufficient evidence to discount active faulting at Yucca Mountain (U. S. Geological Survey, 1984, p. 78). The evidence of Swadley and others (1984) does not completely preclude the presence of capable faults. Although no demonstrable movement less than 40,000 years old was documented on Yucca Mountain faults, stratigraphic controls on Holocene deposits were absent at many locations (U. S. Geological Survey, 1984, p. 41) indicating that the evidence is at best equivocal.

4. The estimated peak ground acceleration (0.4g) at Yucca Mountain is too low based on a reasonable interpretation of future tectonic events. Based on the conclusions of Rogers and others (1983) and U. S. Geological Survey (1984) that Yucca Mountain faults should be considered active, the EA statement (p. 6-231) that "Under the assumption that Yucca Mountain faults are not active, the most likely peak deterministic ground acceleration is estimated to be 0.4g ..." is untenable. If a large (M=6-7) earthquake were to occur on a Yucca Mountain fault, peak ground accelerations approaching or exceeding 1.0g could be possible.

5. The estimated recurrence rate of 2.5 earthquake in 100,000 years per 1000 km^2 (EA, p. 6-232) yields a rerupture time of 40,000 years per 1000 km^2. This is an estimate of the activity occurring randomly within a 17 km radius (1000 km^2) of the site. Since previous work has established that Yucca Mountain faults may be preferred sites of tectonic activity, rerupture times at Yucca Mountain could be significantly shorter than 40,000 years. The recurrence rate (2.5×10^{-5} events/year/1000 km^2) is also comparable to rates measured in areas of Holocene (and historic) faulting in western, central and north-central Nevada (Bell, 1984a, b; Wallace, 1978).

   Using an average displacement rate of 0.11 m/1000 years on the Windy Wash fault (Carr, 1984), 1.1 m of slip would be anticipated in the next 10,000 years. This is equivalent to at least a single earthquake of M6.5-7 (Bonilla and others, 1984).

6. Low ground-water flux rates and travel times (>20,000 years) are not tenable arguments against radionuclide release in the event of fault-induced disruption. These parameters have been calculated on the basis of present geohydrologic conditions and do not consider the probability of increased precipitation, elevated water table, or the effects of tectonic activity such as fracturing or regional deformation. They are also based on incomplete and unsubstantiated hydrologic evidence (see Desert Research Institute review comments).

In summary, the evidence relative to the disqualifying condition is incomplete and equivocal. Previous work in fact suggests that there is a significant potential for tectonic movement; this may result in a loss of waste isolation. A consensus also apparent in the supporting literature is that additional studies must be done before a realistic evaluation of the tectonics condition can be made. It is clearly premature, and possibly wrong, to state (EA, p. 6-233) that the evidence shows the disqualifying condition to be absent.

Pre-Closure Favorable Condition (Section 6.3.3.4.3)

"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."

I agree that this favorable condition is not present at Yucca Mountain.

The principal assumption (EA, p. 6-283) that the present low rate of tectonic processes will continue is incongruous in relation to existing literature as well as to evidence provided in the EA. The instrumental seismic record at Yucca Mountain is only a few years long, and is clearly too short to extrapolate into the near future. Geologic, seismicity, and stress studies conducted in the region (Carr, 1984; Rogers and others, 1983; U. S. Geological Survey, 1984) all suggest that Yucca Mountain lies within an area of relatively high seismic activity and that faults at Yucca Mountain may be stressed to near the rupture point.

Seismic and geologic siting criteria for nuclear power plants are contained in Appendix A, 10CFR100, and are briefly summarized here. An evaluation of all tectonic structures under the site must be made to determine their potential for surface displacement. All faults greater than 1000 feet long must be evaluated as to whether they are "capable" faults if they are within 5 miles of the site. A capable fault is defined by the Nuclear Regulatory Commission as one that has one or more of the following characteristics: a) movement at or near the surface at least once within the past 35,000 years or more than once within the last 500,000 years; b) instrumental seismicity having a direct relationship with the fault; c) a structural relationship to another capable fault such that movement on one could be reasonably expected to cause movement on the other. If capable faults are found within 5 miles of the site, detailed studies must be conducted to determine their geologic history, including their relationship to regional tectonic structures. All capable faults are used to calculate anticipated vibratory ground motion at the site. The most severe earthquake associated with any of the capable faults is used to estimate the maximum ground acceleration at the site.

Studies of faulting in the geologic setting (Carr, 1974; 1984; Scott and Bonk, 1984; Swadley and Hoover, 1983; Swadley and others, 1984; U. S. Geological Survey, 1984) have not sufficiently demonstrated the lack of capable faults. These studies do not establish the assumption "that Yucca Mountain faults are not active" (EA, p. 6-286). To the contrary, these studies indicate that the Yucca Mountain faults should be considered potentially active in light of existing data.

Since the assumption that Yucca Mountain faults are not active is not valid, the estimated peak ground acceleration of 0.4g is too low. If faults at Yucca Mountain ruptured, peak ground accelerations approaching or exceeding 1.0g might be associated with a magnitude 6-7 earthquake. Such vibratory ground motion could exceed accepted design parameters for nuclear facilities.

Pre-Closure Potentially Adverse Conditions (Section 6.3.3.4.4)

Condition (1): "Evidence of active faulting within the geologic setting."

I agree that this potentially adverse condition is present.

Seismic data summarized in Carr (1984) and Rogers and others (1983) support the conclusion that active faulting is occurring in the geologic setting.

Condition (2): "Historical earthquakes or past man-induced seismicity that, if either were to recur, could produce ground motion at the site in excess of reasonable design limits."

I agree that this potentially adverse condition is not present.

Condition (3): "Evidence, based on correlations of earthquakes with tectonic processes and features (e.g. faults) within the geologic setting that the magnitude of earthquakes at the site during repository construction, operation and closure may be larger than predicted from historical seismicity."

I do not agree that this potentially adverse condition is not present.

The assumption that "Yucca Mountain faults are not active" is not reasonable based on existing evidence, as previously discussed. The estimated peak ground acceleration of 0.4g is therefore too low. Since the faults immediately underlying the repository may be stressed to near the rupture point (Healy and others, 1984), they should be considered active and capable of generating an earthquake of magnitude 6-7. Historical and instrumental evidence suggest such an earthquake could produce vibratory ground motion approaching 1.0g. Such levels of ground motion are higher than those generally anticipated in seismic design of nuclear power plants (0.6-0.75g).

The instrumental seismic record at the site is far too short (a few years long) to allow inferences to be made concerning anticipated seismicity during the next 90 years.

Taken together, stress data, historic seismicity, and the indication that fault activity is more dependent on fault orientation than fault age, all suggest that the potential for significant seismicity at Yucca Mountain should be considered (Rogers and others, 1983, p. 27). There is substantial evidence that earthquakes larger than those predicted from historical seismicity may be anticipated at the site. It has not been demonstrated that these earthquakes are not likely to occur during the 90-year life-time of the operating facility.

Disqualifying Condition (Section 6.3.3.4.5)

"A site shall be disqualified if, based on the expected nature and rates of fault movement or 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."

I do not agree that the evidence does not support a finding that the site is qualified. The evidence is, at best, incomplete and equivocal.

Existing evidence fails to demonstrate that the faults at and near Yucca Mountain should not be considered capable by Nuclear Regulatory Commission criteria. The evidence for lack of faulting in the last 40,000 years is incomplete; the evidence for lack of recurrent faulting in the last 500,000 years has not been addressed.

It is not reasonable to assume that all important fault scarps have been detected (EA, p. 6-290). As discussed in a following section, the fault studies to date have not utilized several commonly accepted state-of-the-art investigative techniques in tectonic analyses for nuclear facilities. In particular, low sun-angle aerial photography is capable of delineating small, subtle structural features which otherwise go undetected on standard aerial mapping photography (see for example, Cluff and Slemmons, 1972). Substantial geologic evidence (Carr, 1974, 1984; Rogers and others, 1983; Scott and Bonk, 1984; Scott and others, 1984; U. S. Geological Survey, 1984) suggests that many of the faults at and near Yucca Mountain are predominantly strike-slip, rather than dip-slip in nature. The character of strike-slip faulting is such that surficial evidence may be difficult to recognize. In addition, large, prominent scarps may not be present if faulting, even if dominantly dip-slip, is distributive in nature. Scott and Bonk (1984) show that Yucca Mountain is highly faulted and fractured; if a large Holocene faulting event had occurred, it may have resulted in numerous small scarps being distributed across a broad zone.

Based on existing literature, it is unreasonable to attribute the greatest potential seismic hazard to an earthquake of magnitude 6.8 on the Bare Mountain fault. The U. S. Geological Survey (1984, p. 75) stipulate that their interpretation is based on the assumption that Yucca Mountain faults are inactive, and that, should active faults be discovered at or near the site, the potential for damaging earthquakes and considerably larger accelerations is possible. In addition, other published studies suggest that the calculated magnitudes are too low. New statistical relationships (Bonilla and others, 1984) suggest that the Bare Mountain fault could generate at least a magnitude 6.9 earthquake. Algermissen and others (1983) include the Yucca Mountain geologic setting in an area which could experience a magnitude 7.3 earthquake.

Summary of Pre-Closure Conditions

The seismic record is too short, and the geologic evidence is too incomplete to allow a determination of fault capability at Yucca Mountain according to accepted criteria. Based on existing literature it is unreasonable to assume that Yucca Mountain faults are inactive. Design parameters, such as maximum credible earthquake and maximum anticipated vibratory ground motion, are underestimated since they assume Yucca Mountain faults to be inactive. The evidence for lack of surface displacements at or near Yucca Mountain in the last 40,000 years is equivocal and incomplete and is not substantial enough to allow the conclusion to be drawn that faulting at Yucca Mountain is unlikely during the 90-year pre-closure period.

SPECIFIC DISAGREEMENTS

The following is an itemized page-by-page listing of specific disagreements which I have with statements contained in the tectonics and related sections of the EA. The number refers to the page in the text of the EA on which the statement is found.

3-19. "Displacement of Quaternary alluvium within about 10 to 20 km of the site is limited to a few very small degraded scarps less than a meter or so in height."

The U. S. Geological Survey (1984, fig. 28) show numerous Quaternary faults within 20 km of the site, including Bare Mountain, Crater Flat, and Rock Valley fault systems, all of which have prominent scarps.

The Bare Mountain scarp is about 4 m high, and the Solitario Canyon scarp is about 2.5 m high (Swadley and others, 1984, p. 15, 18). Suggestions that such scarps are "very small, degraded" features are not consistent with the evidence.

3-21. "Under the assumption that Yucca Mountain faults are not active, the peak deterministic acceleration computed at Yucca Mountain, resulting from the maximum earthquake is approximately 0.4g."

The assumption that Yucca Mountain faults are not active is not valid nor is it supported by the existing literature (as previously discussed). This statement is also incongruous in relation to another statement on the same page: "...until there is a better understanding of seismic cycles and of why seismically stable and unstable areas exist within the same structural province, earthquakes near Yucca Mountain should be considered possible."

3-22. "The age and length of fault displacements may not be reliable indicators of future earthquake size and frequency ...".

Age of faulting, particularly in the Basin and Range Province, is an accepted parameter in neotectonic studies (see, for example, Wallace, 1978) and is the only parameter that can be used to establish long-term slip rates. The statistical relationship between earthquake magnitude and fault length has been shown by Bonilla and others (1984) to have a very high correlation coefficient (r^2=99%) for some historic earthquakes in the U.S.

6-132. "No evidence of modern or Quaternary springs or seeps at Yucca Mountain has been found."

Field review with U.S.G.S. personnel showed that the Bow Ridge fault exhibits evidence of spring activity. Carbonate deposits in the fault zone of Trench 14 (Swadley and others, 1984) are attributed to spring activity.

6-222. "The most recent probability calculation for basaltic eruptions at a site on Yucca Mountain range from 4.7×10^{-4} to 3.3×10^{-6} for a 10,000 year period."

This statement implies that only basaltic eruptions are possible near Yucca Mountain. Crowe and others (1984, p. 86) state "... new work and the recent discovery of two additional sites of past hydrovolcanic volcanism have raised questions about the hydrovolcanic activity associated with possible future volcanism at Yucca Mountain."

6-222. "... the average rate of faulting at Yucca Mountain during the last 2 m.y. has been less than 0.01 m/1000 yrs."

This statement implies that all faults at Yucca Mountain have slip rates of 0.01 m/1000 yrs or less. Carr (1984, p. 95) shows that some faults, such as the Windy Wash fault, have slip rates of 0.11 m/1000 yrs or greater. This is an order of magnitude greater than the stated average rate. It is inappropriate to assign an average slip rate to a fault that may have a potential for movement significantly higher than the average.

6-223. "Available data indicate no unequivocal evidence that surface fault displacement has occurred within an 1100 km^2 area around the Yucca Mountain site in the past 40,000 years."

Available data indicate that the evidence is incomplete and equivocal. Not all faults were investigated (Swadley and others, 1984) in sufficient detail to allow the determination that they are not capable faults (see Appendix). A field review with U.S.G.S. personnel (including W. C. Swadley) suggests that there may be evidence of young movement on some faults at Yucca Mountain. Examination of exposures in Trench 14 across the Bow Ridge fault and Trench CF-1 across the Solitario Canyon fault suggest that movement less than 40,000 years old may have occurred.

6-224. "Repeated movements of any consequence on normal faults at or near Yucca Mountain would surely have left prominent scarps."

This definitive conclusion is untenable based on generally recognized structural-tectonic concepts for the Basin and Range. While it is recognized that large-magnitude earthquakes have generally been accompanied by large surface displacements, there have been some notable exceptions that suggest that the absence of a large scarp is not sufficient evidence to preclude significant earthquake activity. The 1932 Cedar Mountain earthquake (M=7.3) occurred on north-trending faults in central Nevada which are structurally analogous to Yucca Mountain faults. Vertical surface displacements associated with this earthquake were relatively small, ranging in general from 0.3 to 0.5 m in height (Gianella and Callaghan, 1934; Molinari, 1984). Similarly, the 1934

Excelsior Mountains earthquake (M=6.3) produced only fracturing and small scarps less than 15 cm high. Surface rupturing associated with the 1903 Wonder earthquake (magnitude unknown) produced only fracturing and fissuring; this fault subsequently reruptured in 1954 (Slemmons and others, 1959).

All of the above examples are possible conjugate structures related to wrench-fault movement on the Walker Lane (Shawe, 1965). Similar conjugate relationships can be postulated for the structures in and around Yucca Mountain.

Geologic evidence (Scott and Bonk, 1984) also suggests that Yucca Mountain is a) highly faulted and fractured and b) cut by numerous strike-slip faults. Both conditions may lead to the absence of prominent scarps; faulting may have been distributive in nature, and strike-slip movement would not be anticipated to produce large vertical scarps.

6-228. "There is no evidence that subsidence related to dissolution of rocks has occurred ..."

The evaluation of subsidence does not include an assessment of surficial warping and/or faulting related to natural sediment compaction or ground-water withdrawal. Both types of subsidence effects are evident in the late Quaternary record of Las Vegas Valley (Bell, 1981a).

The assessment of regional tectonic warping also does not include leveling data such as cited by Longwell (1960).

6-228,229. "Calculations ... show that over the last few million years Yucca Mountain and adjacent areas have been relatively stable, particularly in comparison with tectonically active areas, such as Death Valley and Owens Valley."

Table 6-33 of the EA lists the uplift rate of the Death Valley Black Mountains as 0.3 m/1000 yrs. Carr (1984, p. 95) lists the uplift rate on the Windy Wash fault near Yucca Mountain as also 0.3 m/1000 yrs. It appears from this comparison that the uplift rate at or near Yucca Mountain is comparable to that in Death Valley, which is considered tectonically active.

6-233. "There is no clear evidence ... that a major earthquake is likely to occur at Yucca Mountain."

To the contrary, based on data provided in the EA as well as in major supporting publications, such as Rogers and others (1983) and U. S. Geological Survey (1984) a large earthquake is not only possible but probable during the 10,000 year life of the repository. This statement is clearly incongruous based on existing evidence.

6-233. "To evaluate trends in tectonic activity, it is desirable to consider a period longer than the Quaternary Period."

This assumption is not compatible with observed patterns of tectonic activity in the Great Basin (see, for example, Wallace, 1978). Trends in activity have been recognized as being episodic or cyclic in nature with periods between major episodes of faulting ranging up to tens or hundreds of thousands of years. The Quaternary, especially the late Quaternary, record must be used to establish the present state of these cycles.

6-233. " ... the probability for major earthquakes in the area is about 2.5 per 100,000 years."

This is not a probability, this is a recurrence rate. And, in addition, this is a recurrence rate normalized for an area of 1000 km^2. In other words, it is an estimated rate anticipated to occur anywhere within a 1000 km^2 area irregardless of existing geologic structure. If geologic structure is included, individual faults will have higher rates. This rate (2.5×10^{-5} events/yr/1000 km^2) is also comparable to rates calculated in western, central, and north-central Nevada by Bell (1984,a,b) and Wallace (1978) where numerous historic surface faulting events have occurred.

6-234. "Neither major tectonic activity nor the resumption of large-scale silicic volcanic activity in the area near Yucca Mountain is likely in the next 10,000 years."

Based on existing evidence, this conclusion is premature. Evidence for tectonic activity is available and has been discussed above. Recent studies (Crowe and others, 1984) also suggest that possible hydrovolcanic activity at Yucca Mountain has not been sufficiently evaluated.

6-234. "No mechanisms have been identified whereby future tectonic processes or events could lead to unacceptable radionuclide releases."

This conclusion is inconsistent with existing geologic and hydrologic evidence. A conservative scenario which should be evaluated is the following:

1. Based on existing evidence, at least one large-magnitude earthquake accompanied by a 3-m displacement should be anticipated at the repository during the next 10,000 years.

2. Based on uncertainties in matrix flow travel time, a fracture flow system should also be evaluated, especially with regard to new fracturing associated with faulting through the repository.

3. Hydrologic conditions, such as water-table elevation and hydraulic gradient, should be estimated based on the anticipated pluvial (wetter) conditions.

4. The potential for hydrovolcanic activity should be assessed particularly in relation to the tectonic and hydrologic variables listed above.

5. The overall potential for tectonic processes leading to loss of waste isolation should be evaluated not only for the 10,000 year period but for the 100,000 year time period as well, as required by the potentially adverse hydrologic condition (EA, p. 6-121).

DEFICIENCIES IN TECTONICS STUDIES

In addition to the foregoing, the following is a description of areas for additional study which should be reasonably expected and which have not been accomplished. This is based on a review of the EA and all pertinent supporting literature.

1. Structure-Tectonics of the Walker Lane

Existing evidence (Carr, 1974, 1984; Rogers and others, 1983; U. S. Geological Survey, 1984) suggests that north-northeast-trending faults such as those at Yucca Mountain are preferred structural orientations for future faulting. These studies do not, however, evaluate these preferred orientations in relation to the regional structural-tectonic setting. Such north-northeast-trending faults have been previously regarded as right-lateral conjugate faults related to wrench faulting along the right-lateral Walker Lane (Shawe, 1965). So although no definitive evidence of active northwest-trending strike-slip movement is evident in the Yucca Mountain area, the north-northeast-trending faults may be releasing tectonic strain related to stress on the Walker Lane system. Historic surface faulting in central, north-central, and western Nevada has in fact been restricted to such conjugate Walker Lane features. In particular, the 1932 Cedar Mountain earthquake (M=7.3) occurred on a north-trending fault which can reasonably be related to wrench faulting along the Walker Lane (Molinari, 1984).

The Walker Lane and Las Vegas Valley Shear Zone are regarded by Carr (1974, 1984) as inactive in this region. The activity of these structural-tectonic features should be re-evaluated in light of these possible conjugate relationships. In addition, the activity should be evaluated on the basis of possible listric, or detachment, faulting. Carr (1984) indicates that there is local evidence for such faulting in the Yucca Mountain region, and Molinari (1984) interprets the 1932 Cedar Mountain faulting on the basis of detachment movement.

2. Potential for Strike-Slip Movement

Geologic, focal mechanism, and explosion-induced faulting data (Carr, 1984; Rogers and others, 1983; U. S. Geological Survey, 1984) suggest that north-northeast-trending faults, such as those at Yucca Mountain, are possible right-lateral strike-slip faults and that east-northeast-trending faults, such as the Rock Valley fault, are left-lateral strike-slip faults. Scott and Bonk (1984) and Scott and others (1984) suggest that northwest-trending faults at Yucca Mountain including those at the repository site may be right-lateral strike-slip faults. The EA evaluation of future tectonic activity has been limited to inferred normal faulting events at Yucca Mountain. In light of the above evidence indicating the existence of strike-slip faults, the potential for strike-slip movement should be evaluated, particularly with regard to estimates of maximum credible earthquake and peak ground acceleration. The statistical relations between fault length and magnitude may be different for strike-slip and normal faulting events (Bonilla and others, 1984).

3. Potential for Undetected Fault Scarps

Scott and Bonk (1984) show Yucca Mountain to be cut by numerous parallel and en echelon, north-northeast-trending faults and fractures. The U. S. Geological Survey (1984) indicates that many of these faults are closely spaced and individually show only small displacements; this suggest that much of the faulting may be more related to distributive movement than to movement along a single fault trace. In addition, vertical surface displacements associated with strike-slip faulting would probably be significantly smaller than those associated with dip-slip events. For example, the 1932 Cedar Mountain earthquake (M=7.3) produced scarps ranging generally from 0.3 m to 0.5 m in height (Gianella and Callaghan, 1934) and was dominantly a right-lateral event. Scarps of such small height may not be preserved long as prominent features, especially in alluvium. The conclusion that all important fault scarps of Quaternary age have been identified (Carr, 1984) appears to be based on the assumption that all Quaternary faulting is reflected by large vertical displacements. The above evidence certainly suggests that Quaternary faulting may have 1) involved distributive displacements and 2) resulted from strike-slip movement; both of these factors may contribute to the poor preservation of prominent fault scarps.

An examination of aerial photography covering Yucca Mountain (GS-TS; and inhouse U.S.G.S. low-altitude missions) suggests that there may be unmapped Holocene features in several areas. In particular, both the Bow Ridge and Solitario Canyon faults exhibit geomorphic evidence suggesting they may have had Holocene movement. A field review of trenches across these faults with U.S.G.S. personnel also supports this possibility. Faults exposed in Trench 14 (Bow Ridge fault) and Trench CF-1 (Solitario Canyon fault) may have had recurrent movement, the most recent having a small (<30 cm) displacement.

The potential for undetected Quaternary fault scarps should be evaluated by utilizing low sun-angle aerial photography. This technique is commonly used for neotectonic studies (see, for example, Cluff and Slemmons, 1972) and is primarily designed to highlight subtle geomorphic features, such as small fault scarps, not easily detected on standard aerial mapping photography. Studies by Bell (1981b) also indicate that this is an important tool in mapping fault scarps in western Nevada. Low sun-angle photography is taken when conditions are optimum for detecting geomorphic expression of the fault zone being studied. The sun is normally low on the horizon (10-25^{o}) but the actual flight time is determined by assessing the orientation and general physiographic character of the fault zone and assessing the best lighting conditions, such as sun illumination or sun-shadowing. An east-northeast-trending fault zone with north-facing scarps, for example, would best be photographed in an early morning flight during the winter months when the sun remains to the south.

4. Lineament Analysis

Remote sensing analysis of lineaments is an accepted state-of-the-art technique for detecting regional structural and hydrogeologic relationships as well as for pinpointing potentially active faults (Glass and Slemmons, 1978). Such analyses include the use of Landsat multi-spectral scanner and thematic mapping images, Seasat synthetic aperature radar images, Shuttle imaging radar, and other related multi-format imagery. A comparable study of linear features in west-central Nevada (Rowan and Purdy, 1984) shows that remote sensing is a useful tool in detected regional structures.

The nature and extent of the geologic structures surrounding Yucca Mountain, in particular, the Walker Lane and Las Vegas Valley Shear Zone, should be studied by using state-of-the-art remote sensing imagery.

5. Geomorphic Analyses of Faults

Several state-of-the-art techniques exist in geomorphic studies of faulting that have not been utilized at Yucca Mountain. Studies along the Garlock fault by Bull and McFadden (1977) indicate that tectonic-geomorphic features such as entrenched and unentrenched alluvial fans and pediments, mountain-front sinuosity, and valley floor width and valley height ratios are useful indicators of tectonic activity.

Geomorphic profiling of fault scarps is also a common technique employed to categorize recency of fault movement, particularly in the Basin and Range Province (see, for example, Bucknam and Anderson, 1979). Statistical relationships (regressions) are developed using scarp height and scarp slope, and first approximations of scarp age may be determined. If, for example, the measurements of the Solitario Canyon scarp are used - 1.5 m high, 9° slope (Swadley and others, 1984) - an estimated age of about 12,000 years could be inferred from Bucknam and Anderson's curves. This age is clearly in conflict with the estimated age (1.2 m.y.) of this fault scarp, and suggest some data of Swadley and others (1984) may be in error. See the Appendix for a detailed review of this study.

Topographic profiling of other geomorphic features, such as stream terraces and alluvial-fan surfaces, is also useful in detecting tectonic deformation. Profiling of a wash terrace, for example, may show evidence of warping across a fault zone, even in the absence of surface rupturing.

More detailed geomorphic studies of the Yucca Mountain faults and alluvial features should be conducted using state-of-the-art tectonic-geomorphic techniques.

6. Integration of Structural and Quaternary Geology Relationships

The preliminary geologic map of Yucca Mountain (Scott and Bonk, 1984) shows extensive structural detail, but does not include a differentiation of Quaternary deposits which could be useful in determining recency of fault movement. Conversely, the map of surficial deposits in the Yucca Mountain area (Swadley and others, 1984) shows a detailed differentiation of Quaternary deposits but does not show the detailed structure. In order to adequately assess recency of fault movement, it is important to establish and show the relationship between the structure and the age of faulted, or unfaulted, surficial units. A composite map should therefore be compiled showing both the structure and the distribution of differentiated Quaternary deposits, particularly as related to the faulting.

The Quaternary stratigraphic control should be expanded and integrated with other related data such as archeological and soils information. Pippin (1982, 1984) describes numerous Quaternary stratigraphic relationships, including ages of terraces and alluvial fans determined through archeological research at Yucca Mountain. He also describes a volcanic ash found in alluvium of Yucca Wash. None of this information has been integrated with the studies of Hoover and others (1981) or Swadley and others (1984). In addition, much of the Quaternary age control is based on uranium-thorium dating of pedogenic carbonate, but no comprehensive soils data (such as a regional soils map) are provided. Field review with U.S.G.S. personnel of dated carbonate deposits in trenches indicates that there are anomalous variations in pedogenic carbonate of deposits of the same inferred age (e.g. unit Q2C). These anomalous variations need to be assessed using better soils data.

More exploratory trenching of suspected capable faults should be conducted. Although twenty-three trenches have been excavated across faults in the Yucca Mountain area, Holocene-age deposits were thin or absent in most of them (U. S. Geological Survey, 1984, p. 41). Trenches should be placed where the stratigraphic and structural relationships can be unequivocally determined. More extensive trenching studies should be done on the Bow Ridge, Paintbrush Canyon and Solitario Canyon faults, with the studies conducted in conjunction with a team of independent observers (SAIC, 1984, p. 18).

7. Probabilistic Estimates of Potential for Large Earthquakes and Surface Faulting

The post-closure favorable condition requires that tectonic processes have less than one chance in 10,000 of leading to a loss of waste isolation over the next 10,000 years. To date, no probabilities have been calculated either in the EA or in the supporting literature to assess this condition. The estimated occurrence (EA, p. 6-232) of 2.5 large earthquakes in 100,000 years per 1000 km^2 is not a probability calculation, it is a recurrence rate (2.5×10^{-5} events/yr/1000 km^2). It is a recurrence rate which is normalized for the entire 1000 km^2; rates on individual faults may be significantly higher. It is also a rate comparable to rates calculated in central, western, and north-central Nevada where active (historic) faulting has been relatively frequent (Bell, 1984b; Wallace, 1978).

A probabilistic estimate of earthquake hazard should be based on individual fault analyses sufficient in detail to allow the determination of such faulting characteristics as rerupture interval, recurrence rate, slip rate, holding time, and elapsed time (Cluff and others, 1980). These types of data should be collected for all major faults in the geologic setting especially those immediately underlying the repository site. This data then should be assessed, in a probabilistic fashion, in relation to other pertinent data such as seismicity and stress/strain measurements.

8. Explosion-Induced Faulting

Tectonic strain release has been associated with underground nuclear testing (for example, Hamilton and Healy, 1969). Healy and others (1984) found that *in situ* stress measurements taken in a 1300+ m deep hole at the repository site indicate that the faults at Yucca Mountain may be close to "incipient normal faulting". Vortman (1983) calculated that a hypothetical (but realistic) underground nuclear explosion at Buckboard Mesa could increase the vertical stress by 8% and the horizontal stress by 24% at Yucca Mountain. He also calculates a possible explosion-induced strain of about 1.8×10^{-5} which is several orders of magnitude greater than the natural tectonic strain.

In light of the above evidence, an assessment should be made of the liklihood of explosion-induced faulting at Yucca Mountain.

SUMMARY

A review of the Yucca Mountain Environmental Assessment and supporting technical literature indicates that the site does not meet most of the specified conditions with regard to tectonics. Guidelines established by DOE (EA, p. 6-4) require that conservative assumptions be made in the absence of an adequate data base. They also require that the existing data "clearly support" a condition for a conclusion to be drawn. A review of the data indicates that not only are the data bases inadequate, but that the existing data are in some instances in direct conflict with the EA conclusions.

A review of the post-closure conditions indicates that the favorable condition is not present, five of six potentially adverse conditions are present, and the disqualifying condition is possibly present. The probability of tectonic activity disrupting the repository has not been established as being less than 1 in 10,000 in the next 10,000 years. To the contrary, the existing geologic data suggest that large magnitude earthquake activity accompanied by surface faulting may occur at Yucca Mountain. In addition, the potential for volcanic activity is understated based on new interpretations of hydrovolcanic eruptions. Based on preferred orientations for faulting, _in situ_ stress measurements, tectonic strain release associated with nuclear explosions, and historic seismicity in the geologic setting, it has been reasonably concluded in the existing literature and in this report that there is a significant potential for seismic activity at Yucca Mountain.

In regard to the disqualifying condition, the data base is clearly incomplete as well as conflicting. The data do not "clearly support" the absence of the disqualifying condition. A reasonable interpretation of the existing evidence in fact suggests that there is a significant potential for tectonic activity which could lead to loss in waste isolation. The calculated long ground-water travel time (20,000 years) is also based on incomplete data and is not a tenable argument for waste containment in the event of tectonic disruption.

In reviewing the pre-closure conditions, it is concluded that the favorable condition is not present, two of three potentially adverse conditions are present, and the disqualifying condition is possibly present.

Geologic studies to date have not assessed the potential for faulting during the 90-year operational life of the facility according to criteria established for other nuclear facilities (10CFR100). In particular, the identification of capable faults at and around Yucca Mountain is incomplete, especially as related to recurrent movement in the last 500,000 years. The assumption that Yucca Mountain faults are not active is not valid based on existing evidence. Consequently, the estimated peak ground acceleration is too low since it is calculated from a postulated fault rupture 15 km from Yucca Mountain. If the faults at Yucca Mountain ruptured, vibratory ground motion could exceed accepted design levels for nuclear power plants.

The historic seismic record at Yucca Mountain is far too short (a few years long) to allow extrapolation over the next 90 years of the facility life-time, and is therefore inadequate for design purposes.

This review also indicates that there are numerous other deficiencies in the data base with respect to tectonics. In particular, there is insufficient detail in areas related to regional structure-tectonics, geomorphic and stratigraphic identification of faults at Yucca Mountain, and probabilistic estimates of earthquake activity and surface faulting at Yucca Mountain.

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APPENDIX

Review of Swadley and others (1984),
Preliminary Report on Late Cenozoic Faulting and
Stratigraphy in the Vicinity of Yucca Mountain,
Nye County, Nevada

The study of Swadley and others (1984) analyzes late Cenozoic, in particular late Quaternary, faulting in the Yucca Mountain region. Their conclusions, although preliminary, are utilized in the EA to substantiate the assessment of tectonic hazards at the repository site, especially with regard to recency of fault movement and compliance with criteria for nuclear facilities. Consequently, it is important to evaluate this study in this context, and, while acknowledging the fact that the work is preliminary, to assess the adequacy and accuracy of data contained.

The results of the study, either stated or implied, are that all late Cenozoic faults have been mapped and dated, and that none show evidence for movement within the last 40,000 years (which could make them capable faults by NRC criteria). A review of this report as well as a field review of faults and trenches with W. C. Swadley and other U.S.G.S. personnel suggest that the evidence is insufficient to reach a conclusion regarding fault capability. There is, in fact, some evidence suggesting considerably younger movement on some faults than interpreted in this report.

The following are individual aspects or statements within the study with which I disagree.

1. Faults were identified solely on the basis of interpretation of conventional aerial photography. Investigative techniques in neotectonics studies should include the use of multi-format imagery, in particular low-sun-angle photography. This type of photography is useful in detecting subtle geomorphic features related to strike-slip and distributive faulting, and is frequently found to detect features otherwise undetected on standard aerial mapping photography (see, for example, Cluff and Slemmons, 1972).

The implied assumption in this study is that all significant fault movement will be reflected by large scarps visible on conventional aerial photography. Based on the nature of historic fault scarps in central and western Nevada (e.g. the Cedar Mountain area) as well as on the potential for strike-slip movement at Yucca Mountain, this assumption is not well founded.

There also is an inadequate integration of existing structural data. Scott and Bonk (1984) show many north-northeast and northwest-trending faults in the Yucca Mountain area that were not included in the study of Swadley and others (1984). Field review indicates that many of these faults, including those at and near the repository site, are overlain by Quaternary deposits which can be used to establish minimum fault age.

2. Twenty-three trenches were excavated across faults in the area, but not all potentially capable faults were trenched (for example, faults I, K, L, N), and trenching sites in some instances did not contain adequate stratigraphic control. Accepted trenching practice usually includes selecting sites that have good stratigraphic, especially late Pleistocene and Holocene, age control. Many of the trenching sites in this study do not have good late Pleistocene age control, and the U. S. Geological Survey (1984) indicate that Holocene-age deposits were thin or absent in most trenches. Trench locations should have been selected which provide unequivocal evidence for age of faulting.

3. Stratigraphic age control is provided by the Quaternary stratigraphic relationships of Hoover and others (1981). Both studies lack a comprehensive analysis of pedogenic soils which form the basis for identification and dating of many deposits in the trenches. Nearly all radiometric dates are on pedogenic carbonates but no regional soils relationships (or soils map) are included. Field review suggests that anomalous relationships exist between radiometrically determined ages and degree of carbonate development in some trenches. The age (270,000 yrs) of unit Q2C carbonate in Trench CF-3, for example, is considerably older than suggested by the degree (Stage II) of carbonate development.

4. The Paintbrush Canyon, Bow Ridge, and Solitario Canyon faults exhibit evidence of young movement that has not been thoroughly evaluated. Both the Paintbrush Canyon and Bow Ridge faults lack surficial mapping evidence of Quaternary offset, but the trenching data indicate that Pleistocene deposits are in fact disrupted, suggesting that the surficial (photographic) control is inadequate. The Solitario Canyon fault is marked by a series of sharp, prominent scarps, but the age of offset is estimated to be 1.2 m.y., significantly older than suggested by the geomorphic character of the fault. Field review suggests that this scarp may be compound, with the last movement being much younger than estimated.

All three faults show evidence of fracturing in the late Pleistocene deposits overlying the shear zones, and this fracturing is attributed to minor offset in the underlying bedrock. This indicates late Pleistocene movement irregardless of the lack of offset in the sediments. Field review of the trenches also indicates that the evidence for lack of offset in the sediments is equivocal. In trench 14 (Bow Ridge fault) and trench CF-1 (Solitario Canyon fault), the fractures may be associated with small displacements in the soil on the order of 20 to 30 cm.

A review of the U.S.G.S., in-house, low altitude aerial photography suggests that there are subtle geomorphic features (lineaments) associated with some of these faults. In particular, the Bow Ridge fault appears to continue north to the mouth of Yucca Wash as a series of vegetation lineaments or subtle scarps which may be related to the fracturing observed in the trench.

5. The scarp morphology and age relationships developed for the Solitario Canyon fault are clearly anomalous. The scarp appears geomorphically young and has a measured height of 1.5 to 2.5 m and a slope of 7-9^{o}; based on the occurrence of volcanic ash in the shear zone, the fault scarp is dated at 1.2 m.y. This age is significantly older than that calculated from the scarp morphology evidence. Based on the scarp morphology studies of Wallace (1977), Bucknam and Anderson (1979), and Hanks and others (1984), the height and slope measurements determined for the Solitario Canyon fault scarp suggest that the scarp is latest Pleistocene in age, possibly Holocene. The 1.5 m height and 9^{o} slope, for example, are comparable to measurements made by Bucknam and Anderson (1979)

on the Lake Bonneville shoreline, estimated to be 11,000-15,000 years old. I suggest here that a 1.2 m.y.-age for the Solitario Canyon fault scarp is untenable. More likely is the possibility that the scarp is compound, reflecting recurring movement the first of which occurred about 1.2 m.y. ago and the most recent of which is late Pleistocene or Holocene in age.

The use of the Solitario Canyon fault scarp as a datum for estimating the ages of other surrounding fault scarps does not appear to be valid. Table 4 of Swadley and others (1984) lists numerous faults (J, K, L, N, O, P, U, V, W, X, and Y) that are dated at 1.2 m.y. or greater based on the scarp morphology relationships and the estimated 1.2 m.y. age for the Solitario Canyon fault. In light of the above discussion on the anomalous age and morphology data, it is highly likely that these estimated ages are wrong.

6. The trench logs are not consistent with the level of detail normally expected in state-of-the-art neotectonic studies. The studies of Swan and others (1980) and Bonilla and others (1984) for example indicate that the degree of detail shown in the trench logs can be substantially greater than that done by Swadley and others (1984). Improvement in detail would include better differentiation of lithologic subunits, more detail in the distribution and orientation of shears and fractures, and more definitive detail in the relationship between sheared, and fractured deposits and undisturbed, overlying deposits, particularly the dated soils.

A major deficiency of some trenches is the fact they do not expose the fault in question. They were emplaced across the trend or projection of a fault and consequently only provide negative evidence for the occurrence and recency of movement.

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State of Nevada

Department of Minerals

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March 4, 1985

BOB LOUX
Governor's Office
Nuclear Waste Project Office
Capitol Complex
Carson City, NV 89710

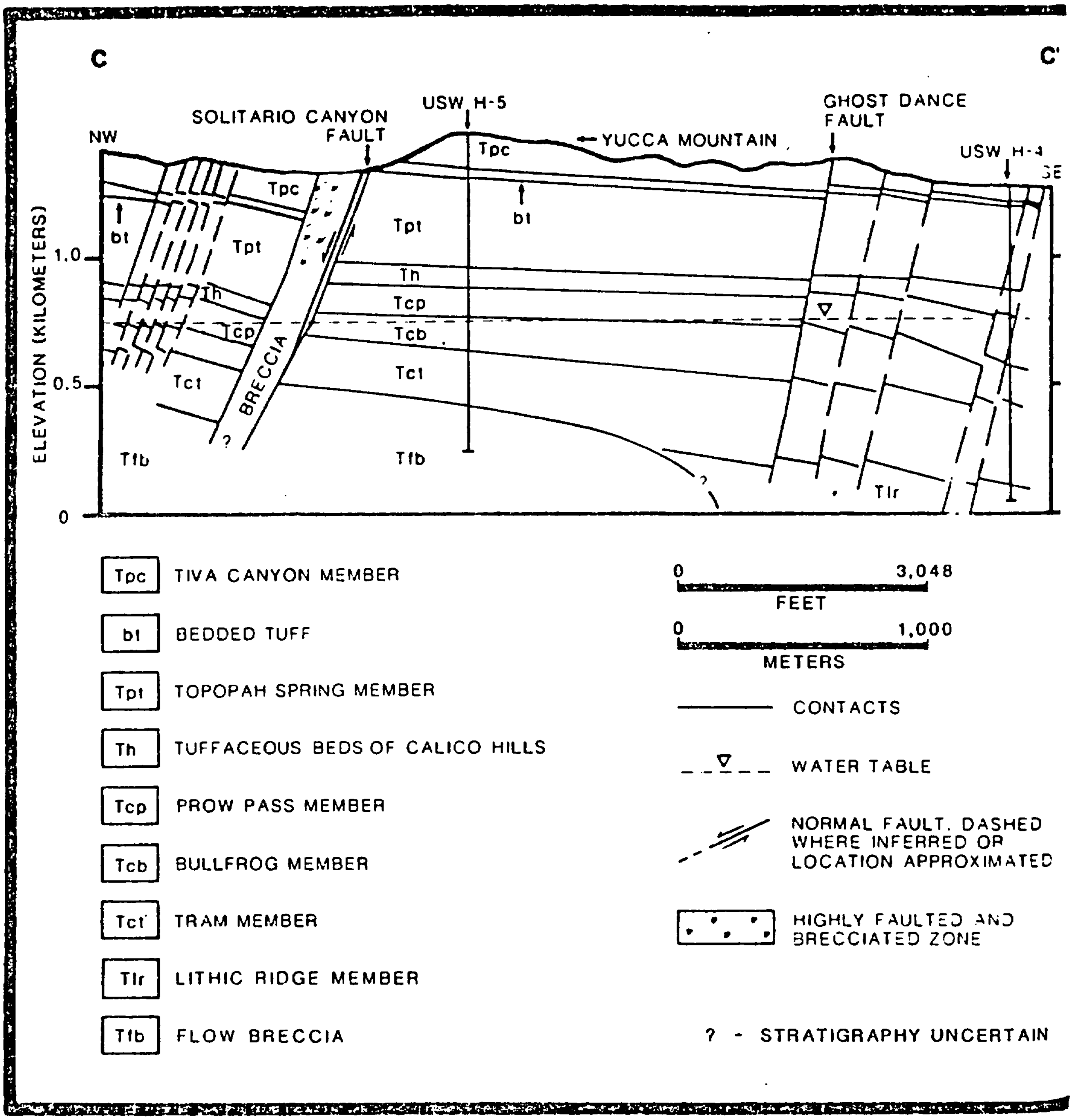
Dear Mr Loux,

The Department of Minerals appreciates the opportunity to respond to such an important issue as the candidacy of the Yucca Mountain site for a potential nuclear waste repository. This response addresses only the known energy and mineral resources in or near the Yucca Mountain Site area, areas of potential resources and areas that need more data.

GEOLOGIC SETTING

The Yucca Mountain area is part of an exposed Tertiary collapse caldera (volcanic depression) system referred to as the Timber Mountain Caldera. This caldera is part of a system of calderas which extends across the Nevada Test Site and Nellis Air Force Range in Nye County, Nevada. The area consists of a complex, high-angle, normal fault system. These faults extend at depth as seen by cross-section C-C'. Yucca Mountain consists of Tertiary volcanic tuffs of the Miocene Paintbrush and Pliocene Timber Mountain formations. The Bare Mountains, approximately six miles west of Yucca Mountain, consist of highly mineralized, complexly faulted formations of Pre-Cambrian to Mississipian age. Also included with Bare Mountain are low-angle thrust faults in the Paleozoic sequence. These formations are in fault contact with Tertiary ash flows and tuffs. Numerous cinder cones exist within the Crater Flat Caldera east of Yucca Mountain and are referred to as "black cone, red cone and little cones" on Crater Flat (Bare Mountain Quadrangle, USGS 15 minute series, 1954). Rocks in the Bare Mountain district were folded during the late Paleozoic-Mesozoic, probably thrust faulted during the Mesozoic, tear faulted along the northwest-trending Las Vegas shear zone during the Cretaceous and block faulted along north-trending structures in the late Tertiary (Cornwall and Kleinhampl, 1961). The situation is further complicated by being surrounded by Tertiary caldera systems, including the Crater Flat caldera system to the east, adjoining Yucca Mountain. The high-angle fault which separates Bare Mountain from Crater Flat appears to mark the termination of precious and base metal mineralization along the eastern flank of Bare Mountain (Larson, Bell, 1982). Ore solutions may have pulsed and caused mineral

O-3738



Northwest-southeast geologic cross section C-C'

Modified from Scott and Bonk (1984).

enrichment at varying time intervals (Paleozoic-Tertiary) into the structurally complex sequence of formations comprising Bare Mountain.

The Calico Hills lie just to the east of Yucca Mountain. A recent investigation by the Nevada Bureau of Mines and Geology for the United State Department of Energy was conducted in the area (NBM&G Open File Report 84-2, 1984, A Mineral Inventory of the Nevada Test Site and Portions of Nellis Bombing and Gunnery Range, Southern Nye County, Nevada). The area is located north of Jackass Flats and is composed of highly altered, bleached and fractured tuff deposits. The area shows evidence of doming and high-angle basin and range faulting.

MINERAL PRODUCTION AND MINING ACTIVITY

Most of the mineral production near Yucca Mountain is centered around the Bare Mountain District. Some prospecting has occurred in the Calico Hills, about 5 miles east of the Yucca Mountain site.

With regard to the Calico Hills, three mining shafts and five prospects are located within dolomites of the Devonian Devils Gate Formation. Mine workings are located along quartz fracture filled veins containing sulfides with associated pyrite, malachite and azurite. The area has been heavily prospected, but there is no recorded production to date. However, fracture systems of this type have excellent potential for sulfide mineralization.

The Bare Mountain (or Fluorine) Mining District lies six miles west of the Yucca Mountain site. This district is noted for gold, silver, mercury, fluorspar and silica production. The district was discovered in 1905 (Lincoln, 1923) and was later expanded to include part of Yucca Mountain to the east. The mines of the area and their production are described:

Silicon mine: Located at the extreme northwest end of Yucca Mountain (about seven miles northwest of the Yucca Mountain site), this mine produced silica which ran 99.7% SiO_2 and 0.04% iron. The silica was mined for ceramics.

Harvey (Telluride) mine: Mercury was discovered here in 1908 and 72 flasks were produced up until 1943 (Bailey and Phoenix, 1944). The mercury occurs as cinnabar in dolomite of the Nevada Limestone of Devonian age. Minor gold is also reported. Another deposit similar to the Harvey occurs 600 feet further north.

Vidano Group: Lying directly west of the Harvey, the Vidano Group has reported gold and silver production from a gossan area in limestone.

Thompson mine: "...small amounts of mercury have been found at the thoroughly explored Thompson mine in the northwest end of Yucca Mountain (Section 29, T.11S., R.48E.). Cinnabar occurs locally as small seams in silicified and opalized rhyolite tuff..." (Bailey and Phoenix, 1944).

Daisy deposit: This deposit occurs in dolomite of the Cambrian Nopah Formation which is controlled by complex tear faults and thrust faults in the area. The deposit consists of a fine grained purple fluorite (CaF_2) found in yellow clayey gouge zones. Some 130,000 tons of fluorspar averaging 75% CaF_2 have been mined since 1918.

Stirling (Panama) mine: This mine, currently operating, produced some 2,500 ounces of gold in 1980-1981. The mine is noted for oxidized fine grained gold along a silicified thrust fault zone between the Cambrian Bonanza King Dolomite Formation and the Pre-Cambrian Stirling Quartzite.

Diamond Queen mine: This mine has produced 75,000 tons of fluorspar from shear zones in the dolomite of the Nopah Formation.

Gold Ace mine: Between 1913 and 1936 some minor gold was produced at a 75 ton mill.

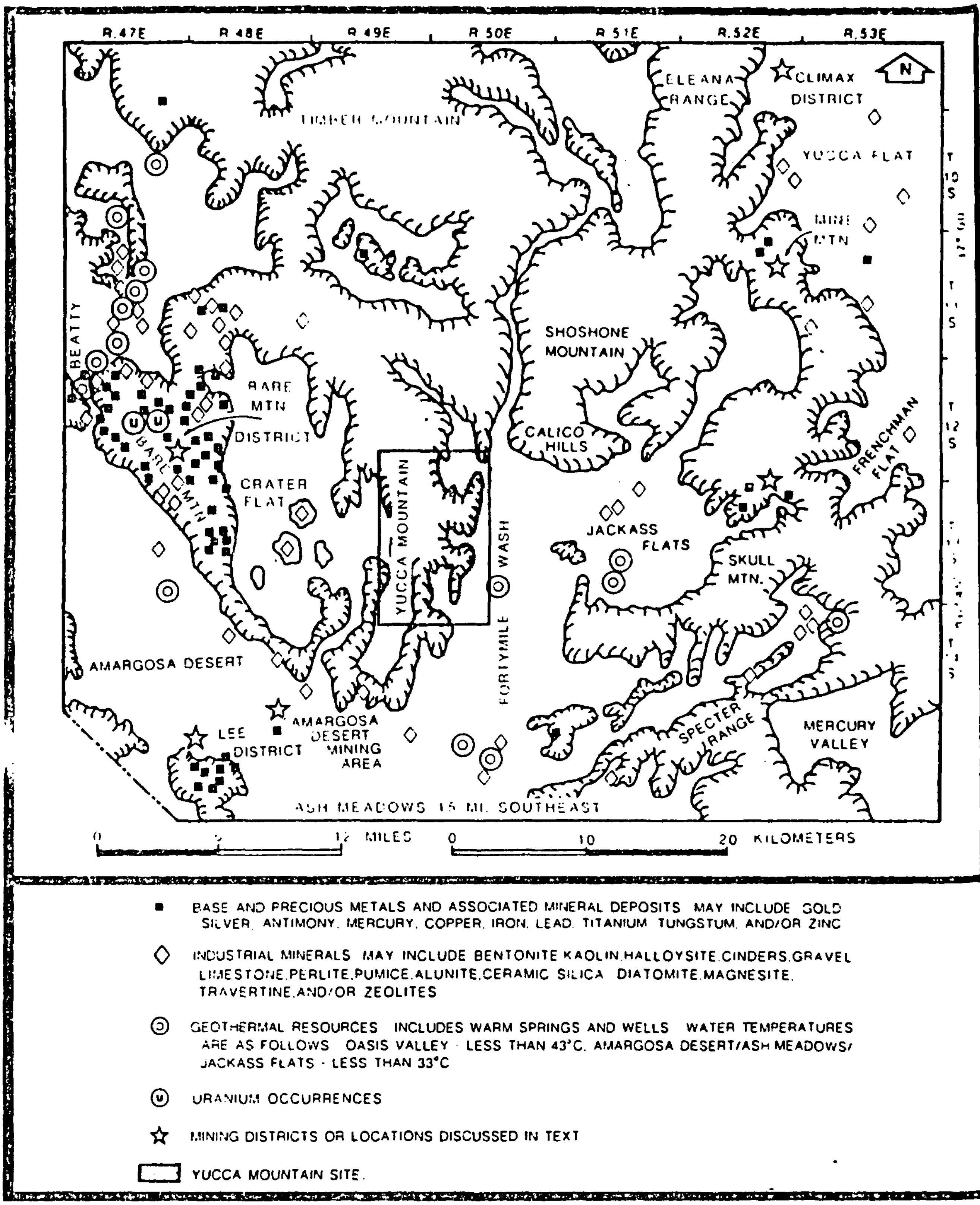


Figure 3-10. Location of metal deposits, industrial minerals, thermal waters, and mining districts in the vicinity of Yucca Mountain. Modified from Bell and Larson (1982) and Trexler et al. (1979).

Other: Minor amounts of uranium, tungsten and lead are reported in the Bare Mountain area, but production has not been in significant quantity. A large variety of industrial minerals are present in the Yucca Mountain area, including zeolites, clays, ceramic silica, alunite, perlite, pumice and volcanic cinder material.

Within the Yucca Mountain Site itself, zeolites occur at depth (1,300 feet or greater). Non-commercial amounts of gold and silver occur in the lower Tram Member of the Tertiary Crater Flat Tuff Formation at 3,515 feet in drill hole USWG-1 which consisted of 0.016 oz gold/ton and 0.64 oz silver/ton (Spengler et.al., 1981). Hydrocarbon resources have not been detected in any drill holes in the vicinity of Yucca Mountain. Low to moderate geothermal resources exist at depths less than 3,300 feet at Jackass Flats, southeast of Yucca Mountain. Figure 3-10 shows the location of metal and industrial minerals, thermal waters and mining districts in the vicinity of Yucca Mountain.

CURRENT ACTIVITY

Since the 1970's, the Bare Mountain area has experienced large blocks of claims being acquired for precious metal exploration. The only discovery which has produced recently is the Stirling mine operated by SAGA/Cordex Exploration of Reno, Nevada.

CONCLUSION AND RECOMMENDATIONS

The Yucca Mountain Site is surrounded on the east and west by mineralized areas. There is a definite lack of information within the Yucca Mountain Site itself. This lack of information is not surprising since: 1) much of this area lies within the Nevada Test Site and Nellis Air Force Range and has been withdrawn or under restricted access for over 30 years; 2) existing and past mining operations are small, and without the money needed to accurately delineate resources; and 3) information on delineated reserves is not commonly released to the public. In light of this, the Department of Minerals recommends that an intensive study be undertaken in the Yucca Mountain Site and surrounding area to further delineate structural trends, ore controls, the geochemistry and alteration associated with mineral deposits, the geochronology of mineral emplacements and the geophysical characteristics of mineralized areas. Only then can the mineral reserves, resources and levels of potential be properly evaluated with respect to present and future resource demands.

Again, the Department of Minerals appreciates the opportunity to comment and make recommendations on such a vital topic. We will continue to respond to the appropriate agencies as further information becomes available.

Sincerely,

Doug Driesner

Doug Driesner
Resource Engineer

DD:wf

Bob Loux
March 4, 1985

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State of Nevada

Department of Conservation and Natural Resources

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MEMORANDUM

March 12, 1985

TO: Bob Loux, Director Nuclear Waste Project Office

THRU: Roland Westergard, Director R.W.

FROM: Verne Rosse, Program Director Waste Management

SUBJECT: Yucca Mountain Environmental Assessment

The Department of Conservation and Natural Resources has reviewed the draft Environmental Assessment (EA) for the Yucca Mountain Site. Yucca Mountain is one of three sites being proposed for site characterization for a high-level nuclear repository.

Review of the EA has resulted in the attached comments. The author of the comments is indicated following each issue. Any questions should be directed to the appropriate author or the editor David Cowperthwaite.

Review of the reference materials has indicated that the work done on the Nevada site was conducted by other than Nevada entities or interests. The work or reviews conducted by DRI, UNR, UNLV and State agencies has not been coordinated nor has the State been involved or participated in any formal review or decision making forum with DOE regarding any Nevada site. Whether the State is successful at being able to conduct its own studies at Yucca Mountain or not, the State (Governor's Office) should be directly involved with, or in any DOE meeting or discussion regarding decisions, establishing policy, or peer reviews concerning Yucca Mountain. This would include the Governor's Office, supervision of any work conducted, any State entity (UNR, UNLV, DRI etc.).

VR/ pr

Attachment

YUCCA MOUNTAIN

GENERAL COMMENTS: PLANNING PROCESS

Review of the Yucca Mountain NNWSI indicates that the state has been allowed minimal input into the early stages of the screening process used to evaluate the potential of NTS to be a high level radioactive waste facility. The outcome of the peer review process employed by DOE in 1979 indicates that State representatives had minor input into a very critical phase of the pre-site selection process. (Cowperthwaite, DEP)

After reviewing the Environmental Assessment, it appears that Yucca Mountain does not have the outstanding geological qualities which should be sought for the repository. Instead, Yucca Mountain (and Hanford) were selected as candidate sites because of land ownership and use. Section 1.2.3 points out that Yucca Mountain was added to the listing of potential sites for the repository because of "the advantages of locating a repository on land already withdrawn and committed to long-term institutional control." The Nevada Test Site fulfulled these criteria because of its long term withdrawal and use for the testing of nuclear weapons. These seem to be overwhelming reasons for selecting Yucca Mountain as a potential site. The establishment of these criteria appear to be designed solely to ensure both Yucca Mountain and Hanford as candidate sites. Once these criteria were established, it appears that the Department of Energy searched for any type of geology which was found at these locations and could be used for the storage of nuclear waste. The document tries to be convincing in heralding tuff as a suitable material; however, it does not succeed. (Wilcox, Statelands)

It would then appear one additional adverse circumstance had to be overcome, namely, that the repository is not compatible with nuclear weapon testing. To overcome this deficiency, it appears that the repository site was located as far away from the nuclear testing area as possible while remaining on withdrawn federal land under the control of the Department of Energy. The portion of the test site that best fit this need and still contained an adequate tuff formation appears to be Yucca Mountain which, is located partially outside of the test site, although still on federally-owned land. (Wilcox, Statelands)

We note that there had been an earlier determination that salt domes are superior to any other geological structure for nuclear waste storage. It appears to us that Yucca Mountain is being considered only because it is already under federal ownership and withdrawn for nuclear purposes. (Wilcox, Statelands)

The inclusion of both Yucca Mountain and Hanford in the group of final candidates seems similarly pre-determined. As pointed out in the environmental assessment, the country was divided into geophysical regions with criteria established that no more than one site from each geophysical region be selected for the "final" five candidate sites. Yucca Mountain and Hanford are the only sites within their geophysical region and were automatically included since only five geophysical regions contained any sites at all. (Wilcox, Statelands)

To further narrow the list of candiate sites to three it was determined that only one of each type of geological setting should be included in the final three. With only four distinctively different types of host rock (basalt, tuff, bedded salt, and domed salt) it was a short step to narrow the final three candidate sites to: (1) a salt type; (2) a tuff; and (3) a basalt site. The narrowing process used to get to the final three sites appears to be pre-designed to include Yucca Mountain. (Wilcox, Statelands)

We must question why the final three sites did not include three sites which have the best capability for high-level nuclear waste storage. According to the environmental assessment, Section 1.2.2., rock salt, either bedded or in salt domes, is the best host material. Only one of the final three sites possesses this characteristic - Deaf Smith, Texas. Instead, much of the environmental assessment is devoted to justifying or showing how the predetermined site of Yucca Mountain can be geologically as suitable as the salt dome site. (Wilcox, Statelands)

The 'justification' downplays serious problems with Yucca Mountain, such as possible contamination of a regional ground water basin, seismicity, nearness to nuclear weapon testing activities, transportation problems, distance from nuclear waste generating sites, withdrawal of ever greater land areas of Nevada, and the further negative impacts on the image and reputation of Nevada because of federal nuclear activities. (Wilcox, Statelands)

The environmental assessment appears to be a self-serving document designed to justify the pre-selection of Yucca Mountain as the site for the high level nuclear waste generated in other areas of the nation. This justification neglects the negative aspects of siting the repository at Yucca Mountain and disregards the tremendous potential health and safety consequences of such a facility for Nevada and the southwestern United States. (Wilcox, Statelands)

We also note that the descriptions and maps of the site are deceiving. The 50,000 acre area to be withdrawn from the BLM is not clearly shown on any map in the document and the impacts are difficult to determine or comment on. (Wilcox, Statelands)

The department has other concerns directly germane to the technical aspects of Yucca Mountain Draft Environmental Assessment. Our concern relates to the fundamental integrity and viability of the proposed site.

COMMENTS - SEISMIC

A basic concern of DCNR is the seismic issue. Various elements of the Environmental Assessment points out the potential instability of the Yucca Mountain area due to historical seismic activity and man (nuclear below ground testing) made seismic activity. While a large body of data has been presented and mitigation assurances made this department believes that a potential problem exists that may make Yucca Mountain a poor candidate for repository selection.

The relationship between underground weapons testing, the proximity to Yucca Mountain and localized natural seismic hazards has not been presented in adequate detail. Substantial evidence that the integrity of the repository would not be affected by the confluence of man made and natural events has not been presented. (Cowperthwaite, DEP)

GENERAL COMMENTS: LAND USE

DCNR is confused about how much land is to be withdrawn for the repository. DOE briefly states that 50,000 acres are to be withdrawn and that this acreage has no natural or mineral resources worth mentioning. DCNR believes that DOE is talking about two distinct issues; the 5,000 acre withdrawal and the 50,000 acre withdrawal. DCNR believes DOE has not adequately addressed the impact of withdrawing the additional 45,000 acres. (Cowperthwaite, DEP)

GENERAL COMMENTS: HISTORICAL RESOURCES

The DCNR is concerned with the preservation of significant archeological, historical, architectural, and cultural properties in the State of Nevada. The DCNR is also involved in ensuring Native American consultation with Federal agencies takes place. (Becker, HP & A)

Under the National Historic Preservation Act of 1966, as amended, the Department of Energy (DOE) must take into consideration the effects of its proposed undertaking on properties of National Register quality. As a part of this process, DOE must consult with the DCNR regarding the identification and evaluation of cultural resources and on determining project-related effects on National Register eligible or listed properties. (Becker, HP & A)

The Department of Energy hired an archeological consultant to identify cultural resources at Yucca Mountain in 1982. The resulting report was reviewed by this office and our comments forwarded to DOE in attached letter dated June 22, 1983. To determine the significance of the cultural resources identified in the survey, the archeological consultant returned to Yucca Mountain to test excavate sites potentially eligible for inclusion in the National Register. The results of this testing were sent to us for review only recently. In our review of the EA, our comments, therefore, are also in response to the 1984 report documenting the results of testing. (Becker, HP & A)

Second, the latest report suggests classes of sites with potential to answer regional research questions but does not make any specific recommendations regarding National Register eligibility. The purpose of test exavating in addition to determining research potential is to determine site significance. According to Section 1(a) of Executive Order 11593 and 36 CFR Part 800.1(a)(3), the Department of Energy shall apply National Register criteria to sites discovered in an area of potential environmental impact and determine site or district eligibility to the Register. The Federal agency must request the State Historic Preservation Office (SHPO) opinion in this matter; and DOE is obligated to complete this task.

Also in this regard, the consultant makes a good case for suggesting early sites located on terraces will address regional research problems. However, the argument for Numic and Archaic site significance is vague and should be more clearly presented. The consultant must also refer to The Archaeological Element for the Nevada State Historic Preservation Plan (1982) to demonstrate how sites at Yucca Mountain would answer research questions presented in the southern Nevada study unit.

Lastly, this brief overview must also document DOE's consultation with Native Americans regarding sites in and around Yucca Mountain of religious or other cultural import. (Becker, HP & A)

To protect sites during site characterization activities, DOE must first determine which sites or group of sites (district) are eligible for the Register; then determine in a cultural resource management plan, which will be subject to direct impacts and which will most attract unwelcome attention resulting in indirect impact (i.e., rockshelters). Rather than a piecemeal, so called "salvage" approach, the DCNR recommends a long-term plan be implemented as soon as possible. A piecemeal approach would necessitate repeated consultation with this office and the Advisory Council and inhibit the development of a unified interpretation of the prehistory of Yucca Mountain. DCNR wishes to discourage the collection of artifacts without the preparation and review of data recovery plans by this office and the Advisory Council (see the Council's Treatment of Archeological Properties: A Handbook, (1980) --a problem that continues to plague DOE. A management plan implemented immediately would make project delays less likely and speed site characterization studies. (Becker, HP & A)

GENERAL COMMENTS: AIR QUALITY

The report should also address the emission of radionuclides in the same form with comparisons to the standards associated with title 40 CFR Part 61. The accidental exposure of normal worker exposure appeared to be adequate.

The Meteorological Monitoring Plan, November 5, 1984 was also reviewed. Why will the baghouses for ventilation discharge control not used all the time. The document indicated they would be used only when radiation is detected. This document does not establish what the level of detection to trigger would be. The ventilation system and the stationary diesel equipment will need a permit from the Nevada Division of Environmental Protection Air Quality Section. (Serdoz, DEP)

The zeolitic rock when mined and disposed of, will have to have stringent controls and an impact analysis conducted to insure protection of the general public and the workers. There seems to be a discrepancy in the number of acres which will be of disturbed land associated with the project. (Serdoz, DEP)

The proposed 60 meter tower for measurement of meteorological conditions should be at least 100 meters as required by most power plant siting towers in Nevada. The data would be gathered at 10 meters, 50 meters, and 100 meters.

The extra 40 meters would still be below the ridge line. This would provide a better data base for the local wind flow patterns. This site would also enable a better projection should there be an accidental release during operation. (Serdoz, DEP)

There is some reference to the Air Quality Regulations (article #3) that have been amended and codified to NAC 445. These references should be corrected. (Serdoz, DEP)

GENERAL COMMENTS: FAUNA

DCNR is in agreement that the best possible method of reintroducing woody plant material into this harsh site would be through containerized stock. Annual, perennial grasses and forbs may be reintroduced through seedling. Each site may involve several rehab steps over a period of a couple of years to meet satisfactory rehabilitation. (Murphy, Forestry)

A question arises on what shall be done with hardcore samples taken from test pads. It is suggested running these cores through a portable crusher and spreading the crushed rock over the pad site. Top soil stockpiled from pad sites can then be re-addressed over this area. (Murphy, Forestry)

The report suggests that new drill sites could be used as test rehab sites. DCNR believes that the rehabilitation does not have to wait for new test drilling. Rehabilitation can start with the existing disturbed sites mentioned in the report. (Murphy, Forestry)

Irrigation of rehabilitation sites is a questionable operation in the establishment of native plant materials. DCNR believes sufficient rehabilitation can be reached by planting at proper times, known as "planting windows". Irrigation of a rehabilitation site can be extremely costly causing potential erosion problems, and possibly leading to failure in establishment of some plant materials. (Murphy, Forestry)

GENERAL COMMENTS: WATER POLLUTION

As indicated in the site evaluation, data collection is still underway or planned to provide more definitive information concerning the migration of radionuclides in the groundwater system beneath the repository site. There is still concern over the higher velocities of the water movement in the faults and fractures through out the site. Further studies and testing should be conducted to obtain more information on the rates and direction of the movements of the groundwater. Several more observation wells should be drilled onsite and off-site to enhance these studies and method of testing water movement. These wells could be used for sampling the groundwaters after construction of the repository. Some of the wells should be drilled in the areas of alluvium, and other permeable soils. (Porta, DEP)

Perched water tables above the repository must be drained and permanent pumping access provided. (This affects the Timber Mountain Tuff). (Porta, DEP)

Runoff water above the repository site should be diverted a safe distance away from the site. The diversion system should be capable of diverting runoff developed from the maximum storm event recorded in this area. The system must be designed to minimize erosion.

Runoff within the site should be treated as contaminated water and disposed of within the site in an approved manner. Percolation into the repository area soils would be prohibited. This area should also be constructed to minimize erosion, groundwater infiltration and confine the surface water. (Porta, DEP)

GENERAL COMMENTS: PARKS

DCNR cannot support this proposal until conclusive proof can be documented to support the EA conclusion that the impact on recreation will be insignificant.

Generally, the document does not address recreational issues in any detail. No systematic attempt is made to study potential impacts. (Weaver, Parks)

It seems to be an assumption that the towns of Beatty and Amargosa will be able to provide recreational facilities to meet the demand generated by increased population. This issue needs to be addressed. (Weaver, Parks)

GENERAL COMMENTS: WATER

The Yucca Mountain site is in an area of Nevada where limited groundwater withdrawal is occurring and in which very limited surface water sources in the form of springs exist. However, the Yucca Mountain Site lies over the deep carbonate aquifer which may be a significant source of water for the future needs of Nevada. Due to the fact that Nevada is the dryest state in the nation, while at the same time experiencing the fastest growth rate, water demand is fast outgrowing the available supply. In order for Nevada to meet future needs, alternate sources of water must be investigated and assessed. One alternative which is currently under investigation is determining the feasibility of tapping the deep carbonate aquifer for a future supply of water. (Thiel, Water Resources)

The quality of water beneath the Yucca Mountain Site in the shallow carbonate aquifer appears to meet the Safe Drinking Water Standards for Human Consumption. Any contamination of this aquifer and subsequently the deep carbonate aquifer could be extremely detrimental to the future growth of Nevada. The interconnection between the deep carbonate aquifer in the hydrologic basin beneath Yucca Mountain and other areas in Nevada where the deep carbonate aquifer may be tapped in the future is unknown at this time. However, it is known that the groundwater aquifers that have been investigated flow from the Yucca Mountain Site to an adjacent hydrologic basin and such waters become interspersed with water originating in other groundwater basins. (Thiel, Water Resources)

Yucca Mountain forms the boundary between Forty Mile Canyon - Jackass Flats hydrologic basin (14-227A) and Oasis Flats hydrologic basin (14-229). Both basins are within the Death Valley Basin which also includes the Amargosa Desert Hydrologic Basin into which the groundwater originating in the Yucca Mountain area flows. The Amargosa Desert Groundwater Basin was designated by the State Engineer in 1979 as a basin in need of additional administration. Applications for appropriation of groundwater for irrigation are no longer being issued by the State Engineer. The Forty Mile Canyon - Jackass Flats Hydrologic Basin flows into the Amargosa Desert Groundwater Basin by subsurface flow in the amount of approximtely 8100 acre-feet per year. Any significant withdrawals of water for the project could be detrimental to the existing rights in Amargosa Desert. However, the amount of water anticipated for the project of less than 400 acre-feet per year would not be significant in terms of outflow to Amargosa Desert. (Thiel, Water Resources)

One of the favorable conditions presumed to be present at the Yucca Mountain site is "Site conditions such that the pre-waste-emplacement ground-water travel time along any path of likely radionuclide travel from the disturbed zone to the accessible environment would be more than 10,000 years".

This condition was assumed to be favorable based on measurements of core samples in the host rock and underlying rock formations and the hydrologic properties in the unsaturated and saturated zones beneath Yucca Mountain.

One test which was not referred to in the report is dating of groundwater by analysis of the quantity of the radioisotope; tritium. This test is based on the uniform decay rate of tritium and the elevated levels emitted during atmospheric nuclear testing. This analysis would be useful as a positive indicator of the reliability of the calculations of travel time through the geologic formations to the water table. The report does indicate that dating of the water found in the rock pores will be undertaken in future testing. This analysis will be very useful in addition to dating the actual groundwater. (Thiel, Water Resources)

SPECIFIC COMMENTS:

p. 1-7 The rationale used to disqualify the salt sites isn't adequately supported. This is in reference to the bedded salt in the Salina Basin. (Cowperthwaite, DEP)

p. 1-13/14 The peer group stated that a repository is incompatible on the grounds of the Nevada test site, other then the southwest corner. DOE's logic is not entirely consistent, since the all potential sites on NTS property were determined unsuitable yet, DOE was able to "find" a suitable site appurtenant to the NTS. (Cowperthwaite, DEP)

p. 2-6 Figure 2-3a shows a schematic cross section of the Yucca Mountain site. The information and inferences presented are questionable. If the figure "facts" are correct then the complex nature of the various rock types leaves large questions as to the suitability of the Yucca Mountain site. (West & Cowperthwaite, DEP)

p. 2-5 The report delineates the groundwater basin in which the Yucca Mountain Site is located as the Alkali Flats - Furnace Creek Ranch groundwater basin. For ease of review by Nevada residents, the location of the site should be referred to in terms of the Hydrologic Basins delineated in Nevada by the State Engineer's office in cooperation with the USGS. (Thiel, Water Resources)

p. 2-45 The statement is made "Ground-water travel time estimates for each rock unit were based on the assumption of porous flow and did not include the effects of heat".

Realizing the effect of heat was considered to be negligible in comparison to the uncertainty in other hydrologic parameters, the analysis for the effects of heat should still be made for comparison purposes. (Thiel, Water Resources)

p. 2-57 The 60 year period of repository activities are expected to average approximately 180 acre-feet per year of water demand. The U.S. Department of Energy currently has two water permits with the State Engineer's office. Permit #45984 was issued for road construction for an annual withdrawal of 61 acre-feet per year. The point of diversion of this well is within the Crater Flat Groundwater Basin at a point within the NE1/4 SW1/4 Section 27, T.13S., R.28E., M.D.B.&M. The only other permit of record for the U.S. Department of Energy for an underground source is located in Stone Cabin Valley approximately 84 miles north of the site. Neither permit is in the area of the well referred to in the text as J13 and J12. Application for water rights must be made to the State Engineer in accordance with the Nevada Water Law. The use of water from well J13 which has occurred since 1962 has not been authorized in accordance with Nevada Water Law.

The water use at the Nevada Test Site if not under permit by the State Engineer's office and no information has been provided as to annual use to determine whether or not the perennial yield of the water basins in which pumping is occurring or is planned to occur would be exceeded. (Thiel, Water Resources)

p. 3-6 Dispersed recreation will be impacted in the BLM area which is presently open to the public. Use will end when it is withdrawn. Conflicting statements occur regarding recreation. On page 3-6, "The BLM administered portion of the land ... is not used for ... recreational purposes." Wheres on page 3-32 they state, "Land use ... includes ... recreation ..." The latter comment is probably more accurate. Dispersed recreation although it may be sparse, does occur. (Weaver, Parks)

p. 3-14 The Environment Assessment concludes that by appropriate engineering a threat to the integrity from seismic activity can be avoided. On page 3-14 DEP reports that the Walker Lane shear zone has had significant seismic and surface movement and that nuclear explosions have triggered surface displacements. An evaluation should be made whether this is good (by relieving stress) or bad (by causing faulting). (Cowperthwaite, DEP)

p. 3-14, 3-21 The statement is made "Moreover, some surface displacements at Pahute Mesa and Yucca Flat north of Yucca Mountain and along a trend between the Las Vegas Valley shear zone and the Walker Lane shear zone have been triggered by nuclear explosions" and on page 3-21, "Surface faulting in response to nuclear tests has been observed at Pahute Mesa and Yucca Flat."

Since surface faulting has occurred due to activities at the Nevada Test site, it is reasonable to assume that underground faulting has occurred and will continue to occur. These additional faults could affect the velocity of the groundwater and the likely paths it will follow. This possibility could cause a significant increase in travel time which could result in contaminated water reaching population centers within 10,000 years. If that flow velocity were occurring at the present time, the site would be disqualified. (Thiel, Water Resources)

p. 3-17/20 The figures 3-7, 3-8 and 3-9 shows significant seismic activity and faulting near, around and within the Yucca Mountain area. DCNR questions the suitability of the site based on the evidence presented by DOE. (Cowperthwaite, DEP)

p. 3-28 The statement is made "Because water cannot move in the direction of higher hydraulic head, it is concluded that ground water in the tuff aquifer beneath Yucca Mountain does not enter the carbonate aquifer." Should the carbonate aquifer be the future source of water for Nevada, the hydraulic heads would change and the water originating at Yucca Mountain could conceivably enter the carbonate aquifer. (Thiel, Water Resources)

p. 3-31 Figures as to the land being irrigated in Amargosa Desert were given as of 1969. To update those figures, in 1983 it is estimated that over 10,000 acre-feet of water was used for the various uses in Amargosa Desert. (Thiel, Water Resources)

p. 3-36 The reference to Ash Meadows should be revised to reflect the purchase by the Nature Conservancy and the turn over of the land to the Federal government. (Cowperthwaite, DEP)

p. 3-47 First, page 3-47 of the EA summarizes the results of testing completed and gives a general overview of the prehistory and history of the Yucca Mountain area. The DCNR should have been consulted regarding the selection of site to be tested since the archeology consultant deleted sites originally slated for testing and added others after the DCNR commented on the first report recommending sites for further testing. The consultant should also have conferred with this office regarding the number of test units to be placed in each site. Close coordination between the Federal agency and the State Historic Preservation Office (SHPO), as described in 36 CFR Part 800, is necessary to prevent future disagreement over site eligibility. (Becker, HP & A)

p. 3-60 There are serious questions regarding adequacy of the National Defense test classification for the Union Pacific line in or near the Las Vegas area. The class A designation of the line should be subject to extensive review, because portions of the rail bed may be in questionable physical condition (Cowperthwaite, DEP).

p. 3-64 Lincoln county an other counties have not been considered as a part of the review area. Since substantial impacts (transportation) could be anticipated to the rural counties, the EA should be expanded to include the affected rural areas. (Cowperthwaite, DEP)

p. 3-74 The statement is made "Actual water use in the Amargosa Valley is unknown..." The State Engineer surveys the Amargosa Desert groundwater basin each year and estimates the amount of water use taking place. The more recent figures are reported in a preceding paragraph. (Thiel, Water Resources)

p. 3-77 Lincoln County is not included in the solid waste inventory. (Cowperthwaite, DEP)

p. 3-78 Table 3-21 "Wastewater Treatment facilities in Clark and Nye Counties" is inaccurate and incomplete. Data on capacity (MGD) for Boulder City, Clark County and Las Vegas is inaccurate. The peak demand column does not make any sense. Lincoln County facilities have been overlooked as well as the other Clark County wastewater facilities. Communities that need to be incorporated includes: Blue Diamond, Paradise Spa, Panaca, Pioche, Caliente, Alamo, Tonopah, Gabbs, Laughlin, Overton, Searchlight and Mesquite. The listed facilities showing no data in the table are regulated by DEP, this providing a source for that data. (Cowperthwaite DEP).

p. 4-1 The assessment appears to address most of the air quality concerns. The project may be of PSD size depending on whether it is constructed as a vertical or horizontal emplacement. The emissions from the site characterization Table 4-1 uses the mid value of diesel fuel consumption, the extreme case would produce over 250 tons of oxides of nitrogen. The report should have looked at both methods with a range of emissions provided. (Serdoz, DEP)

p. 4-19 Standard operating practices should include provisions for storing and managing hazardous materials such as waste oil and solvents from the maintenance of heavy equipment. (Cowperthwaite, DEP).

p. 4-23 On page 4-23 the statement is made that ground motion caused by nuclear explosions at the Nevada Test site may continue to be investigated during site characterization. Realizing that studies of ground motion are different than studies as to nuclear testing induced faults, the ground motion studies should be continued because they provide valuable information as to the nuclear testing effects on the integrity of the Yucca Mountain site. (Thiel, Water Resources)

p. 4-29,30 Impacts due to site characterization are addressed on page 4-29 of the EA. Although DOE minimizes the amount of construction and workers necessary to complete studies, the effect on cultural resources will be great due to the large number of individuals (690) working in a limited area. Archeological sites will not be threatened merely by construction but by vandalism and illegal collection. The DCNR questions DOE's method of prohibiting dalism and illegal collection. The DCNR questions DOE's method of prohibiting excavation or collection (page 4-30) when efforts to date with the existing workforce have not been successful. (Becker, HP & A)

p. 5 5.1.4.1 A highway bypass route along the proposed railroad should be constructed for truck traffic between highway 15 and 95. This would keep the trucks out of the heavily populated North Las Vegas area. (Porta, DEP)

p. 5-2 If Yucca Mountain is selected as a repository, major impacts on significant cultural resources are possible due to the construction of a new highway and railroad routes as indicted in Figure 5-2 of the EA. Historic properties along these corridors must be identified and effects determined in accord with existing Federal preservation laws and regulations. (Becker, HP & A)

It is undetermined what the build-out waste tonnage will be, since the act allows for more then 70,000 MTU. DOE needs to clarify the long term hold capacity of the site. (Cowperthwaite, DEP)

p. 5-7 Figure 5-4 indicates that there will be major fuel storage onsite. Permits will be needed from the State for these facilities. (Cowperthwaite, DEP)

p. 5-34,36,91 DOE states that 50,000 acres will be withdrawn in addition to the 5,000 at Yucca Mountain. No rationale for needing this extra acreage is defined in the Environmental Assessment. (Cowperthwaite, DEP)

p. 5-54 The magnitude of the project (1568 workers average per day shift during the construction phase for five years at Yucca Mouuntain, page 5-13 of the EA) would make it extremely difficult to avoid direct and indirect effects to significant archeological sites identified by DOE's consultant. The division concurs with DOE (page 5-54 of the EA) that a program of data recovery treating the area as a whole would be necessary. Indirect effects to known Register eligible properties around Yucca Mountain should also be taken into consideration. Again, this program must be reviewed by the Division and Advisory Council before it is implemented. (Becker, HP & A)

p. 5-55 DOE reviews radiological effects from repository construction and operation. Since the Yucca Mountain site was appurtenant to the test site during above ground testing and evaluation is needed to assess whether dust emitted during construction will be of a contaminated nature. Re-entrainment of radioisotopes during waste retention need to be explored and defined. (Cowperthwaite, DEP).

p. 6-7 Socioeconomics (p. 6-7) The statement, "Tourism is not expected to be affected ...," is not supported by any substantial proof. It seems to be a foregone conclusion that tourists will perceive nuclear waste as something that need not be avoided. (Weaver, Parks)

p. 6-27 6.2.1.4 Although the area is not subject to severe floods the proper management of the flood waters is required to prevent these waters from infiltration to the groundwater under the site. (Porta, DEP)

p. 6-67 There are conflicting reports as to whether or not the waters in the Yucca Mountain area flow to the Devil's Hole area in Amargosa Desert. This issue should be resolved since Devil's Hole contains federally protected endangered species and excessive pumping at the Yucca Mountain site could adversely affect the springs if they are hydrologically connected. (Thiel, Water Resources)

p. 6-67 A rail line (p. 6-67) is proposed from Dike Station northeast of Las Vegas and will be routed past Floyd R. Lamb State Park. It will pass within .9 miles of the park. Noise is the only impact noted.

A general statement is all that addresses State Parks interest, "...would not exert significant adverse environmental impacts on State protected lands...."

It is unknown what affect the frequent shipments of high level nuclear waste past the state park will have on use. (Weaver, Parks)

p. 6-66/72 The close proximity of Yucca Mountain to Death Valley National Monument may have a negative impact, especially on the eastern portion (p. 6-66 & 72). The mere fact that highly radioactive nuclear wastes are being transported and handled in the vicinity (30 miles away) may be a deterrant to public use. (Weaver, Parks)

p. 6-109 The term "Tourism" (p. 6-109) seems to be directed only toward the hotel and gaming industries. This view should be broadened to include the variety of recreational opportunities which draw visitors to Southern Nevada. (Weaver, Parks)

p. 6-176 6.3.1.3.3 (2) The host rock should have sufficient ductility to seal fractures to prevent the infiltration of water through the repository and carry radionuclides to the groundwater below. This has been stated throughout the document. Yet the conclusion expressed in this paragraph states that to seal fractures is an undesirable feature. This should be listed as an adverse condition. (Porta, DEP)

p. 6-200 6.3.1.4.4 As stated, this area is not immune from flash floods. (Porta, DEP)

p. 6-293 6.3.3.7.4 (5) More drilling is required to ensure that no pressurized brine pockets, water or toxic gases are present in the repository horizon. (Porta, DEP)

p. 6-279 6.3.3.3.3 An insufficient number of boring have been conducted to state that there are no aquifers between the repository and the overlying land surfaces. (Porta, DEP)

p. 6-323 6.4.2.5.1 Additional testing is required to establish percolation rates in the fracture networks of the host rocks. As stated in the conclusion (6.4.2.6) a more refined analysis of the fracture flow should be accomplished after site characterization. (Porta, DEP)

State of Nevada

Department of Agriculture

STATE OF NEVADA

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March 7, 1985

MEMORANDUM

TO: John Walker, State Clearinghouse

FROM: Thomas W. Ballow, Executive Director

SUBJECT: RESPONSE TO DRAFT ENVIRONMENTAL ASSESSMENT, YUCCA MOUNTAIN SITE, NEVADA RESEARCH AND DEVELOPMENT AREA, NEVADA

The Environmental Assessment addresses the topic of the feasibility of a Nuclear Repository in Southern Nevada. The information presented in that document indicates a minimal impact. However, there is much more for the State of Nevada to consider, because the repository also brings with it a commitment to receive high level nuclear waste with an option of retrieval and reuse. Since reprocessing of high level nuclear waste is being done in the U. S. today (Idaho Falls, Idaho), data should be acquired from this site regarding the environmental impact of such operations. Data regarding the relative toxic properties of new and spent fuel rods needs to be compared and additional data estimating the hazards of transportation and handling of spent nuclear material (including decommissioned reactor vessels) needs to be generated.

Concern exists on at least two levels. First, the overall effects of storage, possible reprocessing and movement of this material in Nevada, with its widely separated population centers and large range areas, specifically the major impacts that would be incurred if contamination occurs. Detailed proposals with adequate budgets should be submitted to the Federal government to develop and fund a radiation surveillance network and other monitoring programs for biota, the atmosphere and aquifers as well as for locally produced agricultural commodities. Additional funds should be allocated for the development of specific, local contingency plans to respond to any contamination detected. The University of Nevada System (including DRI) should be encouraged to participate in proposal development. Second, that the individual users of this public land will incur substantial losses even without nuclear accidents. As an example, there may be 78 sq. miles withdrawn from public use plus additional transportation route construction corridors. The priority of multiple uses of public land will be jeopardized as a major industry based on nuclear waste emerges, impacting agricultural producers as well as other citizens of Nevada. For example, prices of agricultural land could be increased as a result of subdivision or related commercial developments, thereby changing the socio-economic structure of the two potentially impacted valleys (Pahrump and Amargosa), from agricultural to urban/agricultural interface raising the cost of agricultural operations. In Section 3.4.1.2. (Agriculture), areas near the site are not considered as prime agricultural land. It should be noted, however, that present land use trends in the U. S. are to use more and more prime agricultural lands for other uses, making marginal lands (such as Oasis Valley, Amargosa Desert and Pahrump Valley) very important in agricultural production.

This department cannot render a decision at this time either for or against the proposed Nuclear Waste Repository at Yucca Mountain until the unanswered issues raised in this discussion are addressed.

Sincerely,

Thomas W. Ballow
Executive Director
NEVADA STATE DEPARTMENT OF AGRICULTURE

TWB:sMc

State of Nevada

Department of Wildlife

STATE OF NEVADA

DEPARTMENT OF WILDLIFE

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RICHARD H. BRYAN
Governor

WILLIAM A. MOLINI
Director

March 4, 1985

Mr. Robert R. Loux, Director
Nuclear Waste Project Office
Office of the Governor
Capitol Complex
Carson City, NV 89710

Dear Bob:

Thank you for the opportunity to provide comments on the Department of Energy's draft environmental assessment for the Yucca Mountain Nuclear Waste Repository Evaluation. Our Las Vegas staff has reviewed the EA and we have the following comments:

GENERAL

The EA adequately addresses potential impacts to wildlife species and habitat in the area of the waste repository site. As pointed out by the EA, wildlife values at the site are relatively low, except for desert tortoise. The desert tortoise has recently been made a candidate for federal listing as a threatened species throughout its range and the EA should address potential impacts to the tortoise with that possibility in mind. The primary mitigations for potential impact to tortoises presented in the EA on page 5-37 through 5-38 was avoidance and/or translocating individuals away from the disturbance area. The supporting studies (EGG 1183-2438, Medica, et al, 1981) for the EA do not recommend translocating as a viable mitigation measure. It appears that the writers of the EA did not pay attention to their expert consultants. Mitigation plans for the desert tortoise in the EA should be reevaluated with regard to the data and suggestions supplied by EGG.

SPECIFIC

PAGE 5-38, LAST PARAGRAPH

The EA mentions that during operation the soil surface above the repository would become about 2 C degrees warmer. What effect would that year-long warming have on vegetation and wildlife? The EA did not adequately address that issue. A change in mean annual surface temperature could lead to a change in vegetative composition on the site. Vegetation changes would very likely result in changes in animal species abundance and/or use patterns. Such changes, in the long-term, could be either positive or negative. The EA should evaluate scenarios that address all possible impacts to wildlife of surface heating.

PAGE 5-2, SECTION 5.1, PARAGRAPH 3, FIGURE 5-2

The EA briefly discussed possible development of a railroad spur from near Las Vegas to the Yucca Mountain site. There was no discussion of the potential impacts of such a rail spur on wildlife values. If the proposed development might include a rail spur, the EA should address the potential impacts of same. We are concerned with potential impacts of a rail spur in the vicinity of the Desert National Wildlife Refuge (DNWR) and through the Spotted Range. Portions of the DNWR are proposed to be declared a wilderness area and the EA should address the potential conflicts associated with placement of a rail spur near the potential wilderness area. This Department has identified the Spotted Range as an area of high potential for a bighorn sheep transplant, and development of a rail spur through potential bighorn habitat could compromise the plans that are being developed by the Department of Wildlife and the USFWS for establishment of bighorn sheep in the Spotted Range.

The review of the EA and preparation of comments required 81 man hours from our regional staff and about 15 man hours of Reno office staff time.

If we can provide any additional information or answer any questions, please advise us.

Sincerely,

Willie

William A. Molini
Director

cc: USFWS
Region III

University of Nevada-Las Vegas

Center for Business and Economic Research

EVALUATION OF DRAFT ENVIRONMENTAL ASSESSMENT
YUCCA MOUNTAIN SITE

William J. Robinson
UNLV

The Draft Environmental Assessment for the Yucca Mountain site contains a number of major structural and conceptual flaws which limit its use for its intended purpose. These same flaws make complete review of the impacts of the development of this site impossible.

The least important, but most obvious, flaw is the poor quality of writing used in the document. Statements such as: "...the evidence does not support a finding that the site is not likely to meet....", are indicative of the stilted, bureaucratese found in the document. Much of the reviewer's time is devoted to translation, rather than analysis.

A far more important flaw with the EA is its lack of hard data to support many of its more vital conclusions. It contains assumptions at the core of almost every segment of basic research. It assumes that settlement patterns of workers will remain unchanged, that demographics of inmigrants will be identical to demographics of current residents, that there is no risk associated with nuclear shipments and quite a few other things. In many of these cases, evidence presented within the EA itself can be raised to contradict the assumptions made earlier. Where these assumptions do not hold, it appears that the results are less favorable with regard to the Yucca Mountain site. That is, the appearance is that the case presented is frequently, but not exclusively, a "best case" scenario.

Another major flaw in the overall design of the EA is the failure to include certain relevant concerns. Most striking, while they admit that current test site workers live in several Nevada Counties, California and Utah, and it is clear that waste will pass through many Nevada counties if it comes south from I-80, they systematically exclude all counties except Nye and Clark.

If waste does pass through other Nevada counties, potential mitgation in terms of emergency preparedness systems should be considered by DOE. Additionally, the strong possibility exists of workers choosing to live in other than Nye and Clark counties. Rather than assume this away, evidence as to this possibility should have been gathered. Given that many of these counties have extremely small populations, even a tiny increment of population can have a relatively large impact.

Also missing is an analysis of rail transfer in Las Vegas. We are told that a rail line will be built from Dike Siding, which is close to Las Vegas. Will entire trains be devoted to waste only and diverted to Yucca Mountain by some mystical means? If not, will there have to be trans-shipment efforts at Dike Siding? How many people will be employed? What is the potential for accident in the process of shifting waste for the trip to Yucca Mountain? Many other questions can also be asked. A better explanation of the railroad shipment method and its attendant impacts should be made.

Among the other missing elements is a serious estimation of demand for the dump's services. Of what significance is the current bust in nuclear plant construction? If demand is much lower than expected, will employment be lower and the site be employed for a greater length of time? Or if demand is significantly higher than expected, can the demand be accomodated without staffing changes, and would the site be closed much sooner than intended, or expanded?

At several points, the EA refers to the possibility of removal of the already implanted waste over a 50 year span. This is of interest for two reasons. First, this process should be included somewhere in the EA, with an appropriate discussion of riskiness, as well as labor force and other technical needs. There should also be a discussion of mitigation in case later findings show unforecast environmental damage requiring removal of the waste. Second, the possibility exists of technological developments which allow for recycling of waste, or condensing the dangerous parts into much smaller packages. This recycling effort would logically be sited at Yucca Mountain, and is a legitimate source of interest for the EA in terms of employment and length of service of the repository.

An assessment of risk perception on the part of Las Vegas tourists should be included as part of any economic impact assessment. It is correctly stated that the long term impacts of the MGM and Hilton fires appears to be insignificant. It is also correctly stated that the above ground testing in the 1950s was a major source of attraction to tourists. However, given the tremendous concern about things nuclear, and the large amounts of publicity that the project would create, some test of potential effects should be made. People regard fires as rare events, and nuclear events were once assumed to be much safer than we now know them to be. If the average tourist knows that large quantities of nuclear waste are being driven a few hundred yards from the Strip and that train loads are passing within a few miles, their perceptions may be altered.

Another concern which was never mentioned is the possibility of terrorist-type activities directed against nuclear cargoes and the potential for destruction in such attacks.

On a more technical basis, there are methodological issues which should be raised. Throughout the analysis, a fixed employment multiplier of 1.54 is used. This multiplier is derived from the ratio of base employment (the so-called export sector) to support employment. Included in the base are gaming employees who work in support of tourists, agriculture, mining, manufacturing, and government (to some extent). These people produce basic goods and services. The support sector includes the doctors, store clerks and aerobics instructors who work (in theory) in support of the base sector people. This study, for example, rests on the assumption that for every base sector job, 1.54 support workers will be employed.

This model has several basic flaws. First, the support sector, once established, may become largely independent of the base. For example, a store clerk can patronize a health club, creating employment. As a result, it is difficult to pin down the actual base and separate it from the support sector.

A more serious flaw, from the perspective of the EA, is that it assumes the multiplier of 1.54 is equally applicable to Nye and Clark Counties, and that the value of the multiplier will remain constant.

A sparsely populated, rural county such as Nye does not have a large, entrenched support sector of its own. Therefore, we do not expect to see as large a creation of support sector jobs created in Nye as this multiplier suggests. There may also be some support sector jobs created in Clark from the employment increase (and population increase) in Nye.

As an area grows, particularly as it grows rapidly, demands are placed on the supporting infrastructure which can, at least temporarily, alter the simple multiplier. Heavy demands on one industry may alter costs and wage rates, and affect other sectors of the economy. If a severe bottleneck is created, the impacts may be totally altered. These changes can lower the value of the multiplier. There may also be lags, as the initial growth in local employment for Yucca Mountain takes off, the support sector may expand more slowly.

An alternative assumption can also be made. This is that news of the impending major construction project will lure significant numbers of workers here in advance of the project beginning. This would markedly increase local unemployment and strain social services. When the project began, there might be no visible increase in support employment, because the influx had already largely occurred.

It is obvious that some additional considerations need to be made before the model becomes acceptable. First, a more reasonable Nye County multiplier should be employed. Second, the possibility of spillover support employment in Clark from Nye base employment should be considered. Third, the possibility of lags between the beginning of construction and support growth (with resulting congestion) should be considered. Fourth, the possibility of an influx of workers before construction should be examined.

It should be noted that the last two are somewhat opposite in nature. Other large construction projects done in isolated areas (such as the Alaskan pipeline) should be examined to determine which of these is the likely case. I suspect that the influx of workers seeking employment will occur before the project actually begins. This could have major impacts on the Clark and Nye social and governmental systems, with increases in costs for unemployment, welfare and other social support services. It would likewise strain private assistance agencies and probably have negative effects on the local crime rate.

A final major point of concern should be raised before turning to more detailed analysis. The EA consistently discusses the employment and income gains that will occur as the site is developed. It just as consistently ignores the declines in employment which occur as the operation moves from construction to operations and from operations to closure.

It is clear that there will be thousands of additional jobs created by the Yucca Mountain facility, both in Clark and Nye (and perhaps other) counties. These people will definitely provide millions of dollars in additional income to the counties involved. However, for many, the employment will only be temporary. In fact, it is likely that most of those employed in the construction phase will not be employed in the operations phase.

The majority of employment in the construction phase is in construction and mining. The mining employment remains roughly constant throughout, but construction employment peaks at 1,929 (or 1,913 depending on method) and declines two years later to zero.

After construction is complete, more than 1,000 workers from other industries are required to continue operation. This means that there will be a boom and bust cycle. First, a large influx of construction workers is required. After a period of five years the need will entirely vanish. These workers will either leave the Las Vegas area, taking their income with them and leaving a vacant house behind, or stay in place and attempt to find other employment.

It would take a number of years to find them all construction jobs, given their number. During the transition, the state would be responsible for unemployment compensation, welfare and various social services. We would also see distortions in the housing market and possible increases in the crime rate normally associated with higher local unemployment.

It is also possible that many support sector workers would follow the construction workers into unemployment, worsening the total negative impact. However, at the same time the construction workers are being laid off, a batch of about 1,400 new workers are being hired. These workers will also need to be housed, fed, etc., and will, therefore, require support sector services.

If the construction workers remain in place, housing demand will include homes for both the construction workers and the operations workers. This is an amount far in excess of the prediction that would be made looking solely at total employment. The site employs a fairly constant number of workers, but it must be emphasized that they are distinctly different groups over the various phases. Actual housing demand could be double that indicated by the simple totals.

So we have a boom-bust cycle for the construction workers. The boom begins in year one and runs through year three, when the decline begins. By year the end of year five, they are entirely unemployed, while the operations workers are beginning their boom phase, which runs until year 35. In many ways, it is more appropriate to view employment at the site, direct and indirect, to be the sum of operations and constuction work forces, plus the needed support personnel for both. This places total employment at roughly 12,000 at peak.

The value of this 12,000 number is that, while no more than 3,348 people will be employed on site at any time, this is the total number of workers and support persons required to complete the task. If the construction and operations workers come largely from inmigrants, and the construction workers remain in the area after year five, this is the number of new households which the "bicounty" area must support.

It is also important to note that an underlying assumption in the EA is that all markets work with perfect efficiency. In particular, this assumption is faulty with regard to the labor and housing markets.

The assumption inherent to the EA is that if 1,900 construction workers are needed, 1,900 construction workers will appear, no more and no less. If too few appear, wage rates are expected to rise and this will draw more workers. Of more concern is the likely possibility that too many workers will appear, adding to unemployment and social and fiscal impacts.

The housing market also functions less than perfectly. In a typical year, about 6,000 new housing units are created in Clark County. If at the end of year five the 1,900 construction workers and there 3,000 support workers were all to pull up stakes and leave town, we would have one year's total housing supply vacant. This would mean that no building would be required for a year.

Here again, the markets work with less than total efficiency. Builders respond to market conditions, and do not have perfect knowledge of total demand. If they build based on the market demand during the first three years of constuction, or the first year of operation, Clark County will have significant overbuilding. Add the over building to the large vacant stock caused by layoff of construction workers and the housing industry in Clark faces severe financial hardship. This hardship could also spillover into the banking industry, who would find it difficult to operate in the house finance market.

If this seems farfetched, it is not. This is exactly the scenario that occurred following the test site expansion in the early 1960s. Severe overbuilding caused a collapse in the housing market lasting until the late 1960s, and caused noticeable concern in the financial markets. Several financial institutions were reported close to insolvency at various times.

SUMMARY OF OVERVIEW

The Draft Environmental Assessment for the Yucca Mountain site is flawed in a number of important respects. It presents a "best case" scenario which minimizes the potential for impact to the social and fiscal systems of Southern Nevada.

In general, it ignores risk, assumes unchanging demographics and believes that all markets function with perfect information. It uses a model of questionable validity, and ignores relevant differences between Clark and Nye counties (and ignores the rest of the world entirely).

In short, significant effort must be expended on later research if we are truly to understand the potential impacts of the Yucca Mountain project.

SPECIFIC POINTS OF REFERENCE

Executive Summary

p. 12 We warn future generations about the dump site, but no mention is ever made of the fact that we are transferring risk to the future.

p. 13 "Since Yucca Mountain is far from the sources of waste, the nonradiological risks are likely to be relatively high." (last para.) If this is so, why were no eastern sites chosen so as to lessen the distance from production to storage of the waste?

Chapter 2

p. 50 It is curious that the only "socioeconomic impact" is water resources.

p. 54 A disqualifying condition is that no surface facility be located in a populated area or adjacent to a high density area. Seems to me that the whole transportation network of moving the waste to Nevada violates this stipulation. The railroad tracks and interstate highways are "surface facilities" being used by the project.

Chapter 3

p. 70,72 The Center for Business and Economics Research at UNLV has more recent data on housing in Clark County.

p. 79 The impacts on training and equipment to prepare the volunteer fire fighters in Nye County for handling radiological emergencies may be severe.

p. 79 Detention facilities are currently overcrowded, and could be impacted by the influx of people. Increases in crime rates are a likely occurrence if population growth exceeds employment growth.

p. 81 Because of the population growth and radiological dangers, it would seem logical that full time medical care should be available to households living close to the site. This is also important in the face of the potential for transportation accidents with radiological consequences.

p. 84,86 The population is fairly homogeneous racially (p. 84), but it contains large numbers of Native Americans (p. 84) and half of some areas are Hispanic (p. 86). Inconsistent?

p. 91 It should also be noted that revenues tend to lag population growth. People live in an area, and may demand full services upon arrival, but they have not contributed tax revenues via sales or property taxes until they have lived here for a longer period. Thus expenditures for inmigrants generally must be made before noticeable revenues are paid by them.

Chapter 4

p. 32 830 residents is insignificant in Clark County, not necessarily so in Nye. Should many choose to settle in one of the smaller communities, noticeable impacts could occur.

p. 31 A reminder that the multiplier of 1.54 is applicable to Clark but not to Nye. Some of the increase expected for Nye may actually take place in Clark (increase in support people).

Chapter 5

p. 13,15 It is hard to take their estimates of total labor force seriously when they admit that portions of what must be done are still unknown. (eg. railroad facility sect. 5.1.1.4.2 p. 5-12)

p. 15,16 Again the concern over the multiplier is present here

p. 17,18 What effect will all this heavy shipping have on road maintenance between Las Vegas and Yucca Mountain?

p. 17,18 The amounts of material needed vary widely from year to year. This is likely to create supply problems and affect local prices. We may see significantly higher prices or lower supply of certain raw materials over brief periods.

p. 23 The waste is stored in packages with life spans a mere fraction of the lethal life of what is being stored. Is it reasonable for us to place a potential burden of this magnitude on future generations of Nevadans without their consent?

p. 72 They argue that transportation accidents severe enough to release waste are unlikely. Note from table 5-31 (p. 67) that there is approximately one accident per million vehicle miles. They seem to be predicting 87,600 truck trips of 100 miles. This would lead us to suspect a total of about 9 traffic accidents involving waste carrying trucks on the roads between Las Vegas and Yucca Mountain. In fact, as congestion increases because of the repository, accident rates are likely to be much higher. There is also no consideration for inclement weather in their transportation schedule or risk assessment.

p. 74 Should be an evaluation of potential sites by transport distance.

p. 77 I-80 entry point is obviously not in Nye or Clark counties.

p. 84 It makes little sense to assume that all safety questions and concerns will be resolved before construction. (5.4)

p. 85 In para. 1 they state that the various operations end points would lead to slower periods of economic growth not unlike we have experienced before. The point is that they are in effect admitting that they plan to cause three recessions within the time period.

p. 85 para2 Again the multiplier is not appropriate for Nye County

p. 85 last para The total employment needed does vary as indicated. But it is more important to remember that the mix is totally different. In is possible that none of the 8,500 employed in 1996 will still be part of the 5,900 employed in 1999.

p. 86 Some employees will live in other Nevada Counties and CA? Table 5-29

p. 86 para 3 "There might be an increase of wages and salaries to induce these workers to relocate to the area"

last para "Potential increases in wages and salaries in the bicounty area could be mitigated by the inmigration of skilled workers from other areas, such as California and Utah."

In other words, higher wages are needed to cause inmigration, but inmigration will prevent higher wages? The economic theory behind this escapes me. There may be an influx of relatively unskilled workers seeking employment which will depress wages in the market for unskilled labor. However, higher wages are almost certain to result in the markets for the more skilled trades needed.

p. 86 Much will also depend on the state of local construction at the time. If construction is depressed, the impact will be much smaller. If we are building furiously, the impact could be enormous. The construction baseline given in the fourth paragraph is misleading because of the large fluctuations which occur in construction employment.

p. 91 Section 5.4.1.6 This repository is something fundementally new, and more study of the potential impact should be made before conclusions are reached.

p. 95 para 4 83 percent in Clark and 13 percent in Nye is only 96 percent of the impacts. Where are the other 4 percent?

p. 95+ Estimates of impact on Nye are shaky because of the possibility of more workers locating there than under current DOE operations. The construction jobs are only temporary, which may induce a larger percentage of workers to locate near Yucca Mountain.

p. 99 Education The Nye school system will have an initial expansion and then a contraction as we move from construction into operations and later closure. Are they going to have to hire teachers, then lay them off? Build schools and then close them?

p. 102 Public Safety Large numbers of inmigrants to Nye (or even Clark) who do not have jobs and have difficulty finding jobs (people attracted in hope of work) could cause a strain on the police systems of the counties.

p. 102 Health Health care might be significantly effected in Nye if large numbers of families move there for a few years only (construction phase)

pp. 92-110 All these estimates assume that the demographics of the inmigrants will be identical to the demographics of the residents. If not true (and its unlikely) the impacts will be different

p. 105 last line "Stable source of employment" The employment is only stable in the operations phase, not the construction phase.

University of Nevada-Reno

Bureau of Business and Economic Research

March 1, 1985

MEMORANDUM

To: Robert Loux, Director
Nuclear Waste Project Office
Governor's Office, Capitol Complex
Carson City, Nevada

From: John L. Dobra, Research Associate
Bureau of Business and Economic Research,
University of Nevada, Reno

JLD

Re: Comments on sections of the Draft Environmental Assessment (EA) for the Yucca Mtn. High Level Radioactive Waste Repository related to Socio-Economic impacts.

The comments below address the data, methods, assumptions, analyses, and conclusions presented in the following sections of the EA:

SECTIONS:		REFERENCES IN EA	TOPICS:
I	3.6	pp. 3-64 - 3-92	Site Description
II	4.2.2	pp. 4-30 - 4-34	Site Characterization
III	5.4	pp. 5-85 - 5-110	Repository Siting
IV	6.2.1.6	pp. 6-74 - 6-85	Suitability

These sections all pertain to socio-economic conditions and possible impacts from the proposed Yucca Mtn project. Comments are arranged by section in the order indicated above. In each case (except for comments on Chapter 3), comments are numbered and generally follow the sequence of the text.

It should be pointed out at the outset that my overall evaluation of the EA is generally positive. The document has problems, but its breadth of scope and level of detail is commendable and should be considered a tribute to the efforts of those who put the EA together. Accordingly, the critical comments below largely question the assumptions and methods applied in the work, and tries to avoid speculations on the motives and skills of the authors.

I. Comments Re: 3.6 Socio-economic conditions

Chapter 3 generally describes the baseline characteristics of "The Site" and, accordingly, discussion in 3.6 presents baseline socio-economic data. The initial comment offered on this section is that it contains no serious factual errors that I can determine. However, after reading and reviewing later chapters, I also think that there are omissions of relevant technical data that should be used in the analyses below.

One notable example is the lack of baseline information public sector finance. The EA does contain data on government services and revenues by source (3.6.5), but data to conduct an analysis of the fiscal impacts for State and local governments of the Repository is not provided. A later section (5.4.5) indicates that impacts on public finance is an area in need of further, more detailed, analysis. Presumably, this explains its omission from 3.6. Nonetheless, the draft of the EA needs to be strengthened considerably in this area.

Another area where baseline data presented in 3.6 is inadequate concerns labor and certain materials markets, especially the market for cement. These two markets, and especially the latter, tend to be more "local" in character than, for example, markets for heavy equipment, and other goods and services purchased in national and international markets. As a consequence, an increase in the supply of mining and construction workers and cement in the local area induced by an increase in demand can only be achieved by bidding up their prices to attract them into the local market or waiting a long time to fill job vacancies and to pour cement.

One problem with the baseline description of labor and materials markets provided in 3.6 is that it provides no indication about the elasticity of supply in these local markets. The implications of this are examined below with reference to specific sections in chapters 4, 5, and 6. Generally, however, since local businesses must compete in local markets for labor and materials, they must be able to pass on these higher costs to be able to stay in business. Examples from studies of "boomtowns" could be used in the baseline data analysis to show these local inflation conditions would or would not be likely to occur around the Yucca Mtn. site.

In any event, referring back to the initial comment on 3.6, that there are no significant factual "errors of commission," my final comment on 3.6 is that the chapter is generally accurate in its own terms. However, in some instances such as those noted above, considerably more study is needed before conclusions are drawn.

II. Comments Re: Chapter 4, Site Characterization Impacts

1. Re: 4.2.2 General Comment

Site Characterization impacts will be small in comparison to later phases and, hence, problems with the analysis of these impacts are of a lower order of magnitude in this sense. However, the analysis, assumptions, methods, etc. in this chapter establish a pattern for later chapters. Hence, comments on these issues in 4.2.2 are provided because they are not of a lower order of importance in spite of the small magnitude of Site Characterization activities.

2. Re: 4.2.2.1.1 Employment & "Bicounty" Comparisons

A "Bicounty" comparison is not generally desirable in assessing impacts of Site Characterization or later phases of the project. Admittedly, the comparison is reasonable for some assessments, e.g., impacts on the local banking industry. However, on the general grounds that the "Bicounty" comparison averages two counties with vastly different characteristics and capacities to absorb the impacts of site characterization and later phases, the "Bicounty" comparisons in the EA appear to be inappropriate in at least some, and perhaps, most cases.

Some of the following comments provide more specific reasons why "Bicounty" comparisons should be viewed with skepticism and avoided when possible.

3. Re: 4.2.2.1.1 Employment & "Bicounty" Comparisons - Multipliers

Previous studies* indicate that multipliers used to estimate indirect impacts vary across counties. Clark County's multiplier is higher than Nye's because Clark has a much more well developed infrastructure of businesses supplying goods and services. In addition, there is a significant sales leakage out of southern Nye County into Clark County.

Also note that the study cited above finds a significantly lower multiplier for Nye than used in 4.2.2.1.1. Clark County's multiplier from the study above is also lower than the 1.54 used in the EA. The multipliers estimated for Nye and Clark were 0.55 and 1.27, respectively.

4. Re: "Bicounty" Comparisons - Geographic distribution of population assumptions

The assumptions introduced in this section regarding the geographic distribution of Yucca Mtn. NNWSI workers between Nye

*See Dobra, Atkinson, and Barone, "An Analysis of the Economic Impact of the Mining Industry on Nevada's Economy," Nevada Mineral Industry, 1982, Nevada Bureau of Mines and Geology, UNR. Also see Dobra and Harris, "The Commercial Structure of Nevada's Economy and Prospects for Development," Nevada Review of Business and Economics, Vol. VII no. 3 (Fall 1983): 2-7.

and Clark Counties is that 83% of DOE workers will commute to the worksite from Clark County while 13% will reside closer to the worksite in Nye County. This assumption justifies using "Bicounty" comparisons to some extent because this geographic distribution is weighted heavily toward Clark County.

However, use of this assumption in tandem with "Bicounty" comparisons tends to obscure and under-estimate potential impacts on communities in southern Nye county. This issue comes up in several contexts discussed below. At this point, however, there are two factors that undercut the assumed 83% - 13% split of workers between Clark and Nye counties and, thereby, undercuts the meaningfulness of "Bicounty" comparisons.

(1) Yucca Mtn. workers will have to commute an additional 40 miles beyond Mercury for a daily (2-way) increase in commuting time of 1.45 hrs. at 55 mph.

(2) This additional commuting time is probably most significant because there is considerably more potential for residential and commercial development in communities conveniently located near Yucca Mtn. than in communities between Mercury and Las Vegas that could serve NTS workers. That is, the communities of Amargosa Valley, Pahrump, and Beatty will provide housing and commercial opportunities for Yucca Mtn. workers that are not as attractive NTS workers.

In short, there are reasons to doubt the 83% - 13% geographic distribution of workers in the site characterization phase. In addition, it could be argued that this distribution is even more doubtful in later phases as these local communities adjust to the impacts of the project.

5. Re: 4.2.2.1.1 Employment - Labor force impacts

Consider the following labor market related observation contained in this section:

> "The peak total site characterization employment is estimated to be about 690 jobs. This represents about 0.2 percent of projected 1985 Nye and Clark County employment."

One problem with this statement and similar ones in later sections of the EA is the "Bicounty" comparison employed, as noted above. However, another, more serious problem is the comparison of the demand for mining and construction workers induced by project activities against the entire labor force of both, or either, counties.

The problem with this comparison is that it implicitly assumes that all workers, including secretaries and casino change-persons are potential Yucca Mtn. workers. Some workers currently employed in other sectors may enter NNWSI jobs, but a more appropriate measure of comparison is the existing baseline supply of mining and construction workers. The table below provides an alternative view of the impacts of site characterization activities.

In examining the table, first note that the 1985 Nye county mining and construction workforce includes 1,419 workers (See Table 3-11 of the EA). Second, assuming that, as indicated in 4.2.2.1.1, third paragraph, only 40% of the estimated peak total direct employment of 273 (109) workers are new NNWSI employees, the table below shows the relative impacts on Nye county labor markets assuming different levels of hiring from Nye county.

POSSIBLE IMPACTS OF SITE CHARACTERIZATION ACTIVITIES ON NYE COUNTY MINING AND CONSTRUCTION WORKFORCES

New Jobs: 109

% Hired from Nye County	% of Nye County Mining and Construction Workforce
100%	7.7%
80	6.1
60	4.6
40	3.1
20	1.5
13	1.0

Note that without bringing in indirect employment effects, the potential impacts of relatively limited Site Characterization activities have a significantly greater potential impact than indicated by the "0.2%" of the total "Bicounty" labor force.

Even under the most restrictive assumption presented on the table above, where the 83% Clark to 13% Nye assumption is used, the impact in Nye County will be around 5 times greater than the EA indicates using a "<u>Bicounty</u>" <u>TOTAL</u> <u>employment</u> basis of comparison. Under the least restrictive assumption, where all of the new mining and construction workers are hired from Nye County, the EA's figure of 0.2% understates the impact in Nye

County by a factor of 38.5.

This last comment on chapter 4 are not intended to imply that the effects of Site Characterization activities will be greater than indicated by the EA. Rather, it is intended for future reference as an indicator of the degree of bias in estimates based on the methodology employed in the EA.

III. Comments Re: Chapter 5, Effects of Locating a Repository at the Site

1. Re: 5.4.1 Economic Conditions - General Comment

Several potential comments on this chapter raise issues discussed previously. As indicated, the assumptions and methods identified above are used pervasively in the document. In the interest of avoiding repetition, comments of this sort are only raised if they constitute a conspicuous example of the methodological points above that have bearing on particular conclusions in this section.

A short list of general comments of this sort that apply to this section include:

1) Inappropriate data aggregation ("Bicounty" comparisons)

2) Unsubstantiated assumptions about the wage elasticity of the supply of labor and the price elasticity of the supply of materials

3) Questionable assumptions about the geographic distribution of employment and population effects.

2. Re: 5.4.1.1 Labor

This section raises the issue of increased wage costs as a consequence of increased local demand for mining and construction workers. As indicated on page 3, above, local inflation phenomena in "boomtown" situations can have significant effects on local businesses and residents. For this reason, it is encouraging to see this issue acknowledged.

However, the last paragraph of p. 5-86 indicates that these problems will be mitigated by immigration into the area. While it is correct that immigration is likely to occur, it is inappropriate to say this will "mitigate" higher wage and other employee related costs (e.g., higher job turnover, lower productivity, etc.). Immigration will reduce local wage inflation but the proposition is backwards labor market analysis since higher wages are required to induce more workers into the local labor market. Hence, the "mitigation" is, in fact, evidence of higher wage costs.

The conditions under which the immigration scenario would work are if construction occurs in a period of significant sectoral (i.e., mining and construction), regional, or national recession.

3. Re: 5.4.1.1 Labor

The discussion of labor requirements as a percentage of "Bicounty" TOTAL employment instead of employment by sector in each of the respective counties has the same methodological problems discussed above on pp. 7-8 concerning the impacts of Site Characterization activities in the local mining and construction industry labor markets. In the comments referred to above, the methods used appeared to underestimate the impacts in county and industry specific labor forces by a factor between 5 and 38.5.

The point of this comment is that a table similar to the one above could be constructed showing increases in labor demand in Nye County under alternative assumptions concerning the geographic distribution of the population. If this were done, it would show impacts on local labor markets 5 to 38.5 higher than those provided in 5.4.1.1 if a linear interpolation were used.

4. Re: 5.4.1.2 Materials and resources

As pointed out above, the "local" nature of markets for cement and possibly other supplies like fuel, requires that local prices must rise before outside resources can be brought in to increase local supply. This section points out (p. 5-87, paragraph 1) that cement and fuel can be obtained in the area. While this is good news for Nevada fuel and cement suppliers, it has been pointed out that local inflation in these markets is an area where mitigating measures may be necessary.

In any event, as pointed out above, the EA does not provide a basis for determining the impact of locating the NNWSI at Yucca Mtn. on local markets for materials and resources.

5. Re: 5.4.1.6 Tourism

The argument on the impact of nuclear weopons testing on tourism in Las Vegas provided in this section is purely speculative. How can the impact be measured? There is no control group or test condition that can be applied to determine if Las Vegas would not have grown faster and attracted other industries besides gaming if the radioactive threat posed by the Nevada Test Site were not present.

In the same spirit, the conclusion that "...the repository would not change the total aesthetic appeal of the Las Vegas area" is probably true since those individuals and industries that are concerned about radioactive wastes as an environmental/public safety/aesthetic concern are <u>already impacted</u> by DOE and DOD activities in the area.

As I understand the quoted comments and their context, the conclusions expressed in the EA are based on pure speculation.

6. Re: 5.4.1.6 Tourism, top of p. 5-92

The incidents cited (hotel fires and Three Mile Island) were all TEMPORARY and there were temporary effects. The Yucca Mtn. Repository will be permanent but, hopefully, a less specular catastrophe.

7. Re: 5.4.1.6 Tourism, General Comment

The EA is noticably weak in an area of vital importance to Nevada.

8. Re: 5.4.3 Community services, p. 5-95, second paragraph

Existing service ratios are extremely questionable for several reasons:

1) Population distribution assumed in EA is the 83% - 13% probably understates the impacts in Nye County.

2) Mining and construction workers in other "boomtown" situations have shown a tendency to place greater demands on law enforcement facilities, lower demands for library books, etc.

3) Some services may be at existing capacity, e.g., schools, while others may be below capacity utilization rates. For example, see 5.4.3.4 on sewage treatment and 5.4.3.3 on water supply capacity.

8. Re: 5.4.3.1 Housing

The most conspicuous thing about this section on Housing is that it does not mention the impacts of repository siting on rents or housing costs. Clearly, the impact of increased housing demand from NNWSI workers depends on the assumed geographic distribution of workers.

Even considering the impacts within the context of a "Bicounty" area, the impacts of the project may not be negligible. That is, there is likely to be a noticeable impact in the Las Vegas area housing market in a scenario that would minimize the impact on Nye County.

Under an alternative extreme case scenario, where most of the impact on housing markets is in Nye County, there could be very substantial impacts on local housing prices and rents. Examples of such market reactions can be found in the impacts of the speculation induced by the proposed MX missile project in areas of rural Nevada.

9. Re: Mitigation Policies

The criticisms above are largely intended to illustrate the indeterminacy of forecasts of impacts of projects of the order of magnitude of the proposed Yucca Mtn. Repository contained in the EA. The criticisms above have not been intended as attacks upon the integrity or professional judgement of those who have worked hard to prepare the EA. Instead, I would argue that these criticisms indicate the degree to which the specific socio-economic impacts examined are uncertain and, therefore, indeterminate. This large degree of uncertainty associated with the repository siting decision suggests that a general mitigation policy of indemnifying local citizens against the burden of these uncertainties would be in order in the spirit of the Nuclear Waste Policy Act of 1982 and related sections of the EA.

A number of areas of economic impact noted above could disrupt primary industry sectors, local cultural institutions, and behavior. For example, high wage rates would hurt local business, and high rents and other housing related costs would impact elderly residents on fixed incomes in Pahrump, Amargosa Valley, and Beatty.

Applying the rule of indemnifying local residents of risks to their economic well-being would require that mitigating actions be taken to provide the State of Nevada and its citizens with an "insurance policy," of sorts, against these general risks. At a minimum, the EA should have used existing data on "boomtown" phenomena in the modern American West, to provide some indication of the potential magnitude of the impact of repository siting.

IV. Comments Re: Chapter 6, Site Suitability

1. Re: 6.2.1.7 Socioeconomics (10 CFR 960.5-2-6)

DOE findings on Table 6-11 indicate that the affected area can absorb project related population by pointing out that the expected increases do not exceed "historical levels." This finding has at least one problem that has not been already pointed out. Specifically, historical comparisons are using percentage changes with very small bases because the impacted areas are sparsely populated, and because the high historical growth trends in southern Nye County have been significantly influenced by DOE and DOD activities in the area.

2. Re: 6.2.1.7.3 (2) Availability of adequate labor force

This section acknowledges one weakness in the analysis pointed out above with the comment on the availability of the mix of skills in the local labor market. See discussion of labor markets and wage induced immigration above.

3. Re: Evaluation of Favorable Condition (3), p. 6-80

The discussion refers to increased tax revenues which were not estimated in chapter 5 and, as noted above, generally ignored in the discussion of baseline conditions in chapter 3. Hence, the conclusion provided in this section is unsubstantiated by the EA.

The conclusion that tax revenues will rise is not unreasonable. It is simply pointed out that any relationship between project induced governmental revenues and expenditures cannot be deduced from the information available in the EA or any supporting documents.

The state tax base is extremely narrow so that the fiscal impact of higher wage earnings in Nye County, in particular, is likely to be small on the revenue side. Assumptions concerning project induced public service needs are also problematic, as noted above. Hence, the statement must be considered to be probably correct, but unsubstantiated by the reported data and analysis.

4. Re: Evaluation of (4), page 6-81 on disruption of local primary sectors

The conclusions expressed on this subject are highly suspect because of many of the factors discussed above.

It should also be pointed out the the fourth condition - no projected disruption of primary economic activities (mining and tourism) is valid only if very restrictive assumptions about labor and materials markets hold. This issue was addressed above in some detail. The point here, however, is that DOE findings are based on the most liberal, i.e., easiest to pass, test of "non-significance," "Bicounty" TOTAL ratios and comparisons of the ability of the Yucca Mtn. site and vicinity to absorb socioeconomic impacts. In short, the findings in table 6-11 and related text are highly speculative.

5. Re: 6.2.1.7.4 Potentially adverse conditions

The finding expressed that "negative impacts on community services and housing supply and demand are not expected to be significant" is suspect for a variety of reasons provided above. In any event, the conclusion is unsubstantiated by the data and analysis in the EA.

6. Re: final comment

Note the language in the Evaluation of (2) Lack of adequate labor force (6.2.1.7.4) as an example of the presentation of data and analysis in the document. The text says that the issue was discussed under "Favorable Condition 2." "Favorable Condition 2" was unfavorable.

State of Nevada

Employment Security Department

MEMORANDUM

STATE OF NEVADA
EMPLOYMENT SECURITY DEPARTMENT

TO Joe Stralin, Nuclear Waste Project Officer DATE February 15, 1985

FROM Jim Hanna, Chief of Employment Security Research SUBJECT Evaluation of Socio Economic Conditions of Environmental Impact

The numbers used in this report are questionable from an Employment Security Department (ESD) prospective. The following are excerpts by paragraph number, comparing the report with the ESD viewpoint.

3.6.1. Economic conditions
The report shows Hotel/Gaming/Recreation employment at 121,000 but the date is not specified. ESD 1984 annual average Hotel/Gaming/Recreation employment was 114,800 or 28.5 percent of total employment. This paragraph also lists other key "employers" but does not address mining which has a significant dollar value contribution to the state economy.

3.6.1.1 Nye County-
The report states that in 1980, 6,700 workers were employed in Nye County, but by 1982 there were 7,508 workers. ESD records place 1982 employment at 8,640 jobs.* Note that the report interchanges jobs, persons and employment-mixing labor force and industrial employment concepts.

The report states 80 percent of 1982 industrial employment was in mining, service or government. ESD records indicate 87.6 percent.

This paragraph goes on to indicate, "As in most of the United States, the service industry is the largest employer in Nye County, but the area's character is better defined by its other large employers: mining, construction and government". According to ESD administrative data, industrial employment by order of size in Nye Co. during 1983 included:

1)	Service	67.4%
2)	Mining	13.1%
3)	Government	8.8%
4)	Trade	5.1%
5)	F.I.R.E.	1.7%
6)	T.C.P.U.	1.6%
7)	Construction	1.3%
8)	Manufacturing	1.0%

Note - construction made up less than 2 percent of total employment.

Table 3-11- This table, "Employment in selected industries in Nye County, 1978-2000", reflects questionable data.

It is suppose to estimate the number of persons employed by industry or the number of jobs provided by employers? Usually industrial employment projections are based on establishment based industrial employment, or the number of jobs, not people employed; these are different concepts.

* The ESD employment estimates are developed in cooperation with the Department of Labor, Bureau of Labor Statistics.

NESD - 1024 (Rev.2-71)

10459

Historically Nye County industrial employment has been growing at an average annual rate of between 2 and 3 percent between 1970 and 1983. Data from the first 6 months of 1984 seem to indicate the 1983-1984 growth will be somewhat higher, around 4.5 percent. Given the other various historical industrial growth rates exhibited by the county, it would appear the projected rates in table 3-11 are acceptable. More importantly however, are the 1978 base line numbers reflected in the table. ESD records show total 1978 industrial employment at 5,390, not 7,909. This is a 46.7 percent discrepancy in employment levels. These employment levels, as well as individual industry levels should be re-evaluated.

Finally, the narrative used in describing Nye county could be very confusing. The time frames of data cited jump from one year to the next in some paragraphs. For example the 1980 total industrial employment level is cited, followed by 1982 distributions.

3.6.1.2. Clark County-
The percent distribution of industrial employment for Clark County:

	Report	ESD
Mining	-- %	.2 %
Construction	6.0	6.4
Manufacturing	--	3.1
T.C.P.U.	6.0	6.0
Trade	21.0	20.1
F.I.R.E.	--	4.7
Service	48.0	47.2
Hotel/Gaming/Recreation	--	31.7
Government	12.0	11.7

Some discrepancies do exist but they are minor.

Table 3-12
In reviewing the data presented in Table 3-12 significant discrepancies are apparent when compared to ESD administrative data and projections of employment levels.

As in the Nye County evaluation it would appear establishment based industrial employment or jobs is being discussed but the table again refers to "numbers of persons employed". Furthermore, the base year numbers vary significantly from ESD administrative data on industrial employment. The data shows 1978 total Clark County industrial employment was 189,400 jobs, while the table reflects 215,758 persons employed. This is a 13.9 percent discrepancy of base year employment levels.

Current administrative data (1984) indicates that the growth rates used on the table between 1978 and 1985 will be very difficult to achieve. Total industrial employment in 1984 was 239,600 jobs. The table reflects 322,096 jobs in 1985. To achieve this level the Las Vegas total industrial job growth between 1984-1985 would have to be nearly 35 percent. ESD data indicates annual average growth in the total number of jobs between 1978 and 1984 was around 4 percent. Job growth in recent years has been somewhat higher at just over 5 percent between 1983 and 1984. ESD anticipates that job growth will increase to an annual average of around 5 to 5.5 percent through 1990. Therefore 1990 employment levels should be around 327,000 jobs. This is significantly less than the 370,221 reflected in table 3-12.

Because it appears that serious discrepancies exist in the data that has been presented, this section of the report should be completely re-evaluated. Input should be solicited from various agencies who are recognized to be responsible for the generation, projections and interpretation of the kinds of data used in this report.

State of Nevada

Department of Commerce

STATE OF NEVADA
DEPARTMENT OF COMMERCE
DIRECTOR'S OFFICE
201 South Fall Street, Room 321
Carson City, Nevada 89710
(702) 885-4250

RICHARD H. BRYAN
Governor

LARRY D. STRUVE
Director

March 12, 1985

Robert Loux, Director
Nuclear Waste Project Office
Capitol Complex
Carson City, Nevada 89710

RE: Transmittal of material to be included in Nevada's response to environmental impact statement for study of Yucca Mountain site as high level nuclear waste repository.

Dear Bob:

Please find attached the memo of March 7, 1985 from the Insurance Commissioner and the March 1, 1985 memo from the Housing Administrator, addressing some of the social economic concerns addressed in the draft environmental assessment of the proposed Yucca Mountain site for a high level nuclear waste repository.

It is my understanding that your office is consolidating the state's response on behalf of all agencies regarding the environmental assessement. I would appreciate your reviewing the attached material and including any relevant portions in the state's response.

In view of the attached material, I would appreciate your office keeping the Department of Commerce informed on the next steps that will take place in connection with the Federal Government's study of the Yucca Mountain site as the final nuclear repository.

Sincerely,

Larry D. Struve

LARRY D. STRUVE
Director

LDS:dl
Encs.

0-1430

transported to or from a nuclear power plant and ultimately, according to the DOE, while it is at the high level waste site.

The coverage is structured in several layers. The first layer which is provided by private insurers, is made up of approximately $160 million in liability insurance. The second layer is made up of assessments upon power plant operators in the event of a loss with each operator being responsible for an assessment of up to $5 million per reactor. With 88 reators in place at this point that would total to an approximate $600 million second layer of coverage. There is a third layer of coverage which is very questionable in nature in that it is a statement in the Price-Anderson Act that congress will "review" any losses in excess of the amounts available under the first two layers to determine if the United States should provide additional monies. In the DOT material there is a statement that the Price-Anderson Act "establishes a statutory limit on the liability". I believe this to be an incorrect interpretation of the Price-Anderson provisions. My reading of Price-Anderson indicates that it is a strict liability statute and that all losses would be compensated without limitation. It would appear that the DOE reading the language concerning congress's responsibility to "review" any extraordinary events with liabilities above the first two layers as placing a "cap" on the liability.

The practical effect of this question presents itself when you consider the transportation network of roads in the state of Nevada. My reading of the impact statement indicates that they anticipate approximately 10 trucks a day moving through Nevada to the site if it is located at Yucca Mountain. Most roads in our states either lead through the heart of our small rural communities or on the periphery of them.

In a worse case scenario one of the trucks moving through a community may experience an extraordinary nuclear occurrence (an "ENO" is defined as the release of nuclear material from the containment device). It is possible that an "ENO" could occur in front of the legislature and require the evacuation of downtown Carson City. While this may not amount to a loss in excess of the $760 to $800 million which is currently available, if you transfer that occurrence to Las Vegas and have the "ENO" occur when a train derails in the vicinity of the "strip", the loss could exceed those amounts.

There is an additional complication in that the congress will be holding hearings this summer on the extension of Price-Anderson. By extension I mean the continuance of the program for any new reactors built after the expiration in 1987 (coverage would continue for all existing reactors). There are a number of suggestions that have been forwarded to congress on the question of modifications to Price-Anderson. In fact, a subcommittee that I serve on at the NAIC will be recommending that private insurers withdraw from the insurance of nuclear liability coverage. In other words, insurers would continue to provide property insurance to the reactors but would not cover third party liability caused by the release of nuclear materials.

It is felt by my colleagues at the NAIC that this is a program designed by the Federal Government to enhance an industry which in the 1950's was considered to be in the national interest. The amount of monies that are available from private insurers in the event of an "ENO" is not significant enough to make it worthwhile for them to participate (I realize that $160 million seems to be a significant amount but you must realize that over $220 million was purchased solely for the MGM fire, further, insurers paid out over $26 million in connection with the Three Mile Island incident even though there was no release of radioactive materials). It will probably be the recommendation of the NAIC that this program be totally funded by the Federal Government.

Regardless of what types of recommendations are accepted by congress, it is imperative that the Price-Anderson Act be modified to explicitly provide that the Federal Government will be liable for all losses related to an extraordinary nuclear occurrence. Assuming that the current structure is maintained this would entail that the statement concerning congress' "review" of "ENO" losses in excess of the first two layers of coverage be modified to state that the Federal Government would be responsible for those losses.

We at the NAIC will be continuing to look at this issue in the future and as we develop information that might be useful I will forward it to your and other appropriate persons in the administration's attention.

DAG:mr

STATE OF NEVADA

DEPARTMENT OF COMMERCE

HOUSING DIVISION

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RICHARD H. BRYAN
Governor

LARRY D. STRUVE
Director

MARC HECHTER
Administrator

MAMIE CHINN
Chief Operations Officer

March 1, 1985

MEMORANDUM

TO: Larry Struve
Director
Department of Commerce

SUBJECT: Draft Environmental Assessment of the Proposed Yucca Mountain Site for a Nuclear Waste Repository

* * * * * * *

You have asked me to review the draft environmental assessment for a nuclear waste repository site at Yucca Mountain in Nye County, Nevada. Your assignment included relating the material found in the environmental assessment to the various points you set forth to the Department of Energy in your April 14, 1983 correspondence to that agency. I have reviewed the materials you sent to my office and offer the following remarks.

Your points of the April 14 letter addressed social and economic conditions related to various factors. The impacts to labor, income and public revenues, housing and the infrastructure for sewage treatment and water supply were most relevant to my review. It is my understanding that matters related to the transportation of hazardous materials, and attendent liabilities, are being addressed by the Insurance Division.

Labor and Employment

The Draft Environmental Assessment projects an employment period beginning in 1993 and concluding in 2053. In the absence of modeling capabilities, it is difficult to analyze the various secondary and tertiary impacts associated with employment base increases and declines as projected to occur over the various phases of operations for the nuclear waste repository. Generally, the population impact is, at least, 2.5 times the stated direct employment increment.

Employment levels range from approximately 1200 workers in the first year to a peak of about 3350 workers in 1996. Employment base declines occur in two phases for the remaining period of time the repository is scheduled to be on line. It appears, on average, that approximately 800 workers are required to fully decommission the site.

Labor market implications for this project include excessive in-migration of workers having mining and construction skills and will, undoubtedly, result in a wage and salary discrepancy with increases over those wages and salaries prevailing in the markets of Clark and Nye County. This could cause a decrease in the existing employment base and existing basic and nonbasic work opportunities as workers shift their employment to the federal government. The switch from essentially nonbasic to basic jobs by employees in the local labor force shifting to direct employment opportunities at the federal facility will create secondary and migratory impacts which are effectively detrimental to the stability of local economies. In essence, a boom and bust cycle, in the sense of treating the project development period as a "boom town", is created. This produces increased burdens both for replacement of migrating workers and absorbtion of workers displaced after the repository is operating.

Income and Revenue

The draft environmental assessment addresses the income potential of the project. This income generation may serve as a possible mitigating factor to labor force disruption and community service impacts noted in the assessment, because the increase of income suggests a subsequent increase in consumption which will be a stimulus to local economies, thus providing opportunities in nonbasic and basic sectors. If, in fact, the projected annual economic stimulus of repository related spending on wages is the 157.2 million dollar mark identified for the five year construction period, it is conceivable that much of the labor disruption which occurs from both out-migration of existing workers and in-migration of new workers may be mitigated. Since I am unable to ascertain the exact modeling structure and depth of input assumptions, although it appears on its face to be similar to that used by the consultant who conducted the MX environmental analysis, it is difficult to determine the validity of the reported impacts.

Besides the direct impact on wages and related economic stimuli, the presence of additional consumptive forces, such as material acquisitions and service industry use, coupled with the suggested pattern of placement for workers (80% in Clark County, 20% in Nye County) suggests that tax revenues will escalate along the normal multiplier chains; but that Nye County may experience greater impacts in the aggregate than Clark County. The presence of new workers, and the likely increase of wages for existing workers, producing the related consumption should result in an increase in sales tax and, probably, property tax revenue. Taking the obvious qualitative approach that we are taking in this review, it is possible to conclude that these events will serve as mitigating factors to the impacts of job displacement and increased demand for community services.

Community Services

The likely increase in population growth, which will occur as a result of in-migration of new workers and the in-migration of persons seeking employment opportunities (which may not be realized), will impact the various community services available in Nye and Clark Counties.

The draft environmental assessment does not address the impact on public services (i.e. public infrastructure) at the municipal level. The environmental assessment, rather, attempts to perform countywide analyses. From a qualitative standpoint it is obvious that Clark County service providers are more able to absorb labor force changes, and consequent additional population and migration, than the rural service providers in Nye County. In the absence of municipal specific assessments, it is virtually impossible to ascertain the true economic impact to the community services that will be felt as a result of the construction and operation of the nuclear waste repository. In all likelihood, with the bulk of the population growth occuring in Clark County, the impacts will be less significant than if the bulk of the new population were to settle in Nye County. Nevertheless, impacts are likely. I should note that at this point in time we are only dealing with impacts and should only consider impacts that are associated with the incremental increase in population growth over those normally projected. Population growth is projected to be between 3 and 5 percent per annum in Clark County over the next 20 year period. The increment associated with the influx of new construction related secondary workers is not as significant in light of planning which already takes into consideration anticipated rapid increases in population.

It is likely that we will have significant quantative impact, (although I note the environmental assessment provided no quantative assessments,) as a result of the new population and related demands. Since the project is not scheduled to begin until 1993 it is difficult to make any kind of an educated, or uneducated, guess as to what the inventory conditions will be as the new population begins to impact upon the communities. It is probable that inventory speculation will take place both in owner/occupied residential and multifamily rental residential properties. This may result in an excess of supply over demand both in the initial period and following the peek construction time when there is a downturn in employment opportunities at the repository resulting in consequent layoffs and terminations. If Clark County population exceeds the projected growth rates anticipated, notwithstanding the project, by the various public planners it is likely that the excessive supply will easily be absorbed in the normal market environment. There is likely to be a temporary disruption, however, such as that which occurred in single family owner/occupied residential sales during the early 1960's and late 1970's - early 1980's in Clark County and appears to be occuring currently with respective vacancy rates in multifamily rental residential properties in Clark County. It is likely that housing in Nye County will be of a temporary nature associated primarily with the con tuction phase and is more akin to the boom and bust cycles of economic impact to which I alluded earlier.

Facilities for sewage disposal and water supply are most likely to experience greater impacts in Nye County than in Clark County. Public infrastructure provided for, and available throughout, Clark County seems sufficient to adequately address the incremental absorbtion of new population. Potential impacts in Clark County are more associated with the fact that the planned growth peeks for which public infrastructure has been designed could be reached at an earlier time than that originally proposed in the development of the sewage and water facilities because of the incremental growth and population associated with the placement of a nuclear waste repository at Yucca Mountain.

In the case of Nye County, the increase of demand during construction may be excessive given existing water and sewer supply capabilities.

Should the federal government propose mitigation assistance, it appears most likely that public infrastructure assistance will be more necessary in Nye County than in Clark County. Some urban county impacts, however, must be mitigated since the planned need for water facilities and sewage treatment facilities must still be met, and the incremental growth associated with the nuclear waste repository I will use the marginal expansion capacities.

I am including with this memorandum a series of pages copied from a technical response to the draft environmental impact statement for the MX Missile System. The material contained in the pages, while not relevant to the environmental assessment for the nuclear waste repository, does provide a model for developing specific quantative responses to the environmental assessment that you may wish to pass on to the appropriate person

I remain available for any comments you wish to make on this or other topics and will await your further instructions.

Marc Hechter
Administrator

MH:pt
Encs.

CHAPTER IV

TECHNICAL RESPONSE

SOCIOECONOMIC

- Socioeconomic Issues
- Population
- Employment & Earnings
- Housing
- Health Services

SOCIOECONOMIC

Issues

Employment opportunities, and the direct and indirect population influxes associated with those opportunities, are the driving forces behind nearly every impact associated with deployment of the MX missile system, be it social, economic, or environmental. While population can be considered a resource for a variety of cultural and societal reasons, a rapid influx in population, due to economic incentives and factors, creates a demand upon community services. Additionally, a rapid influx in economic opportunities creates the potential for the distortion of a variety of markets from housing to the labor force, through distortion of supply and demand perspectives which have more or less operated at equilibrium. If services are not provided for adequately, either through long-range planning or impact assistance, such an influx in population is ultimately supported directly, or in most cases indirectly, by the existing population and resource base of the community.

For these reasons, it is imperative that accurate and acceptable baseline and impact employment and population projections be utilized for planning purposes. Using such projections, local communities and service providers can plan to provide services and facilities necessary to accomodate growing demand.

A chief concern in the analysis is the likely regional distribution of impact populations. Such an expected distribution is a function of Life Support provision policies and contractor staffing policies, all of which should be reactive to local growth management policy. Local growth management policy related to Clark County will be discussed further in an ensuing report.

The ability to meet demands without an influx, such as that associated with MX, is an extremely significant issue in and of itself, given current fiscal limitations, and an ever demanding populace. This can be attested to by any rapidly growing community. Increment that normal rapid growth with a large unplanned influx in a short period of time, such as that which would be induced by MX, and issues become further exacerbated.

SOCIOECONOMIC

Population

General Comments

Population growth in Clark County, as in all areas of the country, is a function of economic vitality. Projections of economic growth developed by analysts not associated with, and external to, Clark County, have proven to be consistently sub-par when compared ultimately to actual growth which had occurred over the forecast period. Locally produced projections, sometimes thought to be "Chamber of Commerce" by some external analysts, have consistantly proven to be more realistic.

The most recent locally sanctioned projections were undertaken as a part of the "208" Water Quality Management Program. For the last five years, Clark County has utilized these projections for a variety of facilities and service planning functions.

Population projections were developed utilizing an input/output model, specifically developed in 1972 for regions of Nevada, with relationships updated to obtain multipliers reflective of the 1975 economy of Southern Nevada (McDonald and Grefe, Inc., 1977).

Clark County recognized baseline projections are compared with DEIS trend line projections in the following Table (see Table 1). Differences range from approximately 12,000 (2%) in the beginning of the planning period to 67,000 (9%) by the end of the planning period (1994). It should also be noted that the DEIS planning horizon of 1994 is inadequate for comparison of DEIS impacts with Clark County facilities and service projections to the year 2000.

TABLE 1

BASELINE PROJECTIONS

	Clark County Baseline Population Projections	DEIS Baseline Population Projections
1980	462,218	N/A
1981	479,600	N/A
1982	497,000	485,433
1983	514,800	503,411
1984	532,400	523,124
1985	550,000	543,857
1986	572,800	559,947
1987	595,600	575,277
1988	618,400	591,447
1989	641,200	607,435
1990	664,000	623,794
1991	686,400	639,690
1992	708,800	655,936
1993	732,200	671,515
1994	753,600	686,699
1995	766,000	N/A
1996	791,000	N/A
1997	816,000	N/A
1998	841,000	N/A
1999	866,000	N/A
2000	891,000	N/A

N/A - Not Available

The most critical concern, specifically related to impact population growth, is that should Clark County plan facilities for higher baseline populations, and should MX impacts be assessed only from a lower baseline rate against such facilities planned at a higher rate, then the impacts falsely appear to be easily absorbed by the apparent excess capacity available within the facilities.

Without arguing the technicalities of differing population methodologies, it is fully expected that Clark County will meet or exceed the growth projected by the McDonald and Grefe forecasts. Therefore, no margin will be available within various facilities for incremental growth absorption considerations. The 1980 census figures discredited many lower baseline projections such as those produced by OBERS and BEA. Those projections utilized internally by Clark County were fully borne out, and in fact were slightly conservative.

Baseline growth forecasts are more of a philosophic problem, with implications concerning marginal availability of services and facilities for impact utilizations. However, forecasts of impact population growth are far more critical. From the beginning of the MX environmental assessment process, data involving direct employment requirements has consistently been in flux. This caveat was adequately stated in the DEIS Overview. The implications concerning population and related impacts are obvious.

Utilizing direct construction employment figures developed by the Nevada State MX Field Office, and direct operations employment available through the Air Force in early December 1980, Clark County developed an internal assessment of the population impact which would be experienced within Clark County. Relationships concerning family size, employment characteristics, secondary inducements, etc; were obtained from studies which followed the identified relationships associated with other major development projects (Mountain West Research, Inc., 1975).

The results of this population impact analysis, as well as several produced by the State MX Field Office are compared with figures presented in the DEIS. In addition, the Nevada MX Local Oversight Committee, in conjunction with the Utah MX Local Oversight Committee and the Utah State Planning Coordinators office, contracted with the University of Utah for services involving the application of several impact assessment models (UPED 79, SAM, etc.) for further analysis (University of Utah, 1980). The University of Utah undertook a similar analysis for the Air Force in mid 1980. These models were calibrated to Clark County baseline population projections and impact assessments were undertaken. Table 2 provides a comparison of the population impact figures produced by DEIS analysis with those produced by Clark County, the State of Nevada, and the University of Utah.

Clark County's analysis is based upon 21,000 direct construction personnel in Nevada as well as 7,690 operating personnel at the main operating base. Assembly and check-out personnel were not considered. The methodology was also applied utilizing the DEIS operating base employment figures.

TABLE 2

MX POPULATION IMPACT COMPARISONS

Clark County, Nevada

	Clark[1] County	Clark[2] County	State of[3] Nevada (MX Office)	State of[4] Nevada (MX Office)	Univer-[5] sity of Utah	DEIS
1982	3,993	3.993	3,741	3,812	4,637	0
1983	22,956	22,811	9,211	21,683	13,472	350
1984	30,199	33,461	22,509	31,923	22,901	5,661
1985	46,776	46,761	38,945	44,512	35,093	17,639
1986	57,623	51,619	49,392	49,135	37,852	27,826
1987	53,390	44,383	52,217	42,179	34,964	26,707
1988	35,598	30,583	48,701	29,524	34,181	24,840
1989	26,143	25,114	42,546	23,707	30,970	18,617
1990	24,964	23,935	22,577	22,577	20,129	16,017
1991	24,964	23,935	22,577	22,577	19,996	15,967
1992	24,964	23,935	22,577	22,577	19,996	15,967
1993	24,964	23,935	22,577	22,577	19,996	15,967
1994	24,964	23,935	22,577	22,577	19,996	15,967
1995	24,964	23,935	22,577	22,577	19,996	15,967
1996	24,964	23,935	22,577	22,577	19,996	15,967
1997	24,964	23,935	22,577	22,577	19,996	15,967
1998	24,964	23,935	22,577	22,577	19,996	15,967
1999	24,964	23,935	22,577	22,577	19,996	15,967
2000	24,964	23,935	22,577	22,577	19,996	15,967
Avg % Diff.	--	-4.8	-5.6	-9.8	-20.8	-45.8

[1]Clark County impact assessment as per staff memo December 12,1980, <u>used for impact analysis</u>. Assumes 21,000 construction workers. <u>Does not include assembly</u>.

[2]Clark County impact assessment utilizing same method as note 1 above, but DEIS main operating deployment schedule. Does not include assembly and checkout.

[3]State of Nevada impact assessment assuming 75% of construction for Clark County with Task Force construction figures. Averages of memo dated 2/9/81. Includes assembly and checkout.

[4]Same as note 3, using 21,000 construction workers for Nevada. Averages of memo dated 1/30/81. Does not include assembly and checkout.

[5]UPED 79 and SAM, using DEIS construction and deployment on Clark County recognized baseline of 891,000 by the year 2000. Does not include assembly and checkout.

State of Nevada projections are based on Task Force average yearly construction, as well as 21,000 direct construction workers being present in Nevada. The State of Nevada utilized the same operating base employee deployment figures as the DEIS. The University of Utah impact assessment is based upon Task Force figures for construction and the same operations as the DEIS. Assembly and check-out personnel deployment impacts were not assessed by any group.

Discrepancies in peak year distribution as well as other minor allocation discrepancies are principally due to the use of different staffing schedules. Major early year discrepancies are due to differing interpretations regarding the ability of the local unemployed labor force to meet the initial MX employment needs. participate in impact abatement. Given the fact that individuals other than those which will actually receive direct and indirect employment will also migrate to seek jobs, no change in the unemployment rate was considered in the Clark County analysis. Quantification of such an impact would be desirable, as such individuals place a potentially large burden on social service agencies.

The bottom line in the table provides the average percentage difference for each impact assessment as compared to column one, the first impact assessment developed by Clark County. The majority are within a range of ten percent difference. The State of Nevada (Task Force) assessment (-5.6%) and University of Utah assessment (-20.8%) are based upon approximately 18,000+ peak year average construction force needs for the entire project while the original Clark County assessment and State of Nevada (MX office) assessment are based upon a peak year construction force of 21,000 for Nevada alone. The DEIS is based upon an approximate 17,000 construction work force for the entire project, approximately 10% below Task Force figures. Given the fact that an additional 6,000 assembly and check-out workers, will also be required, which is 35% of the DEIS construction work force, the impacts as given can be expected to be highly understated.

Specific Comments

Pg. 3-414 Population

"The county's present population is 410,817"

This is an obvious error, as the 1980 census reveals a 462,218 population for Clark County. However, this is a classic example of underestimation of Clark County population and growth potential. The 410,000 figure is a U.S.Census 1980 projection produced several years ago. All P-26 census estimates have proven to be historically inaccurate by 10-15 percent. Use of this data to calibrate forecast models produces totally unusable results.

Mitigation Strategies

Population projections for the base case have been adopted as implicit policy through the implementation of policy measures based on such population projections. It is recommended that this policy be firmed up by adopting formally the projections of Clark County population as the official planning target for the year 2000, defining acceptable rates of growth.

In the absence of state or federal policy regarding growth, it would be irresponsible and presumptive to attempt to restrain regional population growth in the Las Vegas Valley and Clark County. Services shall be provided in an orderly and fiscally responsible manner to meet the needs of a growing population. In general, the growth which is expected to occur in the baseline will be a function of the expanding service oriented tourism economy. This is considered to be primarily in the interest of the community. Actions which are generally considered to be in the interest of the local community and which generally benefit the citizens of the community (economic growth) should be supported by the community. This includes the fiscal responsibility to provide and maintain services and facilities which promote the general welfare by maintaining or increasing a desired level of services.

However activities, such as MX, whose primary benefits are passed onto a community of individuals outside of the local community, even though providing economic benefits to certain sectors of the local economy, should be supported by the benefited community. Negative impacts not associated with economic growth which has been primarily identified as being beneficial specifically to the community in maintaining its desired interests, should be mitigated and socialized by the community of individuals whose interests are primarily served; in this case, the citizens of the United States.

SOCIOECONOMIC

Employment & Earnings

General Comments

In estimating the total economic effect of the deployment of the MX Missile System, HDR Sciences used a variation of the Input/Output methodology, known as the RIMS, Regional Industrial Multiplier System.

Paraphrased from Appendix D of ETR 27, Economic Model, RIMS is an alternate means for estimating the total economic effect, given the initial effect, without the expense warranted by the Input/Output Model. RIMS estimates project specific multipliers needed to estimate changes in regional gross output, regional employment, and regional earnings by first computing an industry's dependence on other regional industries. Implementation of the RIMS methodology requires the use of several data bases. National input-output data, provided by BEA, coordinated with county business pattern unemployment figures furnished by the Census Bureau.

HDR utilizes the RIMS model to develop a system of county-level interindustry models in order to project the deployment of the MX's direct and indirect economic effects. These county-level models use a baseline population projection from which labor force, employment and unemployment are derived or calcualted. Then projected related factors such as employment, earnings, labor force and population changes are added to the baseline estimates. The results are the measured economic impact resulting from the MX deployment. The latter part of the equation is presently assumed to be fairly accurate. It is the first part of the equation dealing with the baseline population projections which are used to derive figures for projecting a labor profile that raises some concerns.

First, the baseline population projections are used to generate a labor profile depicting employment and unemployment figures from which estimates are derived listing the amount of resident labor force available for deployment of the MX Missile System. Consequently, if the baseline population projections are inaccurate, this amount of error will be reflected in each category of the labor profile.

Second, the assumptions used to develop the labor profile are on the high side, compared with the historical period from 1970 to 1979. The comparison of these assumptions are as follows:

	M-X Assumptions	Historical Trend 1970-79
Labor Force Participation Rate	48.0%	43.8%
Unemployment Rate	8.0%	7.5%
Available Construction Labor Force	18.5%	12.7%

Thirdly, the unemployment projections with MX average at 5.5 percent from 1982 through 1994. In conversations with Aileen Rossiter of Nevada Employment Security Department, Las Vegas office, she expects the unemployment rate to be around 16 to 20 percent during construction, judging from the unemployment rates during the construction of the Alaskan pipeline project. The figures on the unemployment rates will be available shortly from Aileen Rossiter.

Fourthly, concerning earnings, the figures available from the Nevada Employment Security Department are based upon job openings and not based upon the average worker's hourly rate. Consequently, the figures that HDR has developed are assumed reasonable until comparisons can be made.

Finally, as RIMS is an input-output associated model, and therefore a static rendering of post demand relationships, its use in this context of impact analysis is debatable. Given the potential for large scale changes in demand caused by MX deployment, a more dynamic modeling process capable of adjusting under projected changing circumstances would be more appropriate.

In regard to assumptions concerning the ability of the local labor force to participate as direct impact construction employees, it appears that the model used in the DEIS does not take into account the fact that such employees absorbed from the local economy will switch from essentially non-basic to basic jobs creating further secondary and migratory impacts. Additionally, although currently unemployed due to slow housing and building markets, the "boom" created by MX will re-stimulate those markets requiring the ability of the local economy to draw on the same unemployed labor force. One worker can essentially supply only one side of this demand causing further migratory needs. Accepting the DEIS assumption for the earlier years requires that during the peak years even more migration will occur than that required to fill just the other direct construction jobs and induced secondary impacts. Construction worker migration will be required to fill the void left by those previously unemployed workers to meet MX "boom" secondary construction needs. Use of the existing labor force for impact mitigation assessment is fine for the near future but is inadequate for MX "boom" employment years. There is always an historic "supply" of unemployed to fill jobs; if not, migration will evolve. This is the basis of unemployment assumptions in any state of the art dynamic economic/demographic model. Altering this model by imposing other assumptions distorts the dynamics of the model and provides false data.

Specific Comments

DEIS:

Page 3-135, Table 3.2.3.1-1

Reviewing information from the Nevada Employment Security Department, the annual average for the civilian labor force in 1977 was 175,700 as opposed to the 174,200 shown in the table. The 1977 unemployment figure of 14,100 is correct. For the period of time from 1970 through 1979, the average growth rate for the civilian labor force was 6.0 as opposed to the 6.3 figure used in this table. Also, checking the 1970 figures, the annual unemployment rate was 5.8% as opposed to the 5.2% shown in the table. (See Table 3 for the information obtained from the Nevada Employment Security Department.)

Page 3-139, Table 3.2.3.1-4

The total employment of 185,198 does not compare with the 168,300 figure obtained from the Nevada Employment Security Department. There is a difference of 16,898. Also, the percentages in the respective categories should be as follows: Agriculture - not available; Mining - .012; Construction - 6.1; Manufacturing - 3.3; Services Share - 46.9; Government - 13.0.

ETR 27 Economic Model

Page 120

Three percent of the unemployment is considered unuseable for employment. Any excess above the three percent is defined as the resident labor force available for direct and indirect employment for MX. This excess is further broken down into 30 percent for project construction, 20 percent for project operations, and 50 percent for indirect employment.

With respect to this information, the following should be pointed out:

1) The source data is obtained from the Nevada Employment Security Department. It should be noted that this information is gathered on those individuals who are insured unemployed. As a result, these figures only reflect those individuals who are actively seeking employment. Thus it may not be necessary to eliminate the three percent from the unemployed labor force due to being considered unuseable for employment.

2) When considering the industrial attachment of the insured unemployed as of January 1981, the percentage unemployed in construction is 16.6% for the state and 12.7% for Las Vegas. These figures do not reflect the 18.5% that is assumed to be available for project construction.

Page 121, Table 4.2-6

A 7.8 percent rate of unemployment was used for Clark County for the years 1982 through 1994. This projection was developed using 1975-78 historical unemployment rate data. Reviewing this information against data obtained from the Nevada Employment Security Department the following is noted:

1) Using 75-78 historical unemployment rate data on average percentage of 8.3 is calculated with a standard deviation of 2.5;

2) Using 70-79 historical unemployment rate data on average percentage of 7.45 is calculated with a standard deviation of 1.78.

The above mentioned historical unemployment rate data, obtained from the Nevada Employment Security Department, is listed in Table 3 of this report.

ETR 2C Clark:

Pages 42 and 50

The table on page 42 is the high projection and the table on page 50 is the low projection. The baseline in both projections are higher than the projections developed by the Nevada Employment Security Department. The Nevada Employment Security Department only projected for the years 1982, 1983 and 1985, the comparisons are as follows:

PROJECTED EMPLOYMENT

Year	Nevada Employment Security	MX High	MX Low
1982	210,307	215,819	215,728
1983	220,067	223,876	223,718
1985	239,607	242,125	241,692

Next, in both of these tables, it has been assumed that for the years 1982 through 1994 there will be a constant labor force population rate of 48%. Using population information from Clark County Comprehensive Planning and civilian labor force figures from Nevada Employment Security Department, an average of 43.8 percent with a standard deviation of 1.5 was calculated for the years 1970 through 1979 (see Table 3).

Finally, it should be noted that a constant unemployment rate of 8% was used for the years 1982 through 1994 in both of these tables. Historically for the period of time from 1970 to 1979, the average unemployment rate was 7.5 percent (see Table 3). Also, the 8 percent figure is not the same as the 7.8 percent figure used in Table 4.2-6 Baseline Unemployment Rate Projection, found in ETR 27 page 120-121.

TABLE 3

CLARK COUNTY
AVERAGE ANNUAL
POPULATION & LABOR FORCE STATISTICS

Year	Population	Civilian Labor Force	Percentage of Population	Employment	Employment Increase	Unemployment	Unemployment Increase	Unemployment Rate
1970	273,288	116,200	42.5	109,000	-	6,800	-	5.8
1971	285,511	120,400	42.2	111,400	2.2	9,000	32.4	7.4
1972	302,406	127,600	42.2	117,500	5.5	9,800	8.9	7.7
1973	325,791	138,200	42.4	128,900	9.7	9,200	-6.1	6.6
1974	393,701	147,500	42.9	135,200	4.9	11,900	29.3	8.1
1975	351,682	156,000	44.4	139,400	3.1	16,500	38.7	10.6
1976	361,948	165,600	45.8	149,500	7.2	16,000	-3.0	9.7
1977	378,947	175,700	46.4	161,500	8.0	14,100	-11.9	8.0
1978	405,376	178,500	44.0	169,500	5.0	9,000	-36.2	5.0
1979	436,062	195,800	44.9	184,500	8.8	11,200	24.4	5.7
	Average		43.8		6.0	11,350	8.5	7.5
	SD		1.6		2.6	3,246	24.8	1.8

Source: Population figures are from Clark County Department of Comprehensive Planning and Labor Force figures are from Nevada Employment Security Department.

Housing

General Comments

Since the projection of housing needs is directly driven by assumptions of population levels, the DEIS housing need projections are considered to be underestimated and directly traceable to low population projections. Clark County estimates peak population impact in 1986 of 57,623 compared to the DEIS estimate of 27,826, a 45.8% difference.

In Clark County, there are several rural towns in close proximity to the proposed operating base (Glendale, Overton, Logandale, Moapa, Mesquite and Bunkerville). There is no consideration or analysis evident in the DEIS concerning availability of housing in those communities. Without such analysis, an evaluation of potential impacts to those communities is not possible and is, in fact, lacking.

The methodology presented in ETR 28, Housing Sector Model Group, is not easily interpretable due to omissions of sources of dependent variables and interconnections with population models. A clear relationship with tables in ETR 2C used to derive housing demands is not evident.

Specific Comments

DEIS, pg. 2-107

The number of baseline housing units projected for Clark County are underestimated. County projections (without MX) are based on the following figures (McDonald & Grefe):

Year	Population	PPH	Vacancy Rate	Housing Units
1982	497,000	2.67	3%	192,000
1994	753,600	2.63	3%	296,000
2000	891,000	2.63	3%	348,000

These figures indicate a 54% increase over the estimated 1982 units by 1994, and an 81% increase by the year 2000.

DEIS, pg. 2-140

The Clark County component of the "20,000 units in 1987" is underestimated. Utilizing Clark County figures for MX induced population, average dwelling unit occupancy of 2.65 (McDonald & Grefe), 3% vacancy rate, and an assumption of on-base/off-base residency of 40/60 percent (University of Utah), Clark County would need 13,430 dwelling units, an 8 percent increase over the normal growth baseline.

DEIS, pg. 2-140

It is unclear whether the statement in paragraph 2 refers to both Beaver and Clark Countys, or either separately. The mixing of statistics in this manner makes it difficult to evaluate impacts for specific areas throughout the DEIS.

Using methodology outlined above, the long-term needs would be 5,820 units in Clark County.

DEIS, pg. 3-414

Clark County has exhibited the highest growth rate in Nevada. Also, the 1970 housing stock figures are incorrect; 1976 figures used for comparison are not most recent data. Current figures are:

	1970 D.U.	1970 % of Total	1979 D.U.	1979 % of Total
Single Family	52,747	56	89,664	50
Multiple Family	30,616	33	63,246	38
Mobile Home	10,248	11	19,410	12

Source: Clark County Dept. of Comprehensive Planning, Task 1 Report, Existing Conditions, Clark County Comprehensive Plan.

Conclusions concerning trends are reverse of that presented in DEIS: Single family units are declining as percentage of all units, while multiple family units are increasing as percentage of all units.

SOCIOECONOMIC

Health Services

Issues

The pertinent issue of MX impact upon health services, specifically those provided by the Clark County Health District, centers upon the level and placement of population in-migration. Prime concern is directed at the allocation of staff services to meet potential demand.

General Comments

The DEIS generally reflects a broad assessment of private and public expansion requirements for health services. While private practitioners and general hospitals will pursue a market approach (i.e., demand will generate a supply) the public sector services are more restricted.

Manpower assessments cannot be made without a more definitive assignment of population. However, a range of needed personnel services can be suggested for such items as air pollution control and environmental health (e.g., sanitation) of one to six persons. The more sensitive direct care services are highly subject to fluctuation because of MX deployment. Some understanding of the local situation is warranted.

At the present time, the nursing shortage in Clark County, Nevada, is great and any addition of new service requests will have tremendous impact on this important manpower resource.

In addition to the nurses who might be required to participate in hospitals and doctors offices, the need for nurses working in the community will be expanded since, with the impact of such a large population, it would seem there would be an increase in a variety of areas such as communicable disease, maternal and child health, and chronic illness problems.

The efforts of control of communicable diseases, be they from Environmental Health issues such as food poisoning, or communicable diseases such as tuberculosis, venereal disease, etc., will have implications on our community health resources.

The Emergency Medical Services system will also be impacted by the anticipated growth. Training of EMT's and paramedics, and providing equipment for them to use, will be vital, and such training and equipment supply may be beyond present capabilities.

A further concern regarding manpower has to do with the "bargaining" for well trained personnel that may rob local offices, hospitals and agencies of well-trained staff and relocate them at new sites near the MX operations.

Mitigation Strategies

Mitigation techniques for services manpower requirements, particularly in public health care operations, are associated with the need for recruitment and employment incentives.

Private and public employment must be made financially competitive. Some form of impact assistance for recruitment and benefit enrichment needs consideration.

The potential personnel shortfall in the health care area, and the effects of this shortfall, should be fully analyzed in the Final EIS or in subsequent MX planning documents. Mitigation strategies developed in response to identified impacts should be coordinated with Clark County Social Services, Clark County Health District, and other local and state agencies.

PUBLIC INFRASTRUCTURE

- o Police Service
- o Fire Protection
- o Transportation
- o Educational Services
- o Wastewater Collection & Treatment
- o Water Supply & Distribution

PUBLIC INFRASTRUCTURE

Police Service

Issues

Key issues affecting the degree of MX impact on police services are the size and phasing of MX-related growth, the spatial allocation of this growth, and the capital facilities needs associated with new or expanded service areas.

General Comments

The DEIS assumes that law enforcement requirements are generated by the total population, regardless of spatial allocation. Further, it is assumed that the requirements are invariant for all population categories.

A parameter value for level of service is established at 2.0 police officers per thousand population, and is considered an overestimation of total impact since the operating base will maintain its own police force.

Capital needs are not addressed in the DEIS except to note a capital cost of $48 per person (1978 dollars).

Staff review suggests that law enforcement requirements are influenced more so by spatial allocation of population in-migration than by a total number relationship. Further, a dependence upon an invariant parameter value is considered questionable in light of the growth trend of service demand (per capita dispatched service calls).

Capital facilities are discussed as a function of expanded service area requirements rather than as a fixed value.

Specific Comments

In regard to the following comments, it should be noted that the population projections and allocations utilized for preparation of the DEIS are underestimated in comparison to projections utilized by Clark County (see socioeconomic issues and population sections of this technical response).

Page 4-507:

> "Law enforcement personnel requirements are assumed to be generated by the total population, whether resident in local communities, the operating base, or in construction camps since any of these persons could be the perpetrator or victim of crime in the area."

The justification for establishing personnel requirements on the basis of total population, irrespective of spatial allocation, as proposed in the statement on page 4-507, indicates a simplistic and unrealistic assessment of existing conditions.

Regardless of variations between Air Force population estimates and those utilized by Clark County, if the majority of the in-migration occurred in Moapa Valley, rather than Las Vegas Valley, significant public investment would be required to meet the demand.

Currently the Metropolitan Police Department maintains three resident officers in Overton, one resident officer in Mesquite, and one sergeant (Overton) to supervise both areas. Holding facilities are equally rural in nature. Overton contains two 2-man cells, one 6-man cell, and no feeding facilities; while Mesquite contains only two 2-man cells, also without feeding facilities. The commitment, evident from current service levels, is toward maintenance of a rural presence in the vicinity of the proposed operating base.

In order to shift from a rural configuration to one capable of meeting new demands, a large commitment of officers will be necessary in the Moapa Valley area to meet the long term commitment from base and off-base personnel. Holding facilities will require an as yet undetermined amount of expansion.

Historical evidence for Las Vegas Valley indicates that the demand for police services are increasing at an increasing rate. Demand, for review purposes, is measured as a per capita relationship of officer-dispatched calls, exclusive of those associated with traffic incidents. Table 4 presents the historical pattern.

TABLE 4

PER CAPITA POLICE SERVICE DEMAND

Year	Dispatched Calls	Calls Per Capita
1974	111,600	.40
1975	120,532	.40
1976	140,831	.44
1977	161,651	.48
1978	168,296	.47
1979	182,758	.49
1980	202,289	.51

These trends have been determined for the service area of the Metropolitan Police Department only (i.e., the City of Las Vegas and Unincorporated Clark County).

Applying Clark County projections for both peak construction and selected long-term commitment (i.e., 1986, 1990, 1995, 2000) the demand is measured at the following for each year of merit:

1986: .60 per capita calls,
1990: .61 per capita calls,
1995: .65 per capita calls, and
2000: .67 per capita calls.

The increase, as a function of population, continues to exceed a one to one relationship. Nevertheless, simply as a matter of a greater economy of scale, resource allocation is more easily accomplished in Las Vegas Valley.

Page 4-507

> "The requirements are further assumed to be invariant for all population categories, with a parameter value of 2.0 police officers per thousand. This assumption tends to overestimate the total impact since police personnel will be part of the operating base complex."

Requirements for police service are not invariant for all population categories. It might be prudent to restate that as a general rule for regional evaluations, the relationship of police to population may be held constant. Further, a review of type of crime correlated to general socioeconomic categories may be warranted.

An overestimation of impact predicated upon the ability of on-base police personnel to meet demands for service is questionable. In light of Comprehensive Planning projections, the significant influx will be in Las Vegas Valley, with the consequent impact to Metro police. Given the current existing relationship between Nellis Air Force Police capabilities and service employees in Las Vegas Valley, it is incorrect to suggest that on-base police service mitigates the impact of a military establishment upon the civilian community infrastructure.

Page 4-508

> "Clark County's peak year requirements total some 85 personnel, or 4.2 percent more than the peak year baseline requirements...M-X is projected to require 36 personnel in the long term..."

The problem faced in responding to this statement is the absence of any clear delineation between police and fire personnel.

Utilizing existing Metro service levels for their jurisdiction (1.95 $\pm$ officers per thousand), needed personnel projections, based upon Comprehensive Planning population estimates, are as follows:

1986	1990	1995	2000
25	11	11	11

The manpower requirements are those required over the base line; and are only reflective of direct M-X impact on the Metro service area. In addition to direct response personnel, administrative and support personnel inflate the needed manpower requirements as follows:

1986	1990	1995	2000
33	15	15	15

Furthermore, it must be understood that this assessment is per shift, since the numbers reflect those manpower requirements at any given static point in time. Thus, the total personnel need to accommodate, and maintain the current 24-hour response configuration, is as follows:

1986	1990	1995	2000
99	45	45	45

In all likelihood the greatest population influx (84% during peak, 60% long term) will occur in the area served by the West (Jones) Substation in the northwest area of the City of Las Vegas. Certain capital investment may be required to expand patrol capabilities. The West Substation currently is maintained at a total of 90 officers for three shifts. Projected peak demand equates to a similar sized facility (or expansion), while long-term demand indicates a 50 percent expansion.

Since the rate of demand is increasing at an increasing rate, it is likely that service capabilities under existing levels are overtaxed. Further, the increasing rate of demand suggests that a synergistic impact will occur from MX deployment. This would place manpower estimates into a conservative (i.e., understated) category. One final note is that impacts on training programs would occur at least one year prior to the dates of the manpower requirements shown above.

Mitigation Strategies

Financial mitigation measures center upon the need to provide public investment capacity for the recruitment, selection, training, and deployment of police manpower. The mechanism by which potential financial aid, or impact assistance, is to be made available can be designed in several ways. Alternatives for management such as a combined state, local, federal authority, a trust fund, or use of existing grant-in-aid mechanisms are available.

Policies that may best reduce the impact on community infrastructure are those that effectively channel the population settlement to Las Vegas Valley. Restrictions on local resources being committed toward expanding Moapa Valley facilities is the key to such channelization. Management strategies that will effect a controlled spatial allocation and assignment of local resources will result in the optimization of the carrying capacity of community infrastructure.

PUBLIC INFRASTRUCTURE

Fire Protection

Issues

Key issues affecting the degree of MX impact on fire services are the size and phasing of MX-related growth, the spatial allocation of this growth, and the capital facilities needs associated with new or expanded service areas.

General Comments

The DEIS assumes an invariant need of 1.65 fire personnel per 1000 population. Further, the DEIS contends that construction camp fire protection will be supplied by the contractors, while on-base needs are to be met by the military.

No commentary concerning existing conditions and service restrictions is presented in the DEIS, nor is the potential demand for capital facilities addressed.

Staff review suggests a channeling of growth to Las Vegas Valley as a means of reducing impact to rural services incapable of meeting a larger demand in Moapa Valley. Further, estimated additions to Las Vegas Valley needs (Clark County Fire Department only) are made.

Capital requirements to meet extended demand caused by MX related population in-migration are noted as a function of expanded service area requirements.

Specific Comments

In regard to the following comments, it should be noted that population projections and allocations utilized for preparation of the DEIS are underestimated in comparison to projections utilized by Clark County (see socioeconomic issues and population sections of this technical response).

Besides the population discrepancies, the DEIS also lacks an awareness of the variety of jurisdictions involved. The response to the DEIS which follows is concerned with impacts to the Clark County Fire Department only; whose jurisdictions encompasses both rural Clark County and the unincorporated urban towns.

Page 4-507

"In many areas, the fire protection force is composed of volunteers. With the influx of a large population, the volunteer force may find it difficult to provide adequate fire protection, particularly for scattered mobile homes and large commercial buildings."

In point of fact, all areas of rural Clark County (which includes Moapa Valley) are serviced by volunteer departments. The Moapa area is served by three volunteer units, one each in Moapa, Logandale, and Overton. Each unit is composed of 15-20 members each and relies upon tankers for fire fighting. No hydrant facilities are available. The capabilities of these units to meet the demands of a significant off-base in-migration in Moapa Valley is severely limited. The volunteers' availability may be further restricted because of personal employment in Las Vegas Valley. Additionally, there is an absence of paramedic and trauma treatment facilities in Moapa Valley.

Equipment for combating fires within the service area of the volunteer units is limited to that capable of handling existing rural structures only. The table below lists the equipment and location.

TABLE 5

MOAPA VALLEY
VOLUNTEER FIRE PROTECTION EQUIPMENT

Unit	Location
1970 Ford 1-T P/U	Logandale
1953 2½-T 6X6 (Modified Tanker)	Logandale
1979 American LaFrance (1000 GPM Tanker)	Logandale
1960 Seagrave Tanker (500 GPM)	Moapa
1976 American LaFrance	Moapa
1952 GMC 2½-T 6X6	Moapa
1979 Ford 1-T Van Ambulance	Moapa
1967 American LaFrance (1000 GPM)	Overton
1977 Ford Modulance	Overton

Volunteer fire units in the vicinity of possible off-base community development are incapable of meeting any new demand in the area without a significant investment in equipment and paid permanent employees.

Page 4-507

"It is assumed that persons and property on the base will be provided fire protection services by the base, while the population in temporary construction camps are provided fire safety services by contractors."

It is recommended that these assumptions be adopted as formally committed policies in the development of life support facilities for MX related population in-migration. Prior discussion of rural service carrying capacity is included, by reference, as justification for such a policy.

Page 4-507

> "The additional personnel needs associated with fire safety services are estimated in a manner similar to that for law enforcement except that only the population resident in local communities is used to generate estimates. ...The personnel needs ratio is invariant for all population groups (1.65 fire personnel per 1,000 population) assumed residing in local communities."

The limitation of the evaluation of fire personnel requirements to local communities is acceptable only insofar as a management policy to provide on-base and construction camp fire protection is inherent to MX development criteria. Furthermore, the assessment of need must take into consideration the ability of rural contingents to meet such need.

As with police service, it is evident that growth related to MX deployment was underestimated, as well as improperly allocated (see population commentary). Staff assessment of need utilized Department assignments and existing combat policy of the County Fire Department to determine potential impacts.

The Clark County Fire Department currently maintains 341 fire personnel to service the urbanized portion of unincorporated Clark County. General combat policy requires that three engines respond to commercial type fires and two engines respond to residential type fires. Of course, there are limitless response variations predicated upon the size of the structure and its content. However, the aforementioned serve as a general rule.

Clark County growth allocations indicate that 26 percent of the in-migration of MX related population to be in the portion of Las Vegas Valley currently served as part of the Southwest Fire Protection District (i.e., western unincorporated valley). Utilizing 1.65 fire personnel per thousand as acceptable on service standard, on-call personnel needs for the peak and selected long-term are reported below by year. These numbers represent added need over baseline requirements.

1986	1990	1995	2000
19	6	6	6

The Southwest Fire District is currently serviced by one station consisting of a single engine company. The station is manned by 18 fire personnel on 24-hour shift. Each shift is worked by one of three platoons on a rotating basis. Essentially, this is 4-5 available personnel per shift. Thus, the peak demand equates to three engine companies (per single shift) in manpower requirements while the long term need is for one additional engine company per shift.

The demand placed on the remaining impacted valley areas of unincorporated Clark County (i.e., Winchester, Paradise, and Sunrise Manor) follows. These numbers are also reflective of a single shift requirement.

1986	1990	1995	2000
18	5	5	5

The total demand for personnel necessary to accommodate a 24-hour response posture for each area discussed is reported below.

Western Unincorporated Valley:

1986	1990	1995	2000
57	18	18	18

Other Unincorporated Valley Areas:

1986	1990	1995	2000
54	15	15	15

Although the need for the remainder of the unincorporated valley is similar to that for the western unincorporated valley, the concentration of resources is not as much a factor, thus reducing long-term capital need. However, capital facilities (i.e., fire station) to accommodate an additional engine company, over baseline needs, in the western unincorporated valley is indicated.

Mitigation Strategies

As with police services, financial mitigation measures center upon the need to provide housing, and deployment of fire prevention manpower. The mechanism by which potential financial aid, or impact assistance, is to be made available can be designed in several ways. Alternatives for management such as a combined state, local, federal authority, a trust fund, or use of existing grant-in-aid mechanisms are available.

Management policies which may reduce the impact on community infrastructure are those that effectively channel the population settlement to Las Vegas Valley. Restrictions on local resources being committed toward expanding Moapa Valley facilities, is the key to such channelization. Consequently, a comprehensive management policy framework which recognizes this issue is warranted.

PUBLIC INFRASTRUCTURE

Transportation

Issues

The most important transportation system issues associated with MX depoly-ment are impacts associated with an in-migration to Las Vegas Valley. Although comments concerning rural county impacts are presented, the most significant transportation system impacts to Clark County are likely to occur in Las Vegas Valley. Principal issues include air and rail traffic, post-construction road supervision and maintenance, and increased trip generation with resultant urban arterial congestion.

General Comments

The DEIS suggests that no significant impacts are anticipated on air or rail traffic as a result of the proposed action. Further, the DEIS notes a positive impact likely to result from the construction of approximately 8,500 miles of new roads in currently limited access areas.

Some expansion requirements are reported, although without assigning capi-tal costs. For example U.S. 93 between the base and I-15 would have to be widened to four lanes, unless mitigation measures such as staggered work shifts or carpooling could be accomplished for workers.

Staff review indicates a potential for damage to sensitive areas as a con-sequence to expanded network development in the rural portion of Clark County. Further, disruption of the quality of life in rural Clark County as a result of indirect impacts (i.e., air pollution, noise, disruption of sensitive areas, etc.) from increased trips may occur.

The majority of transportation system impacts are associated with an assessment of population in-migration and the resultant increased trip generation on Las Vegas Valley street and highway network.

Specific Comments

Page 4-539:

> "No significant impacts are anticipated on air or rail traffic in the selected deployment area."

ETR 19 Page 6:

> "The MX missile itself will be constructed in components in four different cities and shipped to the bases by either railroad or truck."

Staff review suggests that significant impacts are possible. Significant, not in the sense of being detrimental to rail service, but in the nature of traffic impedence. Besides the noted potential components' shipment (particularly stage four components from Los Angeles), shipments of construction material are likely to utilize rail as a means of favored goods movement. Since Las Vegas Valley contains the rail corridor, a potential for traffic restriction exists.

The rail line traverses Las Vegas Valley in a north-south direction and restricts the already limited east-west access points at Tropicana Avenue and Spring Mountain Road, in unincorporated Clark County.

The impact to flow may be problematic. Tropicana and Spring Mountain are currently the only through corridors, serving unincorporated Clark County, for east-west traffic. It is likely that a railroad grade separation may be warranted at Spring Mountain Road (Tropicana RR grade separation is currently under construction). Spring Mountain serves the area of expected major population influx, and flow restrictions at the railroad crossing are likely to be synergistic in detriment because of traffic signals at Valley View Boulevard, Industrial Road, and Las Vegas Boulevard South, on either side of the railroad crossing section. An estimated cost for separation exceeds $4 million because of engineering and right-of-way conflicts at Spring Mountain Road and the railroad tracks.

Air travel issues have been addressed in several planning activities conducted by the Clark County Department of Aviation. Land use policy and population influx are not as much a factor as is the total perspective of economic activity.

Several reports which are on file with the Clark County Department of Aviation, present the planning for airport facilities in Clark County. A draft master plan for McCarran International Airport was completed in April 1979. The final report was adopted by the Clark County Board of Commissioners on November 6, 1979.

The master plan, incorporated by reference, covers a period of 20 years, 1980 through the year 2000. This study is the fourth in a series of independent studies dealing with McCarran's form and future. Some conclusions have evolved through this succession. This document is intended to integrate these conclusions.

The capital improvements generally proposed in the master plan have begun. The terminal facilities as well as financial resources have been delineated in the plan. Consequently, a quantifiable impact for air transportation, as a result of the MX, is not immediately evident.

However, secondary industrial development would increase service demands requiring an expeditious, if not early, completion of the McCarren expansion program. This situation may exist for supplies shipments as well.

Page 4-539:

> "The proposed action would involve the construction of approximately 8,500 miles of new roads in an area of the Great Basin which presently has relatively poor access. Roads constructed for the project will be open to the public, producing a long-term change in the accessibility ...which could encourage development and facilitate use of the area for recreation."

The long-term use of access roads may lead to disruption of sensitive lands as well as a reduction of recreational benefits derived from a "primitive" experience in the rural environ. However, in terms of the transportation network a problem of maintenance is foremost. Assuming construction will be accomplished as part of the MX development, the post-construction road supervision (i.e., traffic safety patrols by Nevada Highway Patrol and Metropolitan Police) and maintenance (Nevada Department of Transportation) demands must be financed. In an already financially constricted environment (i.e., decreasing gas tax revenues) demands cannot be met.

ETR 19 Page 16:

> "Most of the construction traffic itself would use the project roads ...to avoid intersections with heavily or even moderately travelled roadways."

Staff would suggest a specific policy requiring such utilization, and an expansion of the comment to recognize that maintenance and supervision responsibilities will be the responsibility of the Air Force or prime contractor.

ETR 19 Page 16:

> "The anticipated increases in traffic on the existing roads would likely increase the maintenance efforts needed to keep the roads in good condition, especially ...when heavy supply trucks would be using the existing roads."

ETR 19 Page 8:

> "Stage two, including its shipping container, will exceed the weight limits for the state and federal highways over which it will pass and all three stages will probably exceed the size limits..."

Both of these excerpts suggest an awareness of potential maintenance and supervision requirements that will be generated as a consequence of MX deployment under the proposed action. Again, given financial limitations, maintenance and supervision for MX related activities must remain a responsibility of the Air Force or prime contractor.

ETR 19 Page 8:

> "A significant volume of traffic will also be generated within local communities as a direct result of the project.

ETR 19 Page 16 and DEIS Page 4-543:

> "Once the base is operational, approximately 2,400 military and civilian personnel would be commuting to the base from neighboring communities, primarily Las Vegas. ...Within Las Vegas and other nearby communities, such as in Moapa Valley, improvements to the major streets may be required at some locations."

Although there is agreement that Las Vegas Valley will be the primary area impacted, the projections reported in the DEIS underestimate the level of impact (see the introductory statement and population section of this technical response). Accordingly, a review of potential demand and subsequent impacts was undertaken.

Standard transportation planning tools were utilized to evaluate the essential impact from the anticipated population. Technically, the evaluation method is a series of sketch planning applications with heavy reliance upon results generated by the Urban Transportation Planning System modeling package developed by the U.S. Department of Transportation and operated locally by the Clark County Transportation Study.

The technical procedures for the evaluation of population/land use impacts require that dwelling unit and other land use data, (e.g., commercial acreage) be expanded to trip table form by the use of trip rate equations, (e.g., X number of dwelling units produce Y number of Z trips, or X number of commercial acres attract Y number of Z trips). The trip table format allocates vehicle miles traveled onto a base existing and committed street and highway configuration. Certain auto occupancy and transit ridership assumptions, (i.e., 1.08 persons per auto for work trips and .5% transit trips), are included in the allocation. These assumptions are based upon actual survey data compiled by the Clark County Transportation Study.

The authors of the DEIS suggest mitigation measures such as carpooling, or staggered shifts, may be able to reduce demand. The planning method incorporates a variety of technical variables which may account for different measures. These variables include expanding auto occupancy by carpooling or vanpooling assumptions, increasing transit trip distribution, modifying traffic flow, and closing streets to unrestricted auto travel.

The net result of these activities is an analysis of the base case population/land use impacts upon the volume capacity of the urban surface transportation network. At this juncture, sketch planning, as well as conceptual guidelines, are utilized to expand the carrying capacity demand to that generated by the MX increment.

A recommendation that major pieces of infrastructure development was necessary was made only after certain growth related issues were considered.

Each of the issues logically evolved out of an iterative review process and are composed as follows:

- o Selected improvements in auto occupancy and transit ridership would not effect sufficient reduction in volume for existing capacities to meet demand.

- o Increased delays would offset air quality improvements realized from implementation of the programmed transportation control measures, (e.g., traffic light synchronization, ridesharing, etc.).

- o In order for transit ridership to increase, the existing system must be greatly enhanced, because without increasing the capacity on the street and highway system, transit service levels will be restricted.

The results of the initial review, utilizing these considerations, indicated that large portions of the surface network were at or approaching level of service "D", (i.e., unstable flow with little maneuverability) and could not be mitigated by standard low cost transportation system management techniques.

Examples of congested urban arterials are, of course, centered among major activity centers, (i.e., Sahara Avenue from Maryland Parkway to Rancho Road, the Las Vegas Boulevard corridor between Bonanza Road and Tropicana Avenue, Paradise Road from Sahara Avenue to Twain, along Boulder Highway between Five Points East and Nellis Boulevard, Spring Mountain Road from Las Vegas Boulevard to Valley View, and along Maryland Parkway), at the limited east-west railroad crossings within commercial areas; and at several key intersections where major roadways intersect (i.e., Sahara Avenue and Las Vegas Boulevard, Sahara Avenue and Maryland Parkway; Flamingo Road and Las Vegas Boulevard, Flamingo Road and Paradise Road, Flamingo Road and Maryland Parkway, Spring Mountain Road and Las Vegas Boulevard, Tropicana Avenue and Las Vegas Boulevard, Tropicana Avenue and Maryland Parkway; and Main Street and Charleston Boulevard). Future areas of congestion in developing commercial areas of the Valley (i.e., the new Meadows Shopping Center) are expected along Decatur Boulevard and Valley View Boulevard between Sahara Avenue and Washington Avenue. Alta Drive is expected to be travelled heavily due to the new shopping center.

Because the current trend toward rapid population, expansion is anticipated to continue in addition to the suggested MX related in-migration in west Las Vegas Valley, the MX related impacts are considered significant. A heavy reliance upon private vehicles, limited east-west access, and the predominantly grid network, suggest a demand for certain improvements to the regional transportation network in Las Vegas Valley.

The evaluation resulted in the development of a list of the minimum improvement projects necessary to meet projected demand with the MX population increment.

The projects included in the list were selected to provide (1) east-west relief for residential areas in west valley areas, (2) north-south relief for west and east valley areas, (3) potential industrial area improvements and capacity enhancements, and (4) ready access to interstate system from all valley areas likely to be impacted by a population influx. Projects which are suggested follow:

Project	Cost (Unadjusted 1979 Dollar Estimates)
I-515: Las Vegas Blvd. to Boulder Highway	$180,000,000
Flamingo Road: Eastern Ave. to Koval Rd.	4,658,000
Flamingo Road: Valley View Blvd. to I-15	49,082,000
Flamingo Road: Rainbow Blvd. to Valley View Blvd.	7,260,000
Flamingo Road: Koval Lane to I-15	5,873,000
Nellis Blvd: Tropicana to Lake Mead	7,600,000
Tropicana Ave: Jones Blvd. to Paradise	3,300,000
Rainbow Blvd: Flamingo to Sahara	5,800,000
Spring Mtn. Rd: Rainbow to Valley View	3,200,000
Craig Road: Rancho Rd to Las Vegas Blvd North*	12,000,000
Total Capital Requirements	$278,773,000

* An interchange, programmed for development by the NDOT, is not included in the estimate for Craig Road.

Of the projects identified by the evaluation team as pre-MX peak year requirements, only the I-515 extension has relatively immediate financial resources available. Although the remainder of the projects fall within the federal aid urban system, or local funding parameters, no resources are currently available. Consequently, the $98,773,000 must be met by some means of impact assistance since it constitutes the minimum mitigation process proposed for the street and highway network as a result of MX population in-migration.

System demands have been identified by the Clark County Transportation Study Policy Committee, which has produced a series of reports culminating in an adopted Regional Transportation Plan (RTP). The Regional Transportation Plan contains the network improvements required on an areawide basis for the 1987 and 2000 planning horizons, and is recommended reading for the essentials of the non-MX increment requirements. The chart prepared for this analysis is only concerned with identified needs to meet MX related service requirements, and reflects projects from both the Regional Transportation Plan and the individual political entities in Clark County. As noted earlier in the narrative, the projects in the chart are not necessarily different from already programmed projects, they are merely required earlier.

Transit use will be expanded because of MX in-migrants, however, transit measures are not considered a likely mitigation technique to the urban movement problems associated with the MX population influx. The current service provider, Las Vegas Transit System Inc., provides a limited service. The financial constraints of a private, profit-motivated transit enterprise prevent any expansion of service or improvements unless they can be self-supporting. The LVTS operates without public grants or subsidies, therefore farebox revenues must be able to support the operation. Route 6 on the Strip generates enough revenue to support continued service on the other eight routes which either produce marginal profits or operate at a financial deficit.

Although the operation is cost-effective, financially stable and highly productive, numerous service deficiencies exist. The phenomenal growth of tourist and residential population in the greater Las Vegas area over the past fifteen years has created a need for a mass transit system with greater coverage than that which is currently being provided by the LVTS. A number of residential areas and community and business facilities where demand exists are excluded from transit service.

A transit development plan was prepared for Clark County in 1979, and in September 1980, the first update of the plan was concluded.

The capital program included therein sets the tone for service improvements, irrespective of added MX incremental population. However, if the influx occurs as Clark County estimates, the project must be moved ahead one year to meet expected demand.

Advancing the timing may allow the five-year system design to be operational for the demand. Delay in acquisition of equipment is the critical problem which requires advanced scheduling. Current waiting time for equipment approaches one year and is expected to increase.

The Air Quality Implementation Plan, appended to this technical response, contains further details on the transit plan and is recommended for review (see Chapter Two of the Revised AQIP for Las Vegas Valley).

Besides street and highway, and transit problems associated with the MX in-migration, the expected land use policy will not promote expanded use of bicycle facilities or "pedestrianization" programs, because of the lack of congested centralized core activity centers. Competition and conflict with auto traffic will likely occur.

Mitigation Strategies

Issues which relate to the transportation system arising from the expansion of existing development patterns under reasonable constraints (e.g., compatible zoning), plus the MX increment, key upon capital improvement needs. Each element of the surface network, most notably the street and highway segments and mass transit facilities reflect a need for capital improvement and service enhancement.

Surface transportation improvement demands are a direct function of population influx and accompanying land use policy. Both the street and highway network, and mass transit operations are particularly sensitive to an influx of population. Consequently, mitigation efforts should concentrate on these two surface modes. The fact that local government funds are demanded for these elements of the system in significantly large amounts is reason for additional review of a system management approach.

The development of a rational capital improvement programming process which provides a systems approach to decision making is a potential technique to alleviate impact problems. The capital programming process should be an element of a comprehensive management framework which balances transportation system management strategies (i.e., parking management, ridesharing programs, auto restricted zones, limited access, etc.) with major infrastructure investment.

It has been the premise of the preceding evaluation that population influx, and the subsequent spatial allocation of that population, influence the investment demanded of local governments in public infrastructure. Consequently a management framework which provides a comparative, comprehensive, and continuing approach to land use decision making is warranted. An ability to compare the before and after scenario, including all public services, will logically produce a means of determining optimum use of limited local financial resources, and any MX impact assistance funds, for meeting infrastructure requirements.

Educational Services

General Comments

The education services submodel (used to identify DEIS impacts and issues) provided baseline and MX related forecasts of the number of pupils in three grade categories, teacher requirements in the three grade categories, the number of new classrooms and school facilities for each grade category, and school construction costs, excluding land (H.D.R., 1980, ETR 28). The number of teachers was the variable chosen to determine comparative significance on primary and secondary education as this variable reflects the need for schoolrooms and financial support (H.D.R., 1980 pg. 2-142).

"Estimated MX induced peak-year and long-term teacher requirements would be significant" (pg. 2-142). Further, on a regional basis, the educational impact under the proposed alternative is characterized as "high significant impact" in the short term (Fig. 2.3.-1) and "low significance" in the long term (Fig. 2.3.-2).

> "Presently, educational services in the Nevada/Utah deployment region are adequate to serve the existing population. Changes in enrollment demands due to M-X deployment will have a significant impact on many school districts within the deployment region. At the regional level, project-induced enrollments will peak in 1987, generating a need for 826 additional teachers. The regional cumulative impact of M-X and other projects totals 1,183 in peak year 1987, a 43 percent increase over M-X alone" (pg. 4-360).

> "Demands on the school districts in affected counties will occur with such rapidity and magnitude that additional advance planning will be necessary to mitigate the peak year and long-term impacts. Enrollment demands will necessitate considerable funding for construction of new school facilities, temporary facilities, and temporary teacher recruitment. The major planning problem for local areas is the need to provide temporary services during peak construction years without incurring debts that cannot be met by the decreased population of the operational period. This problem is especially significant in the counties without operating bases, where the effects are short term" (pg. 4-364).

The capital expenditure requirement necessary to support growth due to MX is characterized as significant for all counties in the Nevada/Utah deployment region. However, relatively little impact is predicted for the Clark County public education system. Peak enrollments expected in Clark County will create a need for 248 teachers in the peak year, or a relative impact of 3.6 percent over baseline (pg. 4-360). "Clark County will experience 53 percent (204 teacher requirement) of the MX induced long-term regional requirements. For Clark County this increase can be easily accommodated" (pg. 4-364) (emphasis added).

It is evident not only that school system impacts are significant, but that these impacts are underestimated because of population assumption and methodological problems inherent in the DEIS. Particularly in the case of Clark County the magnitude of the school impact was not fully characterized. In order to quantify the MX induced school enrollment and induced teacher requirements, Tables 4.3.2.6-13 and 4.3.2.6-14 were modified (see Table 6 and Table 7) utilizing Clark County School District historical data and projections. The result is a quantifiable MX impact to enrollment of approximately 9 percent (9318 students) during the peak year (1986) as compared to only a 4 percent impact (5833 students) defined in the DEIS. The impact in teacher requirements is also 9 percent (328 teachers) as compared to the DEIS impact of 3.6 percent (246 teachers).

If the measure used to quantify impact significance is the difference between peak year teacher needs and long-term teacher needs (pg. 4-360), then it can be seen that the Clark County impact is significantly underestimated.

it is also evident that the capital expenditure requirements necessary to support growth due to MX will be significant for all Nevada/Utah Counties in the deployment region. With regard to financing, ETR 5 OB:Coyote, page 5 states that the "relatively high tax base in Clark County will allow financing of large scale infrastructure facilities." Although the existing tax base appears to allow this financing, the key issue is whether the population of the impact area should incur, as a strictly localized cost, imported debt service resulting from a national defense project. Further detail on projected MX induced school facility requirements and a discussion of the tax base can be found in the Fiscal Impact Analysis: MX Impacts, in the Public School Infrastructure section.

Specific Comments

pg.2-142; pg.2-205; pg.4-360; pg.4-361 Table 4.3.2.6-1; pg.4-364; pg.4-465; pg.4-465; and Tables 4.3.2.6-13 and 4.3.2.6-14.

The narrative on these pages and the numbers in the tables need to be changed to more accurately reflect the baseline enrollment and teacher requirements and the MX induced school enrollments and teacher requirements. Specifically, the baseline enrollment (hence baseline teacher requirements) depicted in table 4.3.2.6-13 is overstated. A baseline enrollment of 126,000 (1982 in DEIS) is not anticipated by the Clark County School District (CCSD) until 1992, a full ten years after the DEIS indicates (see the Public School Infrastructure section of the Fiscal Impact Analysis Report). This overstatement is further evidenced by the DEIS statement on page 3-415, "In 1979, there were 87,440 pupils in the Clark

TABLE 6

MODIFIED TABLE 4.3.2.6-13

PROJECTED BASELINE AND MX INDUCED SCHOOL ENROLLMENTS*

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Baseline Enrollments	90,114	92,201	95,790	99,580	103,796	108,022	112,256	116,502	120,694	124,580	128,471	132,366	136,267	140,174
K-6	394	2,232	2,925	4,272	4,939	4,247	2,497	1,568	1,452	1,452	1,452	1,452	1,452	1,452
7-9	186	1,052	1,379	2,015	2,329	2,003	1,178	739	685	685	685	685	685	685
10-12	163	926	1,213	1,773	2,050	1,762	1,037	651	603	603	603	603	603	603
Total MX Related	743	4,210	5,517	8,060	9,318	8,012	4,712	2,959	2,740	2,740	2,740	2,740	2,740	2,740
MX Plus Baseline	90,857	96,411	101,307	107,640	113,114	116,034	116,968	119,461	123,434	127,320	131,211	135,106	139,007	142,914
Percent Difference From Baseline	.82	4.57	5.76	8.1	8.98	7.42	4.2	2.54	2.27	2.2	2.13	2.07	2.01	1.95

*Clark County impact area assumed to be Las Vegas Valley and Moapa Valley (97% of Clark County School District 1980 Enrollment)

TABLE 7

MODIFIED TABLE 4.3.2.6-14

PROJECTED BASELINE AND MX INDUCED TEACHER REQUIREMENTS*

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Baseline Requirements	3162	3235	3361	3494	3642	3790	3939	4088	4235	4371	4508	4644	4781	4918
Ratios MX CCSD														
25 30 K-6	13	75	98	143	165	142	84	53	49	49	49	49	49	49
23 28.5 7-9	7	37	49	71	82	71	42	26	24	24	24	24	24	24
22 25.5 10-12	7	37	48	70	81	70	41	26	24	24	24	24	24	24
23.7 Total MX Related	27	149	195	284	328	283	167	105	97	97	97	97	97	97
MX Plus Baseline	3189	3384	3556	3778	3970	4073	4106	4193	4332	4468	4605	4741	4878	5015
Percent Difference From Baseline	.85	4.61	5.80	8.13	9.00	7.47	4.24	2.57	2.29	2.22	2.15	2.09	2.03	1.97

*Clark County impact area assumed to be Las Vegas Valley and Moapa Valley (97% of Clark County School District 1980 Enrollment)

County School District." The DEIS 1982 projected baseline enrollment of 126,212 represents a 43% jump over 1980 actual enrollment of 88,555. Furthermore, the authors assumed approximately 21 percent of the MX related population to be school enrollment, if this ratio is applied to the baseline enrollment of 126,212, then the baseline population in 1982 would have to be 601,009. 1982 DEIS baseline population utilized was 485,433.

The MX induced Clark County growth rate is depicted throughout the text as 3.6 percent for teachers and four percent enrollment. The Clark County MX induced growth rate is shown to be nine percent above baseline for both teachers and enrollment.

For detailed information of Clark County baseline enrollment and teachers and MX induced enrollment and teachers, refer to Tables 6 and 7.

pg. 4-375 - Table 4.3.2.6-3
pg. 4-383 - Table 4.3.2.6-4

Attempts to replicate the methodology for determining school revenues and expenditures as outlined in ETR 29 Public Finance Model pages 13 and 14 and to reconcile the product with the numbers in Table 4.3.2.6-3 proved fruitless. Different per capita and per pupil multipliers were used in DEIS Table 4.3.2.6-3 than those depicted in Table 3.1.1-1 page 14 ETR 29. For example the Clark County per capita multiplier on page 14 is $212; the result of dividing MX DEIS population into the local revenues in Table 4.3.2.6-3 is $216.34. Likewise the state revenue per pupil multiplier on page 14 is $1,362; the result of dividing by MX induced enrollment of 5,833 (yr. 1986) into 1986 MX induced state revenues, $6,184,000 yields $1,060.17.

A full discussion of MX induced Clark County School District operations and capital additions impacts, costs and school revenues is included in the Fiscal Impact Analysis: MX Impacts report.

Mitigation

The costs of MX induced capital additions and operating funds could be financed in the following ways:

(1) MX Trust Fund where direct impact funds would be made available at the time of need.

(2) Impact Assistance through normal grants procedures. Public Law 81-815 has in the past provided federal assistance for capital improvements and Public Law 81-874 provides federal assistance for operating funds to those districts which have experienced substantial increases in enrollments due to the influx of new residents to the district to work in government connected industries. Existing legislation such as Public Law 81-815 and Public Law 81-874 may be utilized,

or new legislation to provide capital and operating funds may be required to address school needs for the new work force that would be a direct impact of MX.

(3) Reimbursement by the Air Force after the impact has occurred.

The desired approach would be (1) direct impact funds through a block grant trust fund, or other institutional relationship. This option would socialize the costs of this national defense system nationally, instead of locally through locally generated debt service revenues.

The remaining options require that the cost for the MX impact be socialized in varying degrees by the community in which the impact occurs. If the impact assistance is after the fact or through normal federal assistance channels, by the time the impact assistance is received the local jurisdiction(s) have already paid interest on bonds or short term financing, with such interim costs underwritten and socialized locally.

PUBLIC INFRASTRUCTURE

Wastewater Collection and Treatment

Issues

The impacts of MX on the wastewater collection and treatment system in Clark County are primarily associated with the capital improvements and additional operating and maintenance costs necessary to service an increased population. Substantial population increases in the Moapa Valley as a result of MX in-migration for construction and operation activity will drastically impact on the wastewater collection and treatment systems for Clark County communities in close proximity to the proposed Coyote Spring operating base.

General Comments

The one rural area wastewater treatment facility likely to be impacted because of MX related in-migration is the Clark County Sanitation District's collection and treatment facility in Overton. The wastewater treatment system for Overton was completed by the Clark County Sanitation District in July, 1977. The new treatment system is projected to be adequate to meet future baseline population growth, an increase of approximately 106 people between 1980 and the year 2000. However the existing Overton wastewater collection and treatment facilities will not be able to accommodate MX related in-migration to Overton or the nearby town of Logandale.

All of the communities in the Moapa Valley are unsewered except for Overton, and are situated in soils which have severe limitations for septic tank use. Due to widely dispersed housing, small populations, and a low probability for significant growth, costs for community sewage collection and treatment facilities for most of these communities are extremely high in light of the benefits to be derived. However, MX-related in-migration can only be accommodated through development of community wastewater collection and treatment facilities.

The fiscal impact of the MX system on Clark County Sanitation District's wastewater treatment infrastructure is attributed directly to the public costs associated with maintaining the existing level of service to new customers settling in the District's service area and because of MX related employment opportunities. MX will cause additional demand for wastewater treatment service that can be supplied only by completing, on schedule, projected major capital improvements to CCSD's wastewater collection and treatment facilities during the period 1981 and 1985 at a total escalated cost of approximately $53,732,709.

Projected costs for major capital improvements to the CCSD wastewater collection and treatment system necessary to meet anticipated customer demand were prepared on the basis of estimated future wastewater flows. Average annual wastewater flow generated by MX related in-migration is projected to reach its highest level of 2.2 million gallons per day (MGD) in 1986 and decrease in 1989 to .7 MGD. MX related average annual wastewater flows are projected to remain at .7 MGD from 1989 through the year 2000. MX related in-migration is projected to reach its highest level in 1986 when projections indicate 24,059 people will be added to the CCSD's service area and decrease in 1990 to 7,534 people. MX related in-migration to the CCSD's service area is projected to remain at 7,534 people annually from 1990 until the year 2000.

The rate of growth which will occur in the CCSD's service area with or without development of MX will be dependent upon economic factors, such as interest rates and resultant building starts, growth policies, and other factors. Completion of CCSD's projected 5-year capital improvement program, along with expansion and development of wastewater collection and treatment facilities in Overton, Moapa and Logandale is essential to accommodate the additional baseline (without MX) population growth. As noted earlier, projected expansion of facilities in the Moapa Valley will be inadequate to accommodate the demand placed on the wastewater treatment infrastructure as a result of developing the MX system. Additional revenue expenditures will also be necessary to meet projected operation and maintenance costs for CCSD's facilities as MX related customer account increases occur in the CCSD service area. MX related impacts to the CCSD are addressed in detail in the Draft January 1981 Fiscal Impact Analysis: MX Impacts, prepared by Clark County Department of Comprehensive Planning, pp. 230-236.

Specific Comments

DEIS, pg. 3-416

The impact of MX on Clark County's wastewater collection and treatment infrastructure cannot be fully evaluated without a description of the existing wastewater treatment facilities and septic system suitability of soils in the Moapa Valley. The DEIS does not provide necessary descriptive information concerning existing wastewater treatment and disposal in the Clark County towns of Overton, Moapa and Logandale which are likely to be impacted by construction of the proposed operating base in nearby Coyote Spring.

PUBLIC INFRASTRUCTURE

Water Supply and Distribution

Issues

Water supply and distribution issues are generated by population and employment growth associated with MX construction and operation. Principal concerns are impacts on the Moapa Valley and Las Vegas Valley water supply systems.

General Comments

The topic of water system impact is briefly mentioned in the DEIS (pg. 3-415) and in ETR 3, Coyote Spring OB (pg. 97), but no substantive discussion or analysis is provided. Las Vegas Valley Water District capacity is described in very general terms, but no information is provided on actual delivery capabilities, costs, or probable impacts of MX related growth. This is a serious deficiency, especially considering the fact that purchase of "surplus water from Las Vegas" for the Coyote Spring OB is mentioned elsewhere (ETR 5, pg. 116) as a strategy to avoid water problems.

The Las Vegas Valley Water District, with sufficient capital investment, should be able to meet additional demands due to MX population growth with the Water District's present service area. The Southern Nevada Water System Stage II, plus wells, will provide the Water District with access to sufficient supply. However, capital and other costs associated with actually making the supply available to meet MX demands are not known and may be substantial, based on recent expenditures and those projected for the near future. In order to accommodate Las Vegas Valley's continuing growth, the Las Vegas Valley Water District has in the last three years added more than $46,000,000 worth of water production transmission, distribution, and storage facilities to its system. In addition to major transmission pipelines, reservoirs and pumping stations, an additional eight miles of pipelines varying in diameter from six inches to 42 inches were added to the Water District's distribution system in 1979. To provide for continued growth, increased emergency supply, and peak demands, additional wells, reservoirs, pumping stations, and major pipelines are planned through FY 1982 at an estimated cost of $25,000,000.

The subject of community water system needs, to provide for MX-related growth in the Moapa Valley, is not addressed in the DEIS. Impacts on the existing private, centralized water system may be substantial, even if only a small percentage of the off-base Coyote Spring OB personnel are located in the Moapa Valley. The small population now served and the very slow baseline (without MX) growth rate, indicate that MX-related population growth could have a significant impact on water delivery capability. Costs and feasibility of water system expansion are not known.

State of Nevada

Division of Emergency Management

STATE OF NEVADA

DIVISION OF EMERGENCY MANAGEMENT

Capitol Complex, 2525 S. Carson Street
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(702) 885-4240

RICHARD H. BRYAN
Governor

ROBERT J. ANDREWS
Director

March 8, 1985

MEMORANDUM

To: Governor's Office
Nuclear Waste Project Office
ATTN: Robert Loux

From: Donald L. Dehne Donald L Dehne
Assistant Director

Subject: Review of Yucca Mountain Draft Environmental Assessment
(Issues: Emergency Planning Preparedness)

Review Comments in Format Requested

A. Comments Prepared by: Donald L. Dehne, Assistant Director, Plans and Programs Phone: (702)885-4240

B. General Comments: The review considered all levels of emergency planning - Federal, State, and local - as they pertain to transportation accidents. Two major possibilities were considered in terms of potential accidents: (1) an incident on the transportation route while the transporter was in motion; (2) an incident while the transporter was stopped or in a static configuration, probably in a fairly or densely populated area. The reviewer presumed that any incident or accident that occurred at or near the repository would be handled by Department of Energy response personnel. This would apply as long as the radiological hazard was confined to the Nevada Test Site.

The draft assessment of emergency planning fairly well covers the current status of preparedness, although, in some areas, particularly at the local levels, it is somewhat vague.

Local planning and preparedness at the local level is a crucial element to any response mechanism in the event of a transportation accident involving radiological material. Plans have been developed or are in various stages of development for Clark County, Lincoln County, and Nye County. These plans include response to peacetime radiological

0-4037

incidents (PRI). In addition, since these counties are contiguous to the Nevada Test Site, they are working in a cooperative effort with DOE in off-site emergency response plans and procedures for accidental venting or seepage. These three counties also have local response personnel trained in the use of radiological instrumentation, however, current State and local planning for radiological incidents rely on the DOE Radiological Response Team (RAT) and the supplemental Nevada Operations Office radiological clean-up team for primary response. Obviously, these resources will be available during repository siting construction, and operation.

The concern of the reviewer is initial response by local and State emergency personnel to a radiological incident pending arrival of DOE RAT personnel. This concern is somewhat lessened by the fact that DOE through the Reynolds Electrical and Engineering Company (REECO) conducts specialized radiological courses for Nevada law enforcement, fire fighters, ambulance operators, and medical personnel. The State Division of Emergency Management also conducts radiological monitor courses for county emergency response personnel. Obviously between now and the beginning of repository operation, there will be significant changes and improvement in the state-of-the-art, i.e., radiological instrumentation, response procedures, personal equipment and training.

The reviewer felt that the references in the EA to State and local emergency preparedness and planning would have been more meaningful had the State Division of Emergency Management (DEM) been contacted/ interviewed during the assessment. The DEM could provide references and information which would have been useful to the EA personnel.

Obviously, the current level of State and local planning preparedness will change significantly in response to the activation of the repository. The key to the planning process necessary to provide as safe as possible environment will be the selection and identification of the transportation routes. This will enable State and local planners to designate key geographical locations in which to concentrate planning and training efforts. In this regard, the EA virtually omitted any reference or discussion of Lincoln County as an issue of concern, although a major portion of the proposed rail transportation artery will, by necessity, be routed through that county. This is a major concern because of a history of past incidents involving train accidents and derailments. Particularly vulnerable is the City of Caliente which has a significant potential for a major railroad accident because of the layout of the city in relation to the railroad tracks, location of a railway traffic stop in the middle of town, and the large percentage of the trains that actually stop within the populated area.

There is a considerable amount of duplication, repetition, and redundancy throughout the Executive summary and sections 1-7. The reviewer recognizes this is due largely to the format and structure required by the

Nuclear Waste Policy Act, however, it does lengthen the review process and generates additional repetition in the review summary.

There are four references available in Nevada regarding radiological emergency preparedness which were not referred to in the EA:

1. Department of Energy (DOE). Off-Site Emergency Response Plans and Procedures for An Accidental Venting or Seepage at the Nevada Test Site, Nevada Operations Office, Las Vegas, July, 1984.

2. State of Nevada. Nevada Emergency Plan, Nevada Division of Emergency Management, Carson City, 1985.

3. State of Nevada. Memorandum of Understanding for Hazardous Materials, Nevada Division of Emergency Management, Carson City, November, 1984.

4. Department of Energy (DOE). DOE Radiological Assistance Program in Nevada, Nevada Operations Office, Las Vegas, August, 1984.

C. Specific Comments

Chapter	Page	Para	
Exec Summary	14	1	Last sentence should read radiological accidents, instead of waste-transportation accidents.
Exec Summary	17	1	Do not entirely agree with first sentence relating to release of radioactive material is not expected to be transported to population centers. DOE has prepared a plan in conjunction with contiguous counties for the possibility of an atmosphere release.
Two	2-49	Table 2-8 (3)	Synopsis: Emergency Preparedness Plan should be conducted with State and local planning.
Two	2-55	2	Add: The State also has a Memorandum of Understanding for Hazardous Materials which includes responsibilities of State and Federal Agencies in response to a radiological accident.
Two	2-59		Add: DOE (U.S. Department of Energy), 1985, Radiological Assistance Team NV Notification Procedure DOE/REECO, Nevada Operations Office, Las Vegas, Nevada
Three	3-46	3	Flash flooding has often impeded traffic and caused delays in rural Nye and Lincoln Counties, and metropolitan and rural Clark County.

Chapter	Page	Para	
Three	3-60	3.5.2	An analysis should be done to determine the frequency and magnitude of accidents/incidents which have occurred on that portion of the railroad between Las Vegas northward to the Utah border. Specifically in the area of Caliente, Nevada.
Three	3-79	3.6.3.7	Public Safety Services. This section should include the Public Safety Services of Lincoln County.
Three	3-83	3.6.4	Third sentence indicates that communities that could be affected by the transportation route could not be identified because routes have not been identified. The potential for routing of rail and truck transportation is so limited that most of the communities which will obviously be on the transportation route could already be identified.
Three	3-90	3.6.4.4	The attitude and concerns of citizens described in this paragraph and displayed in subsequent public hearings in 1985 point up a need for greater in-depth assessment in the area of public safety (emergency preparedness).

Chapter	Page	Para	
Five	5-83	5.3.2.4	Emergency Preparedness. A description of the function of the Nevada Division of Emergency Management should be inserted here - e.g., The Nevada Division of Emergency Management is responsible for coordinating all disaster and emergency response activity by law (Nevada Revised Statute 414) and is responsible for preparing the State Emergency Operations Plan including hazardous material/radiological response.
Five	5-84	1 1st sentence	Change date to (revised November 1984)
		1 after last sentence	The Division of Emergency Management also provides radiological monitor training for State and local emergency response personnel.
Five	5-108	5.4.5 2nd para	Does this mean to imply that State and local governments will be expected to absorb increased costs for road maintenance, traffic escort, and control emergency preparedness from their own revenues during repository operation?

Chapter	Page	Para	
Five	5-108		How does this relate to financial and technical assistance during repository development and site characterization? (Page 109)
Six	6-19	3	Conclusion for disqualifying Condition 3 Noted
Six	6-89	(8)	Department of Energy Funding. Change "wastes" to "materials".
Six	6-96	Last	Evaluation - add after 1983)....and the Nevada Memorandum of Understanding for Hazardous Materials (State of Nevada, Divison of Emergency Management).
Transportation Appendix A	A-7/A-8	A.6.2	Regulations. Is there any provision to provide for radiological instrumentation, monitors, or dosimeters or personal monitoring equipment in transport vehicles or external to the container to monitor for potential leakages?

State of Nevada

Department of Transportation

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION
1263 South Stewart Street
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MAR . 1985
NUCLEAR WASTE PROJECT OFFICE

February 28, 1985

A. E. STONE, *Director*

In Reply Refer to:

Robert R. Loux, Director
Nuclear Project Waste Office
Office of the Governor
Capitol Complex
Carson City, Nevada 89710

Dear Mr. Loux:

The following pages comprise the comments of the Nevada Department of Transportation in relation to the Draft Environmental Assessment for the proposed Yucca Mountain Nuclear Waste Depository.

General Comments

From a transportation standpoint, the Draft Environmental Assessment is totally inadequate. It approaches the location of the facility as if it were only a technical problem. Concern for building this facility within a community is handled in a cursory fashion. Most sections dealing with the projected growth of the area, public fears, harm to the tourist economy and transportation needs are covered in a few paragraphs. Legitimate questions of concern are bypassed by noting conflict in the data and issues are dismissed without discussion. DOE shows only a limited perception of this proposals impact on the cities, counties, state and region in which they intend to base the project.

It is incomprehensible that the issue of transportation was almost totally disregarded when a great potential for harm to the general public is in the transporting of the nuclear waste. Not one disqualifying condition was relatd to the routes on which nuclear waste would be transported. No effort was made whatsoever to consider the specifics of the routes on which the waste would be transported. Those routes should have been identified for each site and analyzed to determine the risk. This should have been done before the number of sites were reduced from nine to three. The risk of accidents can be attributed to a number of factors (such as: traffic volumes, percent trucks, roadway geometrics, population centers around the route, meteorlogical impacts, propensity to rock slides and other natural disasters, accident rates and available alternate routes, etc.). Certainly the same holds true in transporting nuclear waste by rail.

The assessment should have explored the direct cost from a monitoring, emergency response, highway construction, highway maintenance, rail construction, rail maintanance, and safety standpoint. At the very least these should have been included in the economic analysis before the number of sites were reduced form nine to three. A site which was originally considered to be economical may be proven infeasible once these costs are considered.

Risk analysis was developed on the nationwide basis only. No effort was made to minimize risks by considering its effects on a region wide, state wide, county wide or city wide basis.

The DEA only scratches the surface when it mentions the possibility that organized groups will form and become forces to contend with. Las Vegas, once a small resort community, is rapidly becoming a major metropolitan area. As Las Vegas grows and diversifies its interests it will behave with less of the characteristics of a small conservative Nevada town and more like a regional power center. In many respects Las Vegas is already like a city in the Los Angeles basin. DOE grossly underestimates opposition against the Yucca Mountain Depository site. NDOT will be drawn into the debate on the waste site because a large quantity of nuclear waste will move through the freeway system of the city of Las Vegas. One small paragraph in section 5.4.1.6. deals with the handling and transportation of waste to this area. What is not mentioned in the report is a real discussion of moving this waste through a freeway system which DOE admits will be running at capacity at the turn of the century. In addition, DOE claims it anticipates no road building activities as a result of the project. If the substance being moved to the area were not nuclear waste this might prove a correct assessment. However, given the nature of the cargo to be transported, DOE may be forced by public reaction to consider alternate routing of the waste shipment around the Las Vegas population center.

According to DOE, the impacts on Nevada's highways from this project will be (1)"...to move people and materials to and from the proposed Yucca Mountain Respository site", and (2)..."the use of the projected transportation network to move high level waste through the state to the site". The project will mean a work force of up to 3,350 on site, the population increase in Clark and Nye counties of over 24,000 and increased traffic counts on routes leading to the area.

When waste is being deposited at the site, up to two hundred and fifty delivery days a year, eight truck and four rail shipments of high level nuclear waste could enter the site per day. DOE maintains that the number of people brought by the project and the transport of waste will have little impact on the highway system. Their conclusion is that the "effects on the highway infrastructure will be limited to those associated with increased traffic because no roads are planned to be improved for the sole purpose of transporting people and material to the repository site".

DOE may have great difficulty securing clearance to follow the routes for transport of high level radioactive waste that it proposes. They wish to "minimize adverse terrain along the potential waste transport routes" and there is a need to "optimize distance from existing transportation corridors". The routes proposed for carrying waste to the disposal site follow valley floors. Adverse terrain for transport most certainly will be encountered. For example, the section of U.S. 93 across Hoover Dam is narrow and crowded with tourists almost all year long. More important is the fact that almost all of the waste will have to pass through the heavily populated Las Vegas valley. Las Vegas valley contains the majority of existing transportation corridors and it is the hub for the interstate highway system in the area.

If site specific risk analysis had been conducted which considered the impact the concentration of nuclear waste would have on the entire state and if that analysis indicated the risk was minimal, DOE would still have to deal with the perceived risk.

While the increase in the number of jobs (directly related to construction and maintenance of the facility) is not great in terms of the entire labor picture in Las Vegas, secondary impacts are underestimated by DOE. The Yucca Mountain project will mean Pahrump Valley and the corridor along U.S. 95 north of Las Vegas will expand. DOE assumes that settlement patterns of the new employees will be typical of Nevada Test Site employees of the past. Because of distances, difficulties in the commute and the need for cost effective housing, areas projected to grow by small degrees will likely boom. In one respect, growth in these outlying communities will behave much like mining towns in Nevada's past. The perception of growth will draw in a variety of people all eager for new opportunities and with a desire to make money. In the long run the proposed project will make areas like Pahrump Valley into detached suburbs of the Las Vegas Metropolitan area.

For NDOT the growth in these outlying areas will strain the existing transportation network and there will be a need for new roads. A cycle will be started where better transportation increases growth, which strains transportation facilities and creates a need for a better transportation network. NDOT will be in the position of having to obtain the funding, plan, build and maintain the transportation network this project will ultimately call for.

The conclusion is that some alternate routing of waste disposal trucks will ultimately be agreed upon. This would, more than likely, take the form of getting trucks around heavily populated Las Vegas Valley. In looking at the existing highways, there are two possible candidates. First, if State Route 164 west of Searchlight were upgraded, trucks coming from the south, or I-40, north on U.S. 95 would not have to travel completely through the Las Vegas Valley if they were diverted onto S.R. 160 via I-15 and S.R. 161. Second, a bypass of Hoover Dam should be considered. Until specific routing decisions such as these are made it will be impossible for NDOT to determine the impact the selection of the Yucca Mountain site could have on Nevada's network of highways.

From a rail standpoint, the Draft Environment Assessment only addresses in detail the proposed railroad line between Dike Siding and the Yucca Site. Like truck transportation little attention is given to mainline routings into and through the State.

No evaluation has been made as to the number of times a rail shipment would be required to be classified between railroads which would severely impact transit time. Perhaps mileage may not be the indication of rail transport efficiency or safety.

Specific Comments

6.3.1 Page 17 Walt Wagner 885-5680

Summary of site evaluations against the postclosure guidelines. "Routine weapons testing at the Nevada Test Site (NTS) will require workers to leave their underground area at the repository". This infers an unsafe condition.

3.5.2 Page 3-60 Charlie Case 885-4010

Railroad infrastructure and Current Use: The Union Pacific Railroad is a well maintained Class A mainline as noted in the report; however, the present state of the art of current safety devices do not preclude a serious derailment accident from occurring but merely warns the train crew of possible problems. There are currently fourteen dragging equipment detectors and five hotbox detectors located on the Union Pacific mainline through the State of Nevada.

One specific area not addressed in the draft enviornmental assessment (DEA) concerns an industry trend to eliminate the need for a caboose at the end of each train consist, more for economic reasons rather than operating or safety consideration. The cabooses are being replaced with electronic monitoring devices that record certain operating characteristics onn the train. A recent incident occurred on the UPRR mainline in Southern California when equipment broke loose on a flat car, swung transverse to the train taking out several wayside signals and crossing warning gates for several miles before being reported and before the train could be stopped. This points out the fact that the electronic equipment is not infallible, and that perhaps a manned caboose could have discovered the problem sooner and eliminated a more serious problem. A derailed car can also be dragged many miles in a consist taking out anything in its path until the entire train derails. Current trends indicate a possible change in State law amending the "full crew law" allowing the railroad companies to operate trains with a minimum five man crew (NRS 705.390). This action combined with the removal of cabooses does not allow observation or contact with the rear of the train. As an extra precautionary measure, a case could be made for the continued use of manned cabooses on trains transporting nuclear waste material, and prioritizing such trains for direct routing, nonstop, through the state to the repository center at Yucca Mountain.

3.6.4.1.1
Page 3-84 Walt Wagner 885-5680

Rural social organization and structure. Comparisons between Nye County and Clark County are virtually worthless. This paragraph is self-serving. Operating from a small population base it is easy to show rapid growth and low social problems.

3.6.4.4 Page 3-90 Walt Wagner 885-5680

Attitudes and perceptions toward the repository. Attitudes should be gathered on a statewide, and interstate basis. Not enough attention is given to the negative response of Nevada residents who do not stand to "make a buck" off the project.

To avoid oganized social conflict this DEA attempts to isolate the Yucca Mountain Site, encapsulating and making a microcosm out of the potential impacts. Not large "accidents" or sabotage incidents will, or could, affect large numbers of people. To attempt to identify one or two counties as the only recipients of major impacts is misleading at best.

4.2.2.6 Page 4-34 Robert Hamlin 885-3463

Consideration should be given to moving the majority of materials to the site by rail. Also, van pooling or providing buses for the employees would aid in reducing peak volumes. This will reduce the vehicle miles traveled and decrease accident potential and impacts to the levels of service.

5.3.1.1 Page 5-62 Ronald Hill 885-5440

The impacts on the highway infrastructure are directly related to the condition of the highway when construction begins. If this site is selected, a condition survey should be conducted one year before construction is planned to begin. This survey would determine if structural improvements are needed as a result of the additional traffic and would be conducted early enough to allow those improvements to be made before construction begins. The decision that "....no roads are planned to be improved for thesole purpose of transporting people and material to the repository site" has not, to our knowledge, been based on any sort of evalution to determine the adequacy of the roadways. A comparison of the roadway geometrics to the current standards should have been made. The cost to improve the facility to carry the additional traffic safely should have been considered in the economic analysis.

5.1.1.4.1
Page 5-11 Ronald Hill 885-5440

Considering the D.O.E. plans to build the access road 46 feet wide (Section 5.1.1.4.1), it would seem logical they feel this is the minimum safe width of roadway carrying nuclear waste. The access road is located in a restricted area where the general public will not be allowed. Yet they consider it to be perfectly acceptable to route this traffic on SR 305 (100% less than 40 feet in width), SR 376 (100% less than 40 feet in width), U.S.95 (79% less than 40 feet in width). See table 6-12 section 6.2.1.8.

Page 5-66 Robert Hamlin 885-3463

Table 5 adresses the service levels along U.S. 95 from the site access road to the north city limits of las Vegas with and without the repository. Only the main roadway was assessed. The projected service levels show a drop with the repository. Measures to improve these levels and costs of these improvements should be developed.

The intersections of U.S. 95 with SR 160 and the proposed access road of the Yucca site would apear to warrant study and possible geometric/traffic control improvements, if needed, should be identified.

The access to the site was not covered in any detail to determine whether acceleration and deceleration lanes are planned. It is highly likely they will be needed in light of truck traffic to and from the site.

5.3.1.2 Page 5-71 Charlie Case 885-4010

Railroad Impacts: The long term rail usage (30 hrs.+) fails to address the increased rail traffic of the UP mainline under normal growth rate predictions other than saying the CTC circuitry is capable of handling between 20 and 54 trains daily. As rail traffic increases proportionately, so does the length of required sidings needed for storage capacity of passing trains. The associated maintenance costs, increased detection devices, and inspections also increase. A reciprocal effect is caused by delays at existing crossings and increased exposure and possible risk of accidents.

The proposed 85 mile rail access spur (Fig. 3-20 & 5-2) from Dike to the site may pose problems to the State Public Service Commission Rail Safety Inspector who is responsible for inspecting all railroad tracks in the state. The additional budgetary requirements for track inspection may be totally state funded if the current FRA State Assistance Program is eliminated by Congress. The spur line itself should be constructed to mainline standards (using CWR continuous welded rail) for maximum safety and longevity. Additional design and environmental information concerning the structure over Fortymile Wash would be desireable to evaluate potential downstream damage in the event of a major derailment.

Other considerations of concern, but not directly mentioned in the DEA are other alternate rail system routes for nuclear waste shipment across Nevada. If the Paradox, Utah, site is selected, the Southern Pacific Railroad might be chosen as the prime rail carrier, as shown on some D.O.E. RADTRAN maps. The SP line is not currently maintained to the same high standards as the UPRR mainline, and, moreover, it bisects the cities of Reno, Lovelock, Winnemucca, Battle Mountain, Elko and several other smaller communities. The accident risk factor is also higher since the SP Corridor crosses approximately 167 at-grade (public and private) crossings.

5.3.2 Page 5-71 Robert Hamlin 885-3463

The Draft Environmental Assessment and support documents discuss a number of routings for truck transportation. The Environmental Assessment (page 5-76) considers two routing scenarios. Scenario I assumes entry points at I-15N*, I-15S, U.S. 93 and I-80E. Scenario II has entry points at I-15 north and south. Truck routing maps used to calculate percent travel in population zones (RADTRAN II Population Zone Maps) show entry points of I-80 west,U.S. 95 north, SR 160 south and I-15 north and south. The Traffic Density Map which show the estimated number of shipments per year with entry points at I-15 north and south and U.S. 93 from the south.

The potential traffic problems and safety risks along these routes are identical to those along U.S. 95 between the Yucca Site Access Road and North Las Vegas. However, because of the uncertainty of exact truck routings it is not possible to evaluate each segment of roadway in order to identify specific problems. This should have been done before the draft was prepared.

5.3.2.1 Page 5-76 Charlie Case 885-4010

Nuclear waste truck transportation is discussed in routing Scenario I and II. Entry into the state via interstate highways I-15 and I-80 would not pose particular concern to the railroad crossing program in Nevda since all interstate highwys are grade separated at railroad crossings. However, transportation under Scenario I would involve crossing four at-grade crossings on U.S. 93; one crossing on the UPRR mainline south of Wells, and three crossings on the NNRY (Nevada Northern Railway) at Currie, and McGill. The UP crossing is protected by automatic gates with flashing lights, and will have the surface condition upgraded with a rubber crossing during 1985. Additional improvements would be warranted if U.S. 93 becomes a viable nuclear waste route by installations of cantilever flashing lights and improved circuitry design including grade crossing predicators (GCP unit). If shoulder widening of the main highway is recommended, then the railroad warning devices, guardrail, and crossing surface would have to be widened accordingly. This would be true of all crossings statewide that are being considered as nuclear waste routes. The three crossings on the NNRY are all substandard and would have to be upgraded. A typical cost would be approximately $150,000 per crossing. Although the NNRY is currently under a suspension of operations, the White Pine Power Plant planned for Steptoe Valley, North of Cherry Creek, would utilize the NNRY right of way and would rebuild the line for rail transport of coal to the power plant.

The proposed truck route from the Oregon stateline to Mercury via U.S. 95, I-80, SR-305, would not cross an existing at-grade railroad crossing. However, the portion of the N-S Route from the California stateline from Verdi to Mercury via I-80 and U.S. 95 would cross five existing at-grade crossings at Hazen, Schurz, (one each) and Hawthorne (three each). The two SPRR Mina Branch crossings have automatic gates with flashing lights and are deemed adequate for present traffic. Signal modernization should be considered if nuclear waste is to be transported. The Schurz Crossing would need the most extensive upgrading, including surface improvements (on two tracks) and sight distance improvements. In the event the SP abandons the mina Branch, or sells it to a short line operator, increased safety inspections would be warranted. The main emphasis on the existing railroad safety program would be reexamination of the Hazard Index Prioritizing System and possible establishment of an index factor for improvement of at-grade corssings on hazardous or nuclear material routes. An estimate of $500,000 would be the approximate cost of improvements at the current time.

Additional emphasis would be placed on a state initiated "signal insection" procedure by the Safety Engineering Division to insure the railroad automatic warning devices met minimum standards for operation and visibility.

The three crossings on U.S. 95 South of Hawthorne are part of the U.S. Army Ammunition Depot Rail System and are not being adequately maintained at the present time due to a lack of a qualified signal engineer to perform routine maintenance. The main gate and Dock #3 crossings have automatic gates with cantilever mounted flashing lights. Dock #5 flashing lights are obsolete and are not in operating condition at the present time. Both Dock #3 and #5 crossings carry explosive laden trains and would require modernization. At the present time they are posted exempt from certain ICC vehicle stopping conditions because the train is only operating during daylight hours, and the train must stop to unlock a security gate before crossing.

The remaining proposed truck route shown on the RADTRAN II TUFF-NV Truck map is SR 373 from the California stateline near Lathrop Wells to Mercury on U.S. 95 does not cross any railroad tracks and does not pose any problem.

6.2.1.8.2

<u>Page 6-97</u> Charlie Case 885-4010

The DEA comments concerning meterological history are primarily directed toward the repository site, although some mention is given to the Winnemucca and Ely areas. However, almost no mention is given to the routes leading to the site area. Specific mention should be given to the flood prone area of Meadow Valley Wash and Rainbow Canyon. These locations have historically been noted for major flash flooding, and the Moapa area has been the scene of two recent floods causing a UP mainline derailment approximately one year ago. In the event a radioactive cask was involved in a derailment near this area, it is conceivable that this waste material could be carried downstream via the Muddy River directly into Lake Mead, a major water supply for California, Arizona and Nevada.

6.2.1.8.3
Page 6-97 Ronald Hill 885-5440

Although there is discussion about taking flash flooding into consideration in the design of the access road, there is no discussion of the existing highways ability to withstand flash floods.

6.2.1.8.3
Page 6-97 Ronald Hill 885-5440

Annual total snowfalls of up to 150 cm (60") have been observed at some of the higher elevations in the State (DOC. 1968), but these areas are not likely to be traversed by carriers. There are mountain passes on virtually every northern highway in the State, many of which are subject to closure.

6.2.1.8.2
Page 6-97 Charlie Case 885-4010

The conclusion that the State Department of Energy Nevada Operations is capable of responding to accidents during the transportation of radioactive materials, and the assumption that this is a favorable condition at Yucca Mountain is highly questionable. Given the extremely remote areas in the state and great distances involved, plus the rugged terrain, it is doubtful if an emergency crew could respond with the necessary equipment in the event of a major catastrophy for several hours to either a train or truck accident.

If I can be of any further assistance, please do not hesitate to contact me.

Sincerely,

Ronald W. Hill

Ronald W. Hill
Assistant Director-Operations

RWH/ac

Nevada State Museum

RICHARD H. BRYAN
Governor

STATE OF NEVADA

SCOTT MILLER
Director

NEVADA STATE MUSEUM

Capitol Complex
Carson City, Nevada 89710
(702) 885-4810

March 13, 1985

Mr. Carl Johnson
Nuclear Waste Project Office
Office of the Governor
Capitol Complex
Carson City, NV 89710

Dear Mr. Johnson:

I have been requested by your office to review the Draft Environmental Assesment for Yucca Mountain as it relates to threatened or endangered plant species.

I first checked my records for the possible recorded occurrences of sensitive taxa. I was hampered in this effort as there was no suitable description of exactly what parcel of land is under consideration. The map in Figure 2 had no reference points (i.e. latitude and longitude for example). I finally worked the location out to be contained mostly on the Topopah Spring NW and Topopah Spring SW 7.5' quandrangels. I consulted copies of those quandrangles prepared by the Department of Energy and dated March 31, 1978; such quandrangles have plotted locations of threatened or endangered plants. No such locations were plotted within the project boundaries as I protracted them.

Indeed the only plant mentioned in the EA is Sclerocactus polyancistrus and it appears that its presence in the Yucca Mountain area was realized (figures 3-15) after the bulk of the original work was completed. However the statement in the first paragraph of 3.4.2.3 is in error. Sclerocactus polyancestrus is a candidate species. The November 28, 1983 Federal Register (Vol 48, No. 229, page 53658) lists this plant under its Taxa Currently Under Review heading as category 2. On page 53641 of the same Federal Register, there is the statement to the effect that taxa in categories 1 and 2 are candidates.

I have spoken with Tom O'Farrell and Elizabeth Collins of EG&G about the pre-construction surveys conducted before various operations are undertaken. Their comments were in agreement with the last paragraph on page 4-24. So it would seem that, if such surveys are conducted and resulting recommendations are adhered to, there should be no problem.

If you have additional questions, please write or call and I am sorry this is so late.

Sincerely,

Ann Pinzl

Ann Pinzl
Curator of Natural History

AP:ld

State of Nevada

Indian Commission

RICHARD H. BRYAN
Governor

STATE OF NEVADA
INDIAN COMMISSION
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ELWOOD MOSE
Executive Director

COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT OF THE YUCCA MOUNTAIN SITE RESEARCH AND DEVELOPMENT AREA

REVIEWER: Elwood Mose, Executive Director
Nevada Indian Commission
472 Galletti Way, Sparks, Nevada 89431
Tel. (702) 789-0347

SUBJECT : Socio-economic, historic, and cultural issues.

If it is possible that there can be one most unredeeming characteristic of the Environmental Assessment's hundreds of pages of turgid prose and disingenuous analysis of the Yucca Mountain site as a nuclear waste dump, perhaps it is that of the scientific hauteur displayed on page after page of this tedious and baffling document. It should not be too much to expect that the proposed project be explained clearly and expected consequences laid out clearly for the public to consider and judge. Rather, through an arcane series of numbers and organized confusion, this brother of the Air Force' MX DEIS purports to present a clear picture of the effects of the beginnings of the repository.

And if previous experience is a criterion of dealing with federal documents, then the Environmental Assessment fails, as did the DEIS, in addressing properly the concerns of Native Americans. The relationship of Indian tribes with non-Indian culture and government is a unique one, evolved through years of treaty-making, agreements, case law, court decisions, and dealings of the tribes with other governments. The status of Indian tribes is founded on historic and legal underpinnings and involves: tribal sovereignty and government, the federal/Indian trust relationship, and jurisdiction. These elements form the base upon which the Environmental Assessment's treatment, understanding, or ommission of Indian interests is examined in the areas of land ownership and land use, cultural persistence, archeological and anthropological concerns, religious freedom, and emerging groups.

Indian tribes are "distinct, independent political communities" (Worcester v. Georgia, 31 U.S. 518 1832) and "unique aggregations possessing attributes of sovereignty over their members and their territories" (United States v. Mazurie, 419 U.S. 544) The tribes' relationship to the United States is "...unlike that of any other two people in existence" (Cherokee Nation v. Georgia, 30 U.S. 1, 16 1831) Indian tribes retain that degree of sovereignty which they have not relinquished to the United States (Cohen's Handbook of Federal Indian Law 122, 1982). In the Constitution, the states delegated to the federal government certain powers, including whatever powers they may have had over Indian tribes and lands (U.S. Constitution, Article III, Section 8 (3); Worcester v. Georgia 31 U.S. 515, 1832). There are present in laws and policy certain rights which are unique to Indian tribes and Indian people.

The federal trust relationship emerges from this unique relationship between the United States and the Indians with a genesis in international and colonial law. The trust is a relationship characterized by a "duty of protection" which arose because of the "weakness and helplessness" of Indian tribes "so largely due to the course of dealings of the federal government with them and the treaties in which it has been promised..." (United States v. Kagama, 118 U.S. 375, 384 1886). Tribal governments enjoy authority to govern their reservations in much the same way as state governments enjoy their authority; and they possess regulatory, licensing, and other approved powers within their jurisdictional boundaries and rights are absolute except where the federal government pre-empted those powers (Warren Trading Post v. Arizona Tax Commission, 380 U.S. 685 1965).

The Draft Assessment does not consider that two tribal governments are affected by the DOE's plans for a waste site. These two are the Moapa Band of Paiute Indians and the Las Vegas Paiute Tribe. The Assessment prepares did not consider that there are impacts on those two tribes, specifically in the area of transportation on waste materials. No mention of the Indians is made at 3.5, 4.2.2.6, 5.3.1, 6.2.1.8., and at 7.3.2. This is a flaw which cannot be countenanced, in light of the tribes not being included in plans to carry materials through their reservations which straddle Interstate I-15 and Highway 395.

As to cultural persistence, quality of life, archeological and anthropological concerns, and Indian religious freedoms, the Environmental Assessment also is silent. The reading of the material contained in the document leaves one with an impression that the only effect of the project is on the prehistoric and that no current concerns exist among Native peoples. Indians of the Great Basin Area have demonstrated a high degree of cultural activities and cultural integrity. Lands within the holdings of the Bureau of Land Management are used for religious and medicinal purposes but no mention of those uses is even considered by the EA preparers. Lands in Nevada are used for hunting, gathering of plant materials, &cet. but the only concerns of the EA is with archeology.

Any discussion of Native American use of the area in question ought to contain recent documentation, not studies which were prepared in the earlier part of the century. Any extensive preparation of this subject should take into consideration such documents as Fowler's Great Basin Anthropology - a Bibliography, Reno 1970; further, such work requires extensive field work involving interviews with Native Americans. Of particular interest are Native American values connected to to kinship, mobility, and the world view respective to the land status. Also, the American Indian Religious Freedom Act, 92 Stat.469, P.L. 95-341, declares that the United States is to "protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise their traditional religion,including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonies and traditional rites." Certainly, there are Indians who use the area for these purposes but those are ignored by the Environmental Assessment in its sections dealing with socio-economic, cultural, and other resources: 3.4.6., 4.2.1.6., 5.2.8., 6.2.1.7., and 7.3.2.

In summary, the Environmental Assessment is seriously deficient in its addressing of Native American concerns, particularly in in consideration of transportation issues and those issues connected to land use patterns among Native Americans in the area. A more extensive groundwork must be laid before the Assessment can be considered complete.

DESERT RESEARCH INSTITUTE
UNIVERSITY OF NEVADA SYSTEM

TECHNICAL REVIEW COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT: YUCCA MOUNTAIN SITE NEVADA RESEARCH AND DEVELOPMENT AREA, NEVADA

(December 1984, DOE/RW-0012)

WATER RESOURCES CENTER

March 1985

WATER RESOURCES CENTER
Desert Research Institute — University of Nevada System

2505 Chandler Avenue, Suite 1
Las Vegas, Nevada 89120
(702) 798-8882

March 20, 1985
MM:805

Mr. Robert Loux, Director
State of Nevada Nuclear Waste Project Office
Capitol Building, Second Floor
Carson City, Nevada 89710

Dear Bob:

Attached are the technical review comments prepared for the Draft Environmental Assessment (DEA) for Yucca Mountain by the Water Resources Center. The broad areas of hydrology and hydrogeology have been specifically addressed, as well as closely related areas dealing with geochemistry, climate changes, and mineralogy as they pertain to site selection considerations.

We have attempted to make our comments useful to the DOE; they are of technical or scientific review style and therefore direct and specific for clarity. Where possible and appropriate, we reference our comments so that the DOE or support contractors may investigate in greater detail the substance of our comments. We have made a sincere attempt to keep the comments restricted to the most technically important relationships in terms of the DEA site selection guidelines and site licensing considerations. We have also made a sincere attempt to keep the comments technically sound and fair; this has been a challenge at times due to the highly biased and subjective nature of the DEA in some sections. Our guiding rule has been to view the available information and interpretations from the perspective of the nuclear waste program objectives (site selection and licensing criteria). In this manner we believe our comments can best serve the State of Nevada interests by providing the DOE our technical comments to help focus their future efforts.

The bottom line of our review efforts is that of finding the data base generally too sparse to confidently anticipate the viability of the proposed repository at Yucca Mountain. However, several hydrogeologic aspects do not appear particularly favorable based on the sparse data and limited understanding that currently exists.

We would be pleased to respond to questions that may arise from this technical review.

Sincerely,

MARTIN MIFFLIN
Program Director

TECHNICAL REVIEW COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT: YUCCA MOUNTAIN SITE, NEVADA RESEARCH AND DEVELOPMENT AREA, NEVADA

(December 1984, DOE/RW-0012)

By:
Water Resources Center
Desert Research Institute
University of Nevada System

Submitted to:
State of Nevada
Nuclear Waste Project Office
Carson City, Nevada

March 1985

AUTHORSHIP

The DRAFT ENVIRONMENTAL ASSESSMENT, Yucca Mountain Site document review has been performed for the State of Nevada by the Water Resources Center, Desert Research Institute. The prime area of review responsibility assigned to the Water Resources Center has been the broad areas of hydrology and hydrogeology which encompass key site safety issues. Specific comments on other selected topics have also been made. The specific areas of technical responsibility in terms of authorship are as follows:

Climatic Change	Jay Quade
Geochemistry and Mineralogy	M.E. Morgenstein
Geohydrology Guideline	M.D. Mifflin
Hydrogeochemistry	Roger Jacobson
Saturated Zone Hydrology/Modeling	M.E. Campana
Surface-Water Hydrology	John W. Fordham
Vadose Zone Hydrology	Scott Tyler
Field Monitoring	Douglas Zimmerman

Comprehensive review has been the responsibility of M. Morgenstein and M.D. Mifflin. During the process of review and comment development, many multiauthorship comments have resulted.

M.D. Mifflin
Program Director

I. OVERVIEW

The Nuclear Waste Policy act of 1982 established a process for site selection and nomination for the disposal of spent nuclear fuel and high-level radioactive waste. Site nomination is accompanied by an environmental assessment (EA). The DOE has prepared the draft EA for the purpose of review, comment, and evaluation. Our input responds to this facit of the established process.

In the process of our review we observe the following four aspects of the DEA that are not conducive to viable site selection. These are substantiated by general and specific section comments:

1. THERE CURRENTLY EXISTS A DISAPPOINTING PAUCITY OF WELL-BASED TECHNICAL INFORMATION UPON WHICH TO ASSESS THE PROBABLE SUITABILITY OF THE YUCCA MOUNTAIN SITE.

   Our conclusions are based on review of the contents of the DEA and support documents. The paucity of well-based technical information is surprising considering the quantity of human and financial resources that have been expended on evaluation of the proposed Yucca Mountain repository. The proposed site is highly complex due to: 1) the repository position in the vadose zone, and 2) a fractured, welded tuff geologic terrain. The ability to resolve the recognized technical issues with a licensing level of certainty has not been established by site studies to date or studies of similar environments. If these issues are not resolved, we feel that the site will not meet the intent and requirements of the Nuclear Waste Policy Act.

2. MANY DEA SECTIONS HAVE MISUSED TECHNICAL INFORMATION TO THE DEGREE THAT POTENTIALLY FAVORABLE SITE CHARACTERISTICS ARE EXAGGERATED.

   Our conclusions are based on review of the content of the DEA and referenced documents. We find that selective use and misuse of data and conceptual models have compromised the objectivity of the site selection process. For example: The conceptual models in the DEA have been confused with technical fact; consequently, the DOE reaches conclusions with respect to the site selection and licensing criteria that are not always warranted.

The conceptual models admit to a poor support data base and are unsubstatiated by standard analytical techniques and field data. Failure to separate conjecture from well-supported relationships could prove costly to the waste repository program in several ways:

(a) The DOE may choose for characterization sites that are <u>not</u> as favorable as stated.

(b) The DOE may <u>not</u> enter into the appropriate studies required for confident site characterization.

3. IN SEVERAL AREAS OF CONSIDERATION, TECHNICAL DATA, REQUIRED FOR CONFIDENT SITE SELECTION AT YUCCA MOUNTAIN APPEAR <u>NOT</u> TO HAVE BEEN RECOGNIZED BY THE DOE.

We find failure to define research objectives and develop and execute research programs that would have provided a level of knowledge required for confident site selection. In spite of extensive programs of study, key issues related to licensing criteria have <u>not</u> been resolved or confidently explored to date. These areas are:

- Hydrology of Fractured Rocks

  Uncertainty surrounding precipitation, evapotranspiration, infiltration, percolation in fractures of matrix environments, hypothesized capillary barriers, rock-surface wetting effects, hydraulic conductivities, percent saturation, flow-paths and directions, effective porosity, bulk hydraulic conductivity and gradients, all combined with limited knowledge about the vadose zone prevent determination of conservative travel times at the Yucca Mountain site.

- Climate Changes

  The effect of future climatic changes (based on past analogs) on flux rates in the vadose zone (fracture and matrix flow), on development of perched water zones, and on radionuclide travel times have not been adequately addressed to date. It remains unclear whether or not post-closure radionuclide release and transport will be greatly enhanced by future climatic changes.

- Aqueous Geochemistry

  The absence of aqueous geochemistry of vadose water inhibits any conservative determination of potentially sorptive diagenetic mineral production, of diffusion, of sorption, of radionuclide colloids, precipitates, and complexes, and of overall retardation.

- Sorption Mineralogy

  Paucity and virtual absence of information concerning authigenic mineral stability, mineral stability with known chemical composition, distribution of authigenic mineralogy coating fractures and their chemical composition, variations with fracture mineralogy and matrix mineralogy, sorption behavior of authigenic minerals with variations of super cage dimensions and associated chemical composition and chemical composition of vadose water all combine to prevent the determination of sorptive capacity and effective retardation within paths of radionuclide transport.

4. SITE CHARACTERIZATION PLANS ARE EXTREMELY VAGUE, DO NOT ASSURE IMPROVEMENT OF THE DATA BASE, AND APPEAR TO GENERALLY FOLLOW THE PATTERN OF PREVIOUS WORK.

The proposed repository environment requires a carefully planned and executed assessment program of interdisiplinary research. This program should be technically sound as it must assess complex environments plagued by both a paucity of detailed site specific information and an absence of well-established investigative methodologies. The site characterization plans alluded to in the DEA do not provide a comprehensive assessment package. Unless this program is enhanced with an appropriate focus on pertinent issues, it seems unlikely that key licensing issues will be resolved to the level of confidence that is acceptable to the general scientific community.

II. CONTENTS

III. GENERAL COMMENTS SECTION

A. CLIMATIC CHANGES (Paleoclimate and Paleohydrology)

DEA Section 6.3.1.4. Climatic Changes (10 CFR 960.4-2-4)

"The qualifying condition for this guideline is as follows:

> The site shall be located where future climatic conditions will not be likely to lead to radionuclide releases greater than those allowable under the requirements specified in Section 960.4-1."

Specific comments are made within this section in the DEA and in other sections of the DEA regarding paleoclimatic and paleohydrologic issues.

<u>Organization of comments on paleoclimatic interpretations used in the DEA</u>

The nature of glacial-maximum climate is germane to two issues at the waste repository site: former water-table elevations, former moisture flux through the vadose zone, and radionuclide travel times. The following illustrates how the two of the issues are addressed in the DEA, and how they are commented on here.

<u>Water-table elevation (full glacial)</u>	<u>moisture fluxes (full glacial)</u>
Direct geological evidence:	No direct evidence yet available.
(1) Distribution of authigenic minerals in Yucca Mtn. cores-see comments on section 6.2.2.1.3.(6-104 to 105), 6.3.1.1.3.(6-121 to 122), 6.3.1.2.3.(6-149), and Hoover, 1968.	
(2) Elevation of former discharge points	

downgradient (i.e. in Ash Meadows and Death Valley)-see comments on section 6.3.1.4.2.(6-193) and 6.3.4.1.3.(6-199).

(3) Mineral compostion in cores from Frenchman Flat-see comments on section 6.3.1.2.(6-193).

Theoretical approach:

(1) Prediction of Pleistocene precipitation based in part on packrat midden evidence; using modern estimates of the relationship of precipitation to recharge (Eakin et al., 1951), calculate changes in water-table elevation (Czarnecki, 1984).	(1) Montazer and Wilson (1984), using the water-budget method of Winograd and Thordarson (1975), calculate probable modern flux rates. This estimated rate is assumed to be a valid average for the late Pleistocene, and therefore conservative.

See comments below for an evaluation for the theoretical approaches.

GENERAL COMMENTS ON THE SPAULDING'S (1983) PACKRAT MIDDEN EVIDENCE FOR ESTIMATES OF LATE PLEISTOCENE CLIMATE

The specific paleoclimatic estimates mentioned in the DEA come mainly from Spaulding's (1983) work on fossil plants from the packrat middens [6.3.1.1.4.(6-131); 6.3.1.4.3.(6-196-197)]. His work is the principal basis for predicting specific changes in future climate at the site. Czarneki (1984) utilizes Spaulding's estimates to calculate maximum expectable rise in the water table during future climate. More general comments in the DEA on a long-term trend of increasing aridity derive from an incorrectly cited source (see comment on section 6.3.1.4.3. (6-196). Estimates from Mifflin and Wheat (1979) are also cited [6.3.1.4.3. (6-196)], but their figures are not utilized in the table predicting nearpluvial precipitation [6.3.1.4.3.(6-197)] nor elsewhere.

A detailed evaluation of Spaulding's work has been made because it has served as a basis for predicting future changes in water-table elevation and moisture fluxes above the repository. Our conclusions are that Spaulding is not necessarily wrong, but that there are enough inconsistencies to make his argument something less than compelling. To be convincing his interpretations require a better understanding of the ecologic constraints on modern plants (especially precipitation vs. temperature controls), and a more balanced examination of what is already known of their ecology. Furthermore, his estimates are based on poorly documented elevational lapse rates for temperature, and on the debatable assumption that the main ecologic control on juniper-pinyon and creosote bush is basically temperature. Nonetheless, the work of Spaulding and others on packrat midden-remains is of great value, for the information on both the overall nature and the timing of climatic change that they supply.

The nature of Pleistocene climate is a highly contentious issue in Quaternary studies. Many different specific estimates of Pleistocene climate have been formulated using several different approaches (Table 1 [Spaulding, 1983, Table 7]). There is little consensus as to which interpretation is accurate. A major criticism of the DEA treatment of paleoclimate is its reliance on a single analysis (Spaulding's), in the face of so many interpretations and so little agreement. A "conservative" use of the available data would attempt to incorporate more of these interpretations. It would also apply those interpretations to estimates of changes in water-table elevation, as well as flux rates under pleniglacial conditions. The DEA should explicitly recognize that the scientific community is divided on the issue of the comparative importance of precipitation vs. temperature in full-glacial climate. As the attached critique of Spaulding's work and probable future debate will show, Spaulding has not resolved the issue. Moreover, no resolution of the question is in sight given the current level of knowledge. By failing to recognize this, the worse case scenario in terms of pluvial climatic effects on the repository has not been addressed in the DEA. In order for a conservative estimate of glacial-maximum climate to be formulated, the facts (or interpretations) upon which there is some consensus should be recognized and incorporated. Where there is not agreement, a range of plausible temperature

TABLE 1: Spaulding, 1983. Table 7.--*Paleoclimatic reconstructions for the full-glacial period of the American Southwest*

[ΔT_a, changes in °C (degrees Celsius) in annual temperature; ΔT_s changes in °C in summer temperature; ΔT_w, changes in °C in winter temperature; ΔP, change in annual precipitation in cm (centimeters); % (percent), %P, ΔP/modern P; %E (evaporation), ΔE/modern E]

Author	Data base	Location	ΔT_a	ΔT_s	ΔT_w	ΔP	%P	%E
Antevs (1952)	Hydrologic budgets	Lake Lahontan, Nevada	-2.5 to -3.0	----	----	+8 to +16	50 to 100	-30
Antevs (1954)	Relict snowlines	North-central New Mexico	----	-5.6	----	+23	----	----
Bachhuber and McClellan (1977)	Foraminifer distributions	Lake Estancia, New Mexico	----	-9.7	----	----	----	----
Brackenridge (1978)	Relict cirques and cryogenic deposits	Montana to Arizona (lat 45°40'N to 33°20'N)	1/ -7.0	----	----	0	0	----
Broecker and Orr (1958)	Hydrologic budgets	Lake Lahontan, Nevada	-5.0	----	----	+20	80	----
Galloway (1970)	?Solifluction deposits	Sacramento Mountains, New Mexico	-10.5	----	----	-4.6	----	----
Leopold (1951)	Hydrologic budgets and snowline changes	Lake Estancia, New Mexico	-6.6	-9.0	-2.8	+18 to +25	50 to 70	-23 to -50
Mifflin and Wheat (1979)	Hydrologic budgets	Nevada, state-wide	-2.8	----	----	+8.4 to -24	2/ 68	-10
Reeves (1966)	Hydrologic budgets	Llano Estacado, west Texas	-5.0	-8.0	----	+39	89	-27
Snyder and Langbein (1962)	Hydrologic budgets	Lake Spring, Nevada	3/ -5.0	4/ -7.2	----	+20	67	-30
Van Devender (1973)	Packrat middens	Western Arizona	-2.2 to -3.9	----	----	+12.3 to +22.0	----	----

1/ Minimum estimate.

2/ State-wide average.

3/ Extrapolated by Morrison (1965); Schumm (1965); and Mifflin and Wheat (1979).

4/ Extrapolated by Schumm (1965) and Brackenridge (1978).

vs. precipitation scenarios, as proposed in other studies, should be applied, in addition to Spaulding's.

Two important points upon which there is agreement for southern Nevada come from packrat middens (Van Devender and Spaulding, 1979, Thompson and Mead, 1982, Wells, 1983, Spaulding, 1983, Spaulding and others, 1984), pollen (Mehringer, 1967, Mehringer, 1977), and pluvial discharge evidence (Mifflin and Wheat, 1979, Smith and Street-Perrot, 1983, and Quade, 1983). First, and as stated in the DEA, no more than semi-arid conditions were attained in the valley bottoms during the full-glacial. The magnitudes of the changes have not been so great that reasonable analogs (in terms of flora and discharge type) cannot be found in the semi-arid central and northern portions of the state. Another point, based on the packrat midden evidence, is that winter precipitation was probably greater and summer less during the full glacial. This is particularly important since it implies that moisture effectiveness was greater not only because average temperature was lower and average precipitation higher, but because more of the precipitation came in the winter. For example, 75% of modern precipitation falls in the winter and 25% in the summer. Using Spaulding's figures (Table 2 [Spaulding, 1983, Table 10]), this proportion was closer to 90%-10% for the full glacial. Wells (1979) also argues for greater cold-season precipitation, but he attempts no quantification. Spaulding's estimates ought to be viewed as a minimum.

The long-term cyclicity of climate during the Pleistocene and earlier is well documented in the oxygen-isotope record (Shackleton and Opdyke, 1973, Berggren and others, 1980) and European loess record (Kukla, 1975). As Spaulding noted, this record has been convincingly connected to changes in the earth's orbital characteristics (obliquity, eccentricity, and precession), at least for the past half million years (Broecker and Van Donk, 1970, Imbrie and Imbrie, 1980). Kutzbach (1981) has modeled significant and testable effects on climate due to orbital forcing in the past 11,000 years. Spaulding rightly invokes these findings in his discussions of past climates and probable future patterns.

TABLE 2: Spaulding, 1983.

Table 10.—*Summary of estimates of late Quaternary climate for the Nevada Test Site and vicinity*

[ΔT_w, estimated changes in °C (degrees Celsius) of average winter temperature; ΔT_s, estimated changes in °C of average summer temperature; ΔT_a, estimated changes in °C of average annual temperature; % (percent) P_s, estimated percent changes in average summer precipitation relative to current amounts; $\%P_w$, estimated percent changes in average winter precipitation relative to current amounts; $\%P_a$, estimated percent changes in average annual precipitation relative to current amounts; B.P., years before present]

Time (B.P.)	ΔT_w	ΔT_s	ΔT_a	$\%P_s$	$\%P_w$	$\%P_a$
45,000	-2 to -3	---	-1 to -3	1/-60	+20	0
38,700	---	---	-1 to -2	-40	+25 to +50	+10 to +20
37,800	---	---	-5	---	---	+20
30,000	---	---	-3 to -6	---	---	+10 to +25
18,000	1/-6	-7 to -8	-6 to -7	-40 to -50	+60 to +70	+30 to +40
10,000	-1 to -2	+1 to +2	0	2/+50	0	+10 to +20

1/Minimum estimate.

2/Maximum estimate.

However, the referred to models are of a general nature and do not arrive at specific predictions regarding climate. The exact relationship between changing insolation (as caused by orbital forcing) and local or regional climate is open to interpretation.

The various characterizations of full-glacial climate have been reviewed by many authors (see Table 1). As Spaulding (1984) notes, there are two basic schools of thought. One interpretes the full glacial to have been dry and cold, the other moist and cool. A few proponents of the first group are Bachhuber and McClellan (1977), Brackenridge(1978), Dohrenwend (1984), Galloway (1983) and others. The latter group, who support the concept of a moist, "pluvial" climate are represented by Antevs (1954), Snyder and Langbein (1962), Van Devender (1973), Mifflin and Wheat (1979), Wells (1979), and others. Spaulding views himself as intermediate between the two groups in that he sees substantial cooling ($\geq$ 6°C) but also 30 to 40% increase in precipitation in the full glacial (18,000 B.P.). He also interpretes the late Pleistocene (ca. 11,000) as meter (precip. = 100%) than that of today but warmer than the glacial maximum. These estimates were partially incorporated in Czarnecki's (1984) calculations of pluvial recharge and change in water-table elevation. They were not applied to calculation of possible future flux rates.

In view of the current lack of concensus, the principle of "conservative" estimation would attempt to incorporate all the estimates. We suggest that the range of values given in Table 1 should be adapted to the methods used by Czarnecki (1984), as described below, instead of the single value from Spaulding. Furthermore, these values should also apply toward calculating future flux rates above the repository.

Comments on Czarnecki's (1984) use of paleoclimatic data to calculate recharge and potential water-table rise

Czarnecki (1984) calculated a maximum rise in the water table using Spaulding's precipitation values for the late Pleistocene (100% of modern). He does not incorporate Spaulding's temperature estimates for the same period. Czarnecki's method indirectly includes lower temperature by applying lower evapotranspiration rates typical of higher elevation zones with greater precipitation. It has been clearly demonstrated that lower temperatures produce more runoff (and probably more infiltration) for a given amount of precipitation because evapotranspiration is reduced (Langbien, et al., 1949). Following Eakin et al., (1951), this figure resulted in a Yucca Mountain area recharge of about 15 times greater than modern, and in a 130 m rise in the water table.

Czarnecki's (1984) approach and results are probably conservative. A 100% increase in precipitation over modern is a reasonable maximum estimate, and probably one greater than the true figure. The size of the temperature adjustment mentioned above is not clear. But all told, the effective moisture extreme for some future climate has probably been anticipated. Nevertheless, in the interests of truely conservative analysis, we suggest a range of paleoclimatic estimates, such as given on Table 1, be utilized in infiltration calculations. Also, Czarnecki assumes modern seasonality of precipitation and temperature for the future. This is not accurate, but it is not clear if the omission is important.

There is no way to accommodate these changes in the Eakin et al., (1951) method as it stands. A modified calculation should incorporate: a range of temperature and precipitation values for the full-glacial given in Table 1, at least 90% winter precipitation, the presence of pinyon-juniper woodland vegetation, and should differentiate flat valley alluvium from rocky uplands with high roughness values. Analog environments to the full-glacial site in the central and northern portions of the state would be a useful place to examine precipitation/recharge relationships. Czarnecki (1984) acknowledges the importance of some of the above modifications, and closes by saying: "However, one of the major assumptions made in this study is that the empirical relationship between precipitation and consequent increase recharge is valid. Little basis exists for this assumption; additional work is needed to document recharge mechanisms and rates, and to establish analytical expressions between precipitation rates and associated ground-water recharge rates," (Czarnecki, 1984).

Future Climate and Flux Rates

Neither Czarnecki's recharge estimates, nor estimates derivable from other paleoclimate models, were applied to calculation of flux rates in the DEA support literature (see, for example, Montazer and Wilson, 1984). In our opinion, this is a major oversight. Infiltration rates are cited as 4.5 mm maximum throughout the DEA. This value was translated into flux rate above the repository of 1mm/yr (maximum). Montazer and Wilson (1984) contend that their 4.5 mm estimate also in part derives from Pleistocene recharge affects and is therefore conservative. Even if accurate, we believe their figure is only a modern value. Future flux rates will at times be greater. We therefore do not agree that the flux rates cited in the DEA are conservative, for reasons given below.

Montazer and Wilson (1984) claim to anticipate future climatic changes by interpreting the 4.5 mm/yr flux as an average value deriving from modern as well as paleoclimate conditions. They state (p. 39) "A range of recharge rates of 0.5 to 4.5 mm/yr (estimated by the water budget method) for Yucca Mountain probably is conservative, because values in this range represent long-term average values and not necessarily the quantity of recharge that occurs as a result of modern arid conditions. The net infiltration (and resultant recharge) due to modern climatic conditions probably will be much less." Also, "Thus, discharge values [modern] represent average net infiltration that has occurred during a long span of geologic time." The authors do not specify the length of "a long span," but we assume that it extends back to the late Pleistocene, since any conservative analysis would have to include the climatic extremes of that period.

In our opinion this is not a conservative assumption. Ample evidence from southern Nevada in fact does show that ground-water discharge was greater at times during the Pleistocene (Haynes, 1967; Winograd and Doty, 1980; Quade, 1983). In the Las Vegas Valley, maximum marsh expansion centers in time on the peak of the full-glacial climatic extreme (ca. 18,000 B.P.). Furthermore, basically modern (or even dryer) discharge patterns were attained by at least 7000 B.P. (Haynes, 1967; Quade, 1983) in that area. Packrat midden (Van

Devender and Spaulding, 1979) and pollers (Mehringer, 1967, 1977) evidence reflect the shift to modern or near modern arid conditions at about the same time (8000 to 7000 B.P.). If a lag-time between climatic change and discharge response exists, the record suggests it was short, certainly much less than 7000 years. Thus, the affects of increased Pleistocene recharge, whether the system was wholly confined or not, have probably long since ceased to be expressed in discharge values.

In reviewing the data in this matter, it is important not to confuse ground-water travel times with the time required to express recharge changes at discharge points. The two are not necessarily the same, especially in a confined system. Ash Meadows water <u>may</u> be Pleistocene in age (Claasen, 1983); it seems improbable that the volume of discharge is as well.

Discussion in the DEA (See 6.4.2.5 [6-323-325] seems to imply that future flux rates can be estimated as some multiple (say 50 or 100%) of the modern 1 mm/yr value. However, this assumes that infiltration increases geometrically with increasing precipitation. Czarnecki's (1984) analysis shows that probably isn't true. By his calculation, 100% greater precipitation with moderate (?) temperature increase results in 15 times greater recharge over modern. Czarnecki's values were applied only to calculation of water- table changes, <u>not</u> flux rates. This analysis would put maximum future regional recharge at 67.5 mm (15 x 4.5 mm). Very little climatic data and no infiltration data are available for Yucca Mountain itself. However, the estimated order of magnitude of change in recharge developed by Czarnecki (1984) raises serious questions.

With the above in mind, a further critical point needs consideration. That is how matrix versus fracture flow in rock above and around the repository would be affected by such enchanced recharge rates. Throughout the DEA, matrix flow is assumed to dominate at present (which may or may not be accurate). Flux rates are assumed to be under 1 mm/yr. But Rainier Mesa data shows that fracture flow in tuffs is significant. And effective moisture at Rainier Mesa now is probably the same or less than at Yucca Mountain during the full-glacial. Sinnock <u>et al</u>., (1984) places the threshold dividing matrix and fracture flow at 1 mm/yr. Above that flux, ground-water travel times <u>decrease</u>

dramatically. Applying Czarnecki's estimate, recharge could be increased as much as 15 times, at most, during some future climatic extreme. Reference to Figure 13 of Sinnock et al., (1984) shows that such enhanced flux rates (4.55 mm x 15=67.5 mm) would reduce travel times well below the 1000 year acceptable limit. In addition, a maximum postulated 130 m rise in the water table would further reduce travel times. We therefore strongly recommend that these relationships as indicated by Czarnecki's preliminary analysis be carefully considered during further site characterization.

Critical Examination of Paleoclimatic Evidence Used in the DEA

Estimates of Spaulding, 1983, "Vegetation and Climates of the Last 45,000 Years in the Vicinity of the Nevada Test Site," U.S.G.S. OFR 83-835, 199 pp.

The DEA contains over five citations of Spaulding's packrat midden evidence for late Wisconsin climate in the NTS region. It is his estimates of the temperature and precipitation during that period which are a basis for calculating probable future pluvial climate at the Yucca Mountain repository. These calculations are given in 6.3.1.4.3. (6-197) paragraph 12. These estimates are also the basis for calculating probable infiltration and therefore predicted changes in water-table elevation at some future time (Czarnecki, 1984). Full-glacial effective moisture is obviously a critical parameter where high-level waste interment at Yucca Mountain is concerned. The purpose here is to examine the basis for Spaulding's estimates.

In this study and in others Spaulding collected and analysed over 30 middens, several of which contain multiple horizons spanning over 5000 years. Fossilized plants from all of the late Wisconsin are present. The middens come from a wide range of elevations and aspects, although the low elevation sites (<1200m) are the least well represented. Spaulding and others have convincingly shown that the fossil middens accurately reflect the major woody plant species present around the midden sites when they were accumulated. Specific horizons were collected in each of the middens, and determinations were usually made on specific plants. Dates in excess of 30,000 years, especially where there are large counting errors, should be viewed as suspect. But this does not apply to the full-glacial (ca. 18,000) and younger middens, which are the main topic of concern here. In general, Spaulding's collection and analytical techniques are meticulous and probably reliable. Our single criticism of his sampling is that the lower elevation sites are confined to four in the present study. Since many of his estimates of relatively dry full-glacial conditions are based on the presence of desert scrub plants in them as far back as 14,800 B.P., a larger lower elevation sample would establish greater confidence. This is especially important since two of his sites (Owl Canyon-1 and the Last Chance Range middens) contain evidence of woodland at the same time. Moreover, the particularly critical Point of Rocks sites are located on steep, bedrockdominated limestone slopes. They therefore may be anomolously xeric (dry).

Spaulding provides estimates of late Quarternary climate for the NTS Region in Table 2 (from Spaulding, 1983, Table 10). The periods around 18,000 and around 10,000 years B.P., probably represent times of climatic extremes. For convention, these will be referred to as the full-glacial and the latest Wisconsin respectively.

Spaulding arrives at average annual precipitation and temperature for both periods by combining his estimates of the average summer and winter values. These seasonal values are in turn derived from different parameters. The parameters include the temp./precip. tolerances of certain plants, and the amount of downward displacement of the lower woodland boundary during the Pleistocene. The reliability of Spaulding's quantitative estimates depend on the validity of the assumptions underlying the use of these parameters.

Spaulding estimates average winter temperatures 6°C or more below modern for the full-glacial. He bases this on the ecology of the creosote bush, which is absent from his full-glacial middens at any elevation, but is present in the vicinity of his lower elevation sites at present. Spaulding cites Beatley (1974) as saying that the primary modern control on the distribution of creosote bush in the NTS is temperature. Specifically creosote bush cannot tolerate mean minimum temp. below -1.5°C and extreme minimum temperatures below -16.8°C. Since lower elevation fossil middens lack creosote, Spaulding reasons that the sites must have experienced full-glacial winter temperatures below those given above. Subtracting the above extremes from modern temperature values at the sites, Spaulding came up with winter average temperatures for the full-glacial at -6°C below modern (Table 2). He goes on to say that winter precipitation was 60 to 70% greater than today's, based on the qualitative judgement on the overall xeric nature of the plants in the midden. These figures are cited in the DEA (Table 2).

There are two problems with his analysis. As noted by Vasek and Barbour (1977, p. 837), excessive winter precipitation as well as temperature control the modern distribution of creosote. Specifically, creosote cannot tolerate precipitation greater than 183mm (where winter precip. is greater than 35% of the total), in addition to the temperature constraints that Spaulding cited. In fact, Beatley (1974, p. 260) states precipitation exercises more rigorous controls on creosote distribution than does temperature. This fact Spaulding either missed or inexplicably ignored. The 183 mm precipitation value turns out to be 65 to 70% greater than the modern figures for Spaulding's lower elevation sites. Therefore, elevated precipitation, even without a change in temperature (to present the extreme case), could have excluded creosote from those elevations during the full-glacial. Such a scenario is not necessarily advocated here; the point is that his all-temperature interpretation of the distribution of creosote bush is specious.

Furthermore, Spaulding fails to apply this temperature criterion to the latest Wisconsin, where creosote is also absent from the middens. Table 2 shows that Spaulding estimates average winter temperatures to be -1 to -2°C below modern for that period. By his own reasoning, that is 5 to 6°C warmer than the minimum average temperature tolerance of creosote. And yet creosote is not present in the middens. Spaulding nowhere explains its absence in light of his winter temperature estimates for th latest Pleistocene. In Spaulding _et al_., (1983), the authors modified Spaulding (1983) latest Pleistocene precipitation estimates upwards to 100% of modern, or (50% greater than in Spaulding, 1983). That would exclude creosote from the sites according to Beatley's data. However, that would also conflict with Spaulding's original all-temperature control interpretation of creosote distribution.

Spaulding's estimates for the full-glacial summer temperatures are based on the amount of downward displacement that the woodland (juniper) and subalpine (limber pine) boundaries experienced during the Pleistocene. In the Las Vegas Valley, this value is conservatively estimated at 1000m. Assuming elevational lapse rates for temperature similar to modern (0.6 to 0.75OC/100m: see Table 3, [from Spaulding, 1983, Table 8]). Spaulding arrives at a difference in summer temperature during the full-glacial of -7 to -8°C below modern (Table 2). Combining this with winter averages, Spaulding calculated a -6 to -7°C below modern annual average for the full glacial. Thus Spaulding arrives at a cold but moist rather than cool, wet characterization for the full glacial. His precipitation values cited in the text are adjusted downward to reflect the effect of the colder temperatures in the effective moisture balance. He goes on to cite the case of Ely, a town in east-central Nevada with a cold, dry climate located at the lower limit of the woodland boundary, as an analog to full-glacial climate in the southern part of the state (Spaulding, 1983, p. 105).

Four points need to be examined in this analysis:

(1) Do modern lapse rates apply to the past, especially when precipitation was probably different; and are modern estimated lapse rates accurate in predicting modern elevational variation of precipitation/temperature?

(2) Is temperature the only or even the principal control on the elevational (or latitudinal?) distribution of juniper and limber pine?

(3) Is the elevational displacement of juniper and limber pine as a temperature indicator applied consistantly throughout the record?

(4) Is a single vegetational-climatic point like Ely representative?

To address (1):

TABLE 3: Spaulding, 1983.

Table 8.—*Estimates of minimum displacement of Utah juniper and limber pine and resultant calculations of the full-glacial decline in summer temperatures for southern Nevada*

[Lowest elevation fossil record for Juniperus osteosperma is from Mehringer (1967); lowest record for Pinus flexilis is from Spaulding (1981). ΔT_s, relative decline in full-glacial summer temperatures; °C, degrees Celsius; m, meter]

Species	Lowest fossil site; elevation	Present lower limit	Minimum displacement
Juniperus osteosperma	Tule Springs, Las Vegas Valley; 700 m	1,900 m	1,200 m
Pinus flexilis	Willow Wash-4, Sheep Range; 1,585 m	2,650 m	1,065 m

Lapse rate calculations of ΔT_s

Lapse rate[1/] (C°/100 m)	Minimum displacement	ΔT_s
-0.60	1,200 m	-7.2°C
- .70	1,200 m	-8.4°C
- .75	1,200 m	-9.0°C
- .60	1,065 m	-6.4°C
- .70	1,065 m	-7.5°C
- .75	1,065 m	-8.0°C

[1/] Values from Major (1977).

Major (1977) points out the paucity of high elevation stations usable for lapse rate calcuations in the colder Great Basin. The single exception is the White Mountains, which Spaulding uses (0.6 to 0.75°C/100m, Table 8, attached). In the montane west modern lapse rates vary from 0.33 (the west slope of the Sierra Nevadas and the Cascades and Mediterranian California) to 0.86°C/100m (Wyoming). This variation may be in part be a function of precipitation and assessibility to maritime air. Variation in the Mohave itself is large, from 0.51 to 0.9°C/100m. In general, there is a broad variability of lapse rates in the West, and a paucity of data (n=1) at high elevation in the Great Basin. It therefore appears tentative to predict full-glacial temperatures to within a degree or two centigrade using such a data base, especially if full-glacial precipitation was higher.

(2) Wells (1979) argues that the principal control on the latitudinal distribution of juniper versus elevation is the quantity of summer rain. In other words, the higher the summer rain, the lower the elevation of the base of the woodland boundary. The elevation of that boundary decreases from the Great Basin southeast towards the Sonoran and Chihuahuan Deserts, the same direction that summer rain increases. Spaulding also points out that the main control on the location of the lower woodland boundary is summer evaporational stress. The implication is that it is the interplay of precipitation and temperature that is determinant. However, Spaulding seems only to admit to the role of temperature in his analysis. A graph from Wells(1979) shows that the elevation of the woodland limits varies consistently with latitude. Each point on the linear regression of his data points defines a unique temperature-precipitation value. Thus, within a range of values, this boundary can be defined by a number of different precipitation-temperature conditions. In fact, Wells (1979) warns against the all-temperature approach in the interpretation of the fossil plant evidence. He cites the examples of Brackenridge (1978) as misinterpreting the packrat data in strictly temperature terms.

Beeson (1974) presents a different and more complex picture of pinyon - juniper ecology. Based on his own and on Billing's (1954) data, temperature inversions in closed basins exercise the principal control on the conifer distribution. Cool air occurs at the higher elevations, and at lower elevations where cool air ponds in valley bottoms. The elevations between are warmer, allowing juniper-pinyon to grow. Beeson (1974, p. 47), after Niering, et. al., (1969), sees the duration of cold stress, not minimum temperatures, as determinant. Where basin temperature inversions are disrupted by frequent cyclonic storms and low orographic barriers in the northern portion of the state, pinyon and juniper do not occur. Within these temperature tolerances, the presence and relative frequency of pinyon vs. juniper is in part precipitation controlled. In particular, the quantity of juniper decreases with increasing summer soil moisture stress in areas where pinyon can persist (Beeson, 1974, p. 53).

At present, moisture stress probably controls the lower elevational extent of conifer woodland in the southern Great Basin, as noted by Spaulding. But in practice, Spaulding seems to ignore the role of precipitation by attributing woodland displacements only to temperature changes. In addition, winter cold inversions, not summer moisture, may have played a role in conifer distribution in the southern Great Basin during the full-glacial as it does in the central and northern parts now. If such conditions existed, Spaulding may wrongly attribute the presence of juniper alone to more xeric conditions, instead of full-glacial cold stresses due to inversion.

In answer to (3), Spaulding does not apply his use of woodland displacements to the latest Pleistocene in estimating summer temperatures. This is the same inconsistency that he displayed with regard to creosote bush. Juniper-pinyon shows as much as 700 to 900m of displacement during that period (see the Last Chance Range middens, Spaulding, p. 62). By using Spaulding's technique, this should indicate average summer temperatures 5 to 6°C below modern. Instead, Spaulding predicts summer temperatures 1 to 2°C above modern for the period (Table 2). This constitutes a 6 to 8°C discrepancy. Therefore, either the use of downward displacement of the woodland boundary to predict strictly temperature differences is invalid, or Spaulding's latest Wisconsin summer temperature estimate is in need of radical adjustment.

In answer to (4), Ely is only a single data point, and at that it may not be representative. The weather station at Eureka (Table 4 [from Spaulding, 1983, Table 4]), a town in central Nevada also at the woodland-desert shrub boundary, shows annual temperatures 6 to 7°C below modern and 60 to 70% greater precipitation than values for the packrat midden sites. This amount of precipitation is quite different from Spaulding's annual estimate (see Table 3, 18,000 years), and yet Eureka lies at the base of the woodland boundary.

A last point should be made concerning Spaulding's et al's., (1984) discussion of the composition of full-glacial middens from the Eleana Range. In addition to the use of creosote bush and of woodland displacements in his climatic estimates, he cites several other plants as indicative of "cold, dry" conditions. This is a reasonable statement, qualitatively. These plants include limber pine, sagebrush, horsebrush, and rabbitbrush, among others. However, Spaulding does not cite specific tolerances (because they are not documented, to our knowledge) of these plants. Limber pine exists at precipitation values 100% greater or more than what he interpretes for the full-glacial at the Eleana site. This is true for the other plants as well, which also have fairly wide precipitation/temperature tolerances. None of these plants necessarily confirm Spaulding's specific estimate (Ta = 6°C and Pa = 30 to 40%) based on other plants.

The above illustrates the basic shortcoming of this attempt at a quantitative estimate: the ecology of too few plants is well understood. Aside from creosote, the exact tolerances of these plants are not known beyond a range of possible interdependent values representing "dry" (how dry?) and "cold" (how cold?). Indeed, this and other packrat midden studies are not limited for a lack of well-dated fossils, but by a lack of well-documented modern analogs. We suggest that study of the ecology of the modern plants is an urgent need.

Conclusions: major questions arise as to the validity of some Spaulding's quantitative interpretations of climates. They are internally contradictory, and in one case rest on poorly documented lapse rates. Probably most importantly, his quantitative estimates rely on the ecology of only three

TABLE 4: Spaulding, 1983, Table 4.—*Temperature and precipitation data from six stations in Nevada*

[Data from U.S. Weather Bureau, 1965, and Environmental Data Service, 1961-78.
Abbreviations for vegetation types are: Gds, Great Basin desertscrub; Mds, Mojave desertscrub;
wd, pinyon-juniper woodland. m, meter; mm, millimeter; °C, degrees Celsius]

Station (vegetation)	Beatty (Mds)				Winnemucca (Gds)				Elko (Gds)			
North latitude; west longitude	37°00'; 116°43'				40°54'; 117°48'				40°50'; 115°47'			
Elevation (m)	1,082				1,311				1,547			
Parameter	Average temperature (°C)			Average precipitation (mm)	Average temperature (°C)			Average precipitation (mm)	Average temperature (°C)			Average precipitation (mm)
	January	July	Annual		January	July	Annual		January	July	Annual	
1931-60	---	---	---	---	-2.1	21.7	8.8	215.1	-4.9	20.8	7.4	248.4
1961-78	5.2	26.3	15.0	134.6	-1.2	22.3	9.4	205.4	-3.9	21.2	7.9	254.4
	1/ 16	1/ 16	1/ 9	1/ 17	---	---	1/ 17	1/ 17	---	---	---	---

Station (vegetation)	Austin (wd)				Eureka (wd)				Ely (wd/Gds)			
North latitude; west longitude	39°30'; 117°05'				39°31'; 115°58'				39°17'; 114°51'			
Elevation (m)	2,014				1,994				1,906			
Temperature and precipitation parameter.	Average temperature (°C)			Average precipitation (mm)	Average temperature (°C)			Average precipitation (mm)	Average temperature (°C)			Average precipitation (mm)
	January	July	Annual		January	July	Annual		January	July	Annual	
1931-60	-1.3	21.1	8.6	302.3	---	---	---	---	-5.6	19.7	6.8	221.0
1961-78	-.8	21.4	8.6	364.9	-2.1	21.0	8.0	348.6	-4.9	19.7	6.8	244.7
	1/ 17	1/ 17	1/ 14	---	1/ 14	1/ 14	1/ 14	1/ 14	---	---	---	---

1/ Number of years of record (1961-78) if less than 18.

plants for which the temperature-precipitation controls are misquoted, or are debated. A large body of evidence of other fossilized plants does not enter into the quantitative anlysis for lack of a precise (as to temperature and precipitation) understanding of their modern ecologies.

Based on this examination of Spaulding's (1983) work, major questions arise as to its quantitative validity. These quantitative estimates should be reconsidered due to the risk of not anticipating the extreme case for moisture effectiveness and therefore for marked increases in flux to the repository horizon during the life of the repository.

B. GEOHYDROLOGY GUIDELINE

DEA Section 6.3.1.1 Geohydrology Guideline (10 CFR 960.4-2-1)

> "The present and expected geohydrologic setting of a site shall be compatible with waste containment and isolation. The geohydrologic setting, considering the characteristics of and the processes operating within the geologic setting, shall permit compliance with (1) the requirements specified in Section 960.4-1 for radionculide releases to the accessible environment and (2) the requirements specified in 10 CFR 60.113 for radionuclide releases from the engineered-barrier system using reasonably available technology."

Specific comments are made on DEA Sections:

6.3.1.1.1, 6.3.1.1.2, 6.3.1.1.3, 6.3.1.1.4, 6.3.1.1.5, 6.3.1.1.6, and 6.3.1.1.7. Section 6.3.1.1.6 is the qualifying condition on the postclosure geohydrology guideline.

We comment here on the entire section 6.3.1.1 and these comments apply in addition to and in conjunction with specific comments made for each section and general comments made concerning vadose zone hydrology and ground-water hydrology.

Our comments commence by reviewing Table 6-15 (pages 6-114 through 6-118) which are a summary of analyses for Section 6.3.1.1 concerning geohydrology.

6.3.1.1. (Starting page 6-114), Table 6-15, Favorable Conditions.

> (1) We find that there are insuffient data to determine travel times. We find that the assumptions adopted to determine travel are not conservative; therefore, we find this condition is not present. Other general and specific comments support our statements here.

(2) We concur that this condition is not present, and note further that the degree to which the water-table position and flux are expected to be affected are unknown. Consequently, we do not view the affect on the isolation potential as determinable given either conservative assumptions or existing data.

(3) We concur that this condition is not present, and note further that site specific field data that would permit accurate modeling of the hydrologic system have not been established in similar environments. Therefore, it can not be assumed that the near-field and meso-field environments of the site can be modeled with reasonable certainty. Broad scale modeling (subregional) with reasonable certainty is judged feasible with a sufficient data base.

(4) (i) Analysis has not recognized fracture permeability. Low conductivity has therefore not been demonstrated.

(ii) It has not been demonstrated that there is a downward gradient in the host rock.

(iii) It has not been demonstrated that the hydraulic gradient is very low due to potential fracture flow in the host rock. It has not been demonstrated that the hydraulic gradient between the host rock and immediate surrounding geohydrologic units are very low since fracture flow is feasible.

(iv) It has not been established that the hydraulic gradient is low in the Calico Hills tuffs due to the potential for fracture flow.

(5) (i) We do not find that there are sufficient data to assume that the degree of host rock saturation is probably relatively constant over time. We find that this assumption is not

conservative, and therefore do not find that this condition is present.

(ii) In a fractured terrain it is not clear that this condition has been met with the quantity of data available.

(iii) We concur that this may be possible and also note that the condition may also channel all infiltrated water via fractures to the repository.

(iv) It has not been demonstrated with data that the host rock provides free drainage. However, this condition probably exists due to the extensive fracturing systems in the repository horizon and surrounding units. There are contradictory data as to the existence of free drainage. For example, the observed saturation in UZ-1 drilling, the T.V. borehole logs, the apparent highly permeable fractures from cores, and saturated zone pump testing point to different conclusions.

We note further that this statement is contradictory to statement (1) (Table 6-15, page 6-114). If in fact it is found that the system is free draining, then the anticipated radionuclide travel times may be significantly reduced.

(v) We find this favorable condition potentially misleading. Average annual historical precipitation is a small fraction of the average amount of potential evaporation. But this may not relate to site specific infiltration, percolation, and flux through a vadose environment. Short-term availability of moisture at land surface which greatly exceeds evaporation may cause significant infiltration and recharge in some arid environments.

6.3.1.1, (page 6-117), Table 6-15, potentially adverse conditions.

(1) The evidence indicates that this potentially adverse condition _is_ present at Yucca Mountain. Data and analysis to date indicate that substantial increases in recharge flux (15 X current) would result in fracture flow and greatly increase rates of radionuclide transport, as well as moisture contact with waste containers.

The geology (hydrogeology) of the proposed site at Yucca Mountain encompasses a host of issues related to acceptability of the vadose environment for a high-level nuclear waste repository. It has been postulated that an arid climate vadose zone may prove acceptable for such repositories. However, there is little detailed knowledge of the hydrogeology of such environments.

The site proposed by the DOE within welded and highly fractured tuff constitutes an extremely complex and difficult environment to confidently characterize. The moisture regime in this proposed environment is still essentially unknown. What little is known from possible analog environments, such as Rainier Mesa of the NTS, is not particularly encouraging with respect to certain licensing criteria. However, important differences in the moisture regimes could exist between Yucca Mountain and Rainier Mesa. Therefore, careful _in situ_ assessment of Yucca Mountain is required. The most obvious differences are the greater amounts of winter moisture available at Rainier Mesa. However, at Rainier Mesa, moisture contents are high, and fracture flow, with some seasonal pulses, is present in some fractures intercepted by tunnels and boreholes.

In most cases the existing data base and general understanding of the proposed site is so limited that clear conclusions are not possible. We believe that the DOE should have carefully and objectively applied the siting guidelines (6.1.2 on pages 6-3 and 6-4). We demonstrate that conservative analyses have _not_ been made by the DOE for a number of site suitability questions. Conservative analyses should, when possible, address the site selection questions with as many different analytical approaches as possible. Such an approach maximizes the utility of a limited data base. As the data base and fundamental knowledge is so limited, it can be (and has been in some cases) misused to create misleading quantitative results. The conceptual model of the vadose zone is also essentially unsupported by sufficient in situ data or experience in approporiate analog environments. It is, therefore, little more than subjective opinion. Travel-time analyses applied to only one unsubstantiated conceptual model is not a conservative approach to site selection.

The pre-waste emplacement ground-water travel time of more than 10,000 years, along any path of likely radionuclide travel to the accessible environment, is open to serious question. Conservative analyses using existing data demonstrates that the vadose zone travel times could be very prolonged, as postulated by the DOE. Or travel times may be much shorter (approximately 1000 years while using the matrix flux conceptual model), as demonstrated in the following section on the vadose zone. Travel times were estimated from hydraulic properties of the assumed travel path in fractured terrain. However, these estimates are highly suspect and essentially meaningless when hydraulic gradients, effective porosities, bulk hydraulic conductivities, matrix hydraulic conductivities, and true travel paths are not well known. Some of these properties and parameters can vary from less than one order of magnitude to as much as three or four. The associated calculations of travel time also may vary accordingly in magnitude. The confidence that should be placed on such calculations in the absence of other, independent evidence is very low.

Two other approaches to travel time are possible. One is use of input/output hydrologic models. Indirectly this approach has been briefly addressed in reference documents. It has been suggested that if vertical flux is greater than about lmm/yr, fracture flow may occur. However, the values of either input or output are uncertain as well as the hydraulic conductivity of lmm/yr. There is little basis, therefore, to adopt this approach at the present time. Indeed, if the postulated recharge value of 4.5mm/yr were adopted as input, fracture flow may occur or even dominate. Actual travel time within the vadose zone may be much shorter than travel times calculated thus far.

The other recognized method of calculating travel times is by estimating water age with tritium and carbon-14. In spite of all the DOE efforts at site characterization thus far, and the potential utility of the approach in fractured terrain, the data base for this approach is scanty. All reported water-chemistry samples and associated data seems to relate to samples of opportunity and not to a carefully designed hydrogeochemistry program directed at understanding the regional and local hydrology of Yucca Mountain. Because of this, only a few water samples have been collected that give perspective on vertical water-chemistry differences. No samples have been reported from the unsaturated zone. In summary, we find the DOE hydrogeochemistry program to date to be undeveloped. DOE has not recognized the potential utility of a carefully designed water sampling program with three dimensional control. Absence of such a data base currently hinders the following hydrogeochemical assessment of travel time, direction of flow, and recharge or source relationships.

Consideration of limited data base of hydrogeochemistry in and around the repository allows another perspective on travel times. This method is uncertain because of problems in correcting apparent carbon-14 ages and obtaining water samples from known hydrostratigraphic depths. Combining the water-table maps which indicate a generally southerly flow direction, with carbon-14 age dates, it would seem possible to estimate travel times. The ground-water ages directly under the proposed site appear to have a corrected carbon-14 age of about 10,000 years. Since the corrected age of the ground water north (upgradient) of the Yucca Mountain Site is also 10,000 years, two scenarios exist: 1) ground-water movement beneath the site is extremely rapid; and/or 2) a substantial amount of rapid recharge occurs through Yucca Mountain. The first scenario is perhaps supported by the relatively flat water-table gradient beneath the site. The second scenario implies rapid recharge fluxes, much greater than the DEA estimate of 1 mm/year. The ratio of the two waters (Yucca Mountain recharge and northern underflow) is unknown and obviously research is needed in this area. Another problem is evident in comparing ground-water age from Yucca Mountain versus that from south and southwest of Lathrop Wells, the apparent discharge area (Waddell, Robinson, and Blankennagel, 1984). The apparent average age of the two waters is approximately 13,000 years, with the corrected ages approximately 10,000 years. This could be interpreted as very rapid flow or mixing with younger ground waters. A proposed source of younger ground water is recharge along Fortymile Wash (Claasen, 1983). The corrected age of this water is approximately 5,000 years, which is younger than the other two ground waters. The problem with this hypothesis is that the stable isotopes of oxygen and hydrogen, which fingerprint the water molecules, indicate that very little of the water discharging in the Lathrop Wells area was recharged through Fortymile Wash. Other waters that may mix with Yucca Mountain ground waters and discharge near Lathrop Wells are all older waters. They could not dilute the ground-water ages substantially. The stable isotopic composition of waters from Yucca Mountain and Lathrop Wells are nearly identical and therefore only small amounts of ground waters from the Fortymile Wash area could be mixing with this system. The conclusions that follow from the above relationships are: 1) The hydrogeochemical data that exists are indicating travel times that are not consonant with those calculated with hydraulic properties and assumptions, and 2) the general approach may prove of value in developing a better understanding for the hydrogeology of the fractured terrain.

The previous comments are primarily related to the saturated zone, but the approach should be used on the vadose zone if sufficient water-chemistry data can be developed. The travel time of the waters in the vadose zone, especially waters traveling in fractures, is most likely rapid. The travel velocities in fractures within the Rainier Mesa vadose zone have been estimated at meters/day. The Yucca Mountain ground waters, which are likely admixed with older water from other areas, date at only 10,000 years old. This is inconsistent with the DEA postulate waters take 20,000 years or more to travel from the bottom of the repository to the water table, or 25,000 years to travel from the surface to the water table as presented on page 6-121. We conclude that either the carbon 14 age estimates are seriously in error, or the travel time estimates of the DEA are in serious error.

Tritium determinations, very useful to establish rapid travel times in recharge environments, are not widely available or are not reported. Bomb tritium appears in water samples from two wells along Fortymile Wash, indicating very rapid travel times in the vadose zone through the alluvium and underlying tuff. However, we find no tritium analyses reported for Yucca Mountain water samples, and indeed, we are aware of no samples or analyses for perched zone water encountered in UZ-1 and H-1. This is unfortunate, because both tritium and carbon-14 analyses would greatly aid in the resolution of the importance and presence of fracture flow versus matrix flow, and therefore aid in the resolution of travel time questions in the vadose zone.

Vadose Zone Hydrology

The Yucca Mountain DEA does not present a comprehensive view of vadose zone hydrology, and does not consider all of those available data. In order to thoroughly review the DEA, the mass of supporting documents (references) have been reviewed to link raw data to conclusions drawn in the DEA.

For a review of the vadose zone sections of the DEA, the following documents are of paramount importance and have been used extensively in this review:

Montazer and Wilson, (1984)
Weeks and Wilson, (1984)
Peters *et al.*, (1984)
Travis *et al.*,(1984)
Sinnock *et al.*, (1984)

Characterization of the vadose zone at Yucca Mountain will be a very difficult process. Although soil/water interactions have been studied extensively for agricultural purposes for many years, little work has been done on movement of water and solutes in low matrix permeability or in fractured rocks under high matric potentials. Although the DEA does not discuss this lack of a theoretical/ field data base, the key references acknowledge this fact.

Based upon our current level of understanding of the vadose zone, several generalized comments are presented on two areas of the DEA analysis of flow in the vadose zone. In the first comment, the approach of the conceptual model will be analyzed with respect to available data. The second area of discussion will be the calculation of travel times and their unreported uncertainties.

Conceptual Model -

The conceptual model used in the DEA appears adequate to describe some of those data gathered to date. We are concerned, however, that other, more-or-less favorable models could have been chosen to fit these data as well.

In general, it does not appear that enough data have been presented (or are available) both in the DEA or in the cited references to judge the validity of the adopted conceptual model. Nor has the DEA presented any other conceptual models which might fit the existing data base. For example, one plausible conceptual model would encompass both matrix flow in the non-welded units and localized fracture flow in the more densely welded units. This fracture flow might be very localized, perhaps due to heterogeneities in rock hydraulic properties or to the effects of topography on recharge, i.e., concentration of recharge below washes. Unfortunately, those available data make any conceptual model difficult to prove or disprove. The limited number of deep, vadose zone drill holes (2) where fracture water would be easily detected is not sufficient to statistically sample the vadose zone. Even with a large number of drill holes, the likelihood of encountering fracture water may be quite small. This type of probability could be very roughly estimated by using perched water data from Rainier Mesa. In the case of Rainier Mesa, the ratio of fracture water encountered to rock volume samples is quite low. This ratio at Yucca Mountain, with considerably less precipitation may be even smaller. Since available data are insufficient to overcome the low probability of encountering fracture water, it is suprising that only limited attention is paid to it. Since several conceptual models potentially fit the present sparce data base, the DEA should report the wide range of conceptual models and their associated likelihoods. This would provide a better understanding of the ranges of conditions possible at Yucca Mountain for site selection considerations.

One particular area that the conceptual model does not fit existing field data is the vitric member of the Calico Hills. In the context of DEA's unit hydraulic gradient approach, the water flux, q, is exactly equal to the hydraulic conductivity, $K\ \theta$, of the formation at the water content found in the field. Since the DEA has assumed a one dimensional steady state flow system in its vadose zone travel time calculation, the flux going into the system (through the Tiva Canyon) must equal the flow of water to the saturated zone. Since the conductivity of each formation is a function of its degree of saturation (water content $\div$ saturated water content), it is possible to construct the water content profile expected at Yucca Mountain given the input flux and the relationship of conductivity to water content for each formation.

Given this analysis, it is expected that units having high saturated matrix conductivity (Paintbrush nonwelded tuff, vitric Calico Hills) would have low water contents in order to match their conductivities to the flux from overlying units. Field data, however, indicates that this adjustment has not occurred in the vitric Calico Hills unit. Its reported water content is 33% (Montazer and Wilson, 1984). Those data presented in Peters et al., (1984) indicates that the conductivity at this water content is several orders of magnitude greater than the 2.7 X 10^{-6}m (1mm/year) flux reported in the DEA through the vitric Calico Hills.

These data would indicate that, under the conceptual unit gradient approach, a much higher flux is occurring in vitric Calico Hills unit than is estimated for recharge at Yucca Mountain. The existence or cause of this apparent flux is not addressed in the DEA and is ignored in the travel time calculations. Although its existence may be unrelated to the overall flux, it does pose questions as to 1) the validity of the conceptual model and the unit gradient approach and 2) the use of flux limiting conditions on travel time calculations. Unfortunately, no discussion or alternatives are given to explain the discrepency in the conceptual model.

Therefore, a valuable approach towards the acceptance of the conceptual model would be to conduct a series of simulations with realistic input parameters (recharge, duration, anisotropy, etc.). Outputs from such a study would give additional insight into critical parameters for Yucca Mountain and provide direction to field data collection necessary to verify the proposed conceptual model.

The capillary barrier approach should also be assessed from the view of wetting front instability. Although capillary barriers and restrictions have been designed, very few if any documented cases of natural capillary barriers exist in the literature. Hill and Parlange (1972) and Philip (1975) have studied capillary barrier breakthrough in layered soils under unsteady conditions and found that hydraulic gradients and conductivity ratios may play important roles in the ability of a capillary barrier to perform in field situations. Their analysis has given insight into the modes of failure (breakthrough) in natural systems. This type of analysis should be applied to existing data, as well as any data on continuity, variability and infilling of fractures between the Paintbrush non-welded tuff and the underlying Topopah Springs.

Travel Time Calculations -

As required by the National Waste Policy Act, a travel time calculation for each candidate site must be made to estimate the safety of the site. Those data available for each site are quite variable. Yucca Mountain appears to have some in situ data on the saturated zone. However, in situ data for the vadose zone are considerably less. Critical recharge calculations are based upon simple water-budgets developed for large ground-water basins, geothermal data, and core data, and not upon direct field measurement.

In water budget and geothermal modeling, the parameter estimate errors are of the same or greater order of magnitude as the flux calculation. Flux measurements therefore should not be taken as a single value, but instead should be treated as a random variable with a realistic confidence interval.

The use of core data in the DEA's travel-time calculations are also misleading due to their spatial variability. The DEA typically reports the single value of hydraulic conductivity. This value has been calculated from a limited number of cores whose conductivity distribution was taken to be log-normal. However, the DEA does not make use of the variance (or confidence intervals) of the conductivity process to give travel-time calculations a representative uncertainty. This is not a problem specific to the DEA. It is common to much of the Yucca Mountain supporting documents (Montazer and Wilson 1984, Weeks and Wilson 1984, and Sinnock et al., 1984). The range of measured conductivities spans four orders of magnitude. If one calculates a travel time using the unit gradient approach, the calculated travel time can also range over four orders of magnitude. In order to show the effect of including data variability, data presented in Table 6-17 (p. 6-139) were scrutinized by applying some rudementry statistics to calculate a range of travel times similar to Table 6-18 (p. 6-141).

The travel time calculations used in the DEA within the vadose zone assume Darcy's flow; such that:

$$\text{Travel Time} = \frac{\theta\ T}{K(\theta)\,i} \qquad (1)$$

Where i is the hydraulic gradient, $K\theta$ is the hydraulic conductivity, θ is the volumetric water content, and T is the unit thickness. In order to estimate a range of expected travel times, the variance of each of the parameters in Equation 1 must be accounted for.

Traditional statistics would suggest that the mean value of each variable, plus and minus one standard deviation, (σ) would encompass more that 60% of the range of a normally-distributed population. Although not strictly correct, a similar approach can be taken with the log-normal conductivity distribution to estimate a range of expected values. If $\mu_{\ln K}$ represents the mean of the log (conductivity) process, then a range of expected conductivities may be calculated as:

$$K_{min} = \exp\ (\mu_{\ln K} - \sigma_{\ln K}) \qquad (2a)$$

and

$$K_{max} = \exp\ (\mu_{\ln K} + \sigma_{\ln K}) \qquad (2b)$$

Unfortunately, the Yucca Mountain references do not report the values of $\mu_{\ln K}$ Typical values of $\mu_{\ln K}$ reported range from 0.4 to 3.6 (Bakr, 1976, Freeze 1975). As this example, we shall use the fairly low variance value reported by Bahr (1976) of 2.56 ($\mu_{\ln K} = 1.6$) for the Mt. Simon sandstone. This value can be used in equations 2a & b to estimate a range of conductivities. For the illustrative example, shown in Table 1, we have only varied the conductivity, although each of the variables in equation 1 also has an associated variance. The effects of these variances, although significant in the travel time calculations, may not be as significant as the conductivity variance. This fact does not however, justify the DEA's ommision of these data.

TABLE 1

CASE A*

UNIT	lnk	K_{max} m/d	K_{min} m/d	TRAVEL TIME (years min)	TRAVEL TIME (years max)
Topopah Spring	-12.74	1.4 X 10^{-5}	5.9 X 10^{-7}	978	23,218
Calico Hills Non welded (zeolitic)	-11.74	1.3 X 10^{-5}	1.6 X 10^{-6}	1404	34,247

CASE B*

UNIT	lnk	K_{max}	K_{min}	TRAVEL TIME (years min)	TRAVEL TIME (years max)
Topopah Spring	-12.74	1.4 X 10^{-5}	5.9 X 10^{-7}	978	23,218
Calico Hills (vitric)	-5.52	1.9 X 10^{-2}	8.1 X 10^{-4}	7.2	169

* Similar to Table 6-17 p. 6-139

Using this very simple statistical analysis, a range of vadose zone travel times of 1,000 years to 57,000 years is estimated assuming the conceptual model of matrix flux. This type of analysis points out the significance of the lack of treatment of the variability of the conductivity of the natural system. The use of a mean travel time calculation is misleading since we are not only concerned with the mean or peak concentration, but also with the first arrival of contaminants which is governed by the high conductivity zones of the system. By using the mean of lnk, the DEA has <u>not</u> taken a conservative approach.

Certain aspects of the conceptual model could be tested with available data, thereby removing some of the conjectural points. In particular, the effectiveness of the non-welded Paintbrush Tuff as a capillary barrier could be estimated using transient 2-dimensional computer simulations and the available core data. The literature has several fine examples of this approach (Frind, et al., 1976; Corcy and Horton, 1969). Frind, et al., estimates capillary barrier breakthrough in systems where the water entry pressure of the lower layer was exceeded at the interface. Critical factors affecting the breakthrough were rainfall intensity and cover slope. Frind, et al. (1976), also notes that the width, or length of run downslope of the capillary barrier will play a critical role in determining the effectiveness of the capillary barrier, although this aspect was not modeled.

Saturated Zone Hydrology

Site characterization plans (Section 6.3.1.1.7, page 6-142) are extremely vague. The saturated zone flow system is extremely complex with fracture flow undoubtedly dominant (p. 6-123). Fracture flow systems are extremely difficult to characterize/simulate on a scale necessary for this study, yet there is little indication of how the DOE proposes to do this (i.e., the suite of approaches/tests planned).

The ground-water models referred to frequently in the DEA -- Waddell's (1982) regional model and the subregional model of Czarnecki and Waddell (1984) -- need to be improved before they are used to estimate rates of radionuclide transport (it should be noted that both publications state this in their final paragraphs). Methods for improving both models are discussed in the respective reports; these methods rest primarily on the need for additional data -- particularly of the three-dimensional type. The DOE should also seek to collect data that would permit the use/development of models that can specifically account for fracture flow, which is the dominant type of saturated flow in the vicinity of the repository. The aforementioned models, as well as, the one of Rice (1984) are typical porous-medium flow models. Sufficient information must be collected so that three-dimensional modeling can be attempted, so as to incorporate vertical lithologic/hydrologic variabilities into the flow model; both modeling efforts recognized the need for this. Both models performed sensitivity analyses. A weakness in the flux sensitivity analysis of Waddell (1982) is that it did <u>not</u> account for the uncertainties due to possible violations of the basic assumptions of the flow model (i.e., homogeneous, isotropic zones; no vertical flow; steady-state system, etc. -- see p. 61). This flaw should be corrected in future efforts, since some of the assumptions are admittedly (even by the author) suspect. We assume that the sensitivity analysis of Czarnecki and Waddell (1984) took the same approach (not accounting for possible violations of the basic assumptions of the model).

The conceptual model of Winograd and Thordarson (1975) was the basis for that of Waddell (1982), which in turn was used by Czarnecki and Waddell (1984).

Although differences in the various conceptual models are recognized, we believe that more effort could go into testing different flow-system hypotheses than has been done up until now.

Water Table Configuration -

The DEA recognizes the fact that flow in the saturated zone is dominated by fracture flow (p. 6-123) and alludes to this fact frequently. However, nowhere in the DEA could one find reference to the realization that such a fracture flow system may result in a water table that is not a smooth surface as one might infer from Figures 6-2A (p. 6-127), 6-7 (p. 6-180), 6-8 (p. 6-208) and 6-12 (p. 6-265). In addition, the highly faulted nature of the region will further compartmentalize the flow system (see Figures 6-3, p. 6-138), 6-7, 7-8, and 6-12). Such compartmentalization could make accurate characterization of the water table extremely difficult. In such a case in which the water table is not smooth and the flow system is compartmentalized, the use of average hydraulic gradients (Eqn. 6-1, p. 6-137), bulk hydraulic conductivities and bulk (?) effective porosities (p. 6-137; Table 6-17, p. 6-139; Tables 6-18 and 6-19, p. 6-141) will lead to gross errors in travel time estimates.

As saturated zone travel times are currently believed to be substantially less than those in the vadose zone, such errors may <u>not</u> be as serious as they first appear. However, the use of more sophisticated ground-water flow models will require accurate characterization of the water table for calibration. In addition, predictions of water-table rises in response to climatic change mandate that the detailed shape of the water table is known.

Water-Table Rise -- Next 10,000 Years -

The DEA states (last paragraph, p. 6-1999 and second paragraph of Section 6.3.1.4.4, p. 6-200) that the water table will not rise more than 130m during the next 10,000 years and that this rise will not inundate the repository; Czarnecki (1984) is cited as the prime authority. The rise in the water table was obtained by subjecting a ground-water flow model to increases in recharge that would result from increased precipitation. The greater recharge from the higher precipitation was estimated by using the Ma✓ey-Eakin formula, an empirical approach that provides only approximations to ground-water recharge; such an approach has uncertain validity in a study of this importance. In addition, the model used may not be appropriate for flow in a fractured medium.

Calculation of Saturated Zone Travel Time -

The approach by the DEA to establish saturated zone travel time suffers from a difficiency of appropriate data as well as a paucity of data. There remains, in terms of confident application to travel calculation, serious gaps in the data base. Representative element volumes of terrain and associated hydraulic conductives or transmissivities and effective porosities would be necessary along the travel path with hydraulic gradient to demonstrate a generally acceptable or reasonably confident travel time for type of fracture and faulted terrain found in the area. Without these (possible only to derive through various multiwell pump and tracer tests) a data variance analysis should have been established similar to that suggested for the vadose zone to demonstrate the possible range in travel times in the saturated zone. The range in results, assuming effective porosity values were contained to one or two orders of magnitude, would still have ranged over several orders of magnitude. We believe the presented saturated zone travel time has very little basis in fact, and that not only a better data base in terms of the necessary hydraulic parameters is required in representative areas but also hydrogeochemical data using relative age relationships may prove necessary to combine with such data to extend the localized hydraulic property information to the scale of interest of travel times along the flow path to the assessible environment.

C. GEOCHEMISTRY GUIDELINE

DEA Section 6.3.1.2, Geochemistry Guideline (10 CFR 960.4-2-2).

> "The present and expected characteristics of a site shall be compatible with waste containment and isolation. Considering the likely chemical interactions among radionuclides, the host rock, and the ground water, the characteristics of and the processes operating within the geologic setting shall permit compliance with (1) the requirements specified in Section 960.4-1 for radionuclide releases to the accessible environment and (2) the requirements specified in 10 CFR 60.113 for radionuclide releases from the engineered-barrier system using reasonably available technology."

Specific comments are made on DEA sections:

> 6.3.1.2.2, 6.3.1.2.3, 6.3.1.2.4, 6.3.1.2.5, and 6.3.1.2.6. Section 6.3.1.2.5 is the qualifying condition on the postclosure geochemistry guideline.

We comment here on the entire section 6.3.1.2 and these comments apply in addition to and in conjunction with specific comments made for each section.

The issues of paramount importance with respect to geochemistry are the potential sorption characteristics of the host-rock within the reactive (near-field) and transport directions (far-field including fracture and matrix), and the geochemical interactions between radionuclides and the aqueous phases.

The USGS has identified potential transport paths as matrix and fracture conduits and has indicated a possible 1 mm/yr flux for saturated tuff and a higher flux for vadose fracture flow. It has been stated by various publications cited in the DEA that the actual flux rates are <u>not</u> adequately assessed. Comments on this issue are offered under our general comments for hydrology and paleoclimate, and for specific section/comments for almost all chapters in the

DEA. In summary of those comments, and in corresponding agreement with the literature, we find insufficient data to offer reasonable estimates of the flux rates and transport directions in the vadose zone.

We find serious voids in the geochemical characterization of the vadose water, since no information has been offered on this topic. Although J-13 well water has been offered as similar to Yucca Mountain ground water, we find significant variance in Eh and cation compositions in waters from the same well through time, from various stratigraphic water levels in the same well, and with respect to inter-well water correlations. Further, we find uncertainties concerning the Eh of J-13 water itself.

Knowledge of the geochemistry of the ground water (and vadose water) is fundamental to an understanding of its age, flux rates, travel-time estimates and radionuclide behavior and retardation capacity. Del carbon-14 and carbon-13, and tritium are significant measurements in aqueous geochemistry. Tritium data, in a usable format of sensitivity, are reported for very few samples (UE 29-a#2, UE 25b#1, and J-13), even though analyses have been completed on most aqueous samples. The void in comprehensive investigations in these areas seriously compromises the DOE geochemistry program to date.

We find tritium data for UE 29a#2 in Fortymile Wash indicative of a young water component (eg. within 30 years - assuming a base data of 1954). We note that there are strongly depleted values for del carbon-13 which indicate a soil-water contribution. Both of these forms of evidence disagree with del carbon-14 apparent ages indicating that there are carbon-14 problems in determining chronologies of ground water and that there have been significant influxes of water into Fortymile Wash within the immediate past. Further, we note tritium values in J-13 indicate a component of recharge within a 30 year period from present.

These data strongly suggest that infiltration rates and potential flux rates as described in the DEA are reasonably at issue. However, given the poor data base, we are unable to resolve the significant questions.

Lastly, as both iron and manganese are probably responsible for buffering oxygen in the ground water and vadose water, we would expect to see a discussion of data on these points in the DEA, expecially in the light of reported ferromanganese oxhydroxides along fracture conduits. These information are extremely important with respect to radionuclide transport and overall retardation.

Batch sorption studies (as reported on tables 6-21a & b, 6-22a & b, pages 6-154 through 6-157, and table 6-23 page 6-159) provide preliminary data indicating that the tuffs possess sorption (and desorption) characteristics for certain radionuclides (Heiken, 1982). Batched sorption studies used crushed-tuff in contact with J-13 water. Differences in sorption were recognized on the basis of differences in lithology, size fraction of the crushed-tuff, and radionuclide species. The correlations attempted between mineral content and batch sorption results were inconclusive; however, sorption of radionuclide species with respect to stratigraphic position were obtained. Batch sorption studies were also made under atmospheric and controlled atmospheric conditions. These data and crush-rock column study data were similar to batch sorption studies. These laboratory data indicate that, under the specific geochemical conditions for J-13 water with crushed-tuff matrix material, certain radionuclides show sorption characteristics. These data do <u>not</u> indicate that sorption, at the levels observed, will occur with uncrushed samples (whole-rock in a natural setting). This is because the surface area for reaction is considerably different, the access to potentially sorbing minerals under natural conditions may be limited due to perturbations in the flux (not all pore spaces have access to the aqueous system), and Eh and pH conditions in the vadose and saturated zones may not be approximated by J-13 water.

Heiken (1982) report uranium and plutonium solubilities as a function of various oxygen fugasities (atm), Eh from +700mV to -200mV, because the Eh potential of J-13 water is uncertain. They state: (page 285) "...it is possible that more than one oxidation potential may be required to define the state of the water from different tuff strata." They found (Heiken, 1982) that uranium complexes with carbonate, phosphate, and hydroxyl, whereas plutonium complexes with carbonate. The also found that the greater oxidation states contained significantly more complexes. They (Heiken, 1982, page 231) state: "Another aspect of a waste repository's geochemistry that must be understood can be inferred from these calculations. Both carbonate and phosphate complexes are important to the solubility of uranium and plutonium. If sources of these anions are available in the local minerals, the total quantity of available carbonate and phosphate could be greater than is indicated by an analysis of the water alone. A similar situation exists in calculations involving the Eh of the ground water. It is important to consider not only the Eh of the water, but also the oxidation-reduction capacity of the mineralogy. Although these calculations did not consider the local mineralogy, a comprehensive analysis of the solubility of actinides in natural waters must take the local minerals into account."

We find as a consequence of the review of these studies that sorption characteristics are present in the tuffs of Yucca Mountain and that the degree to which these tuffs will sorb radionuclides have not been determined.

One further area of concern appears in a drying-out scenario which has been brought forth in several Yucca Mountain support documents. Presuming the heat flux drives out vadose water from the near-field and keeps the near-field dry for a period of time, we expect a potential desalting of the vadose water in the near-field producing carbonate precipitates. The presence of these subsurface evaporites may influence significant uranium and plutonium (as well as other radionuclides) complexing, whereas previously such complexing might have been less significant. If this were to occur, sorption effectiveness would presumably be greatly reduced. It appears that such a scenario could be modeled in the laboratory as it might have bearing on the overall retardation question.

Variations in cation composition of the aqueous phases (vadose, tuff aquifer ground water, and evolved mineral water due to dehydration) relate to variations in CEC reactions with heulandite, clinoptilolite, mordenite, smectite, other zeolites, and ferromanganese oxyhydroxides. The stability of the zeolites are partially dependent upon the cation composition (and Si/Al ratios) in their supercage. Without accurate aqueous chemistry, mineral stability is undeterminable.

Sorption behavior of the authigenic mineral components in the system are also partially dependent upon their cation composition as this relates to supercage dimensions. Thus, the sorption behavior of Ca-clinoptilolite is not necessarily similar to the sorption behavior of the Na-clinoptilolite (none of the clinoptilolites are pure end member of the Ca or Na species, but have varying cation compositions and must be treated on this basis during sorption studies). Since the cation composition in the zeolites varies with stratigraphy and geography at Yucca Mountain, we expect so will the sorption capacity of these zeolites. We find very little reference to this problem in the Yucca Mountain literature, especially with respect to sorption.

We find that the present cation concentrations in the clinoptilolite (independent of their time of genesis) are probably a function of last exposure to vadose and ground water and are consequently related to the geochemistry of the aqueous system. Further, we find that clinoptilolite fractionation selectivities can be reconstructed by use of matched pore-water and zeolite chemistry (including Si/Al ratios) (see Boles and Wise, 1976, pages 235-243). If these data (Boles and Wise, 1976) are reconstructed on the basis of Yucca Mountain clinoptilolite compositions and DSDP site 214 clinoptilolite and pore-water, reasonable approximations of the composition of the aqueous phases can be determined. Nevertheless, matched zeolite and pore-water chemistry is non-existent for the site. Consequently, the technique is limited by a lack of data. This is unfortunate since it could be powerful technique for determining vadose transport, paleohydrology of Yucca Mountain, and sorption reactions with respect to vadose water chemistry.

Variations in plant and soil cover, infiltration rates and timing, and microclimes, are some of the factors probably responsible for chemical variations in near-surface vadose water. These variations may be transformed to slight, yet significant chemical differences in the mid to lower vadose stratigraphy. Consequently, mineral stability and radionuclide reactions with the aqueous phases may differ in the vadose zone. Similar differences for other reasons may be experienced in the saturated zone.

Variations in the heat flux due to physical parameters (intergrain connections, degree of welding, etc...) of the matrix may be responsible for less than an ideal heating envelope within the near and far fields of the repository. These variations may affect mineral stability, evolution of attached water, and provide less than ideal transport paths through the matrix and fracture system. In addition, the actual heating envelope may provide anomalous zones of hydration and dehydration, complexing mineral stability, vadose water chemistry, and radionuclide transport.

The distribution of unaltered volcanic glass and authigenic minerals have been documented for several cores on Yucca Mountain and these data are reported as a sound baseline for matrix mineralogy. A similar effort with respect to fracture mineralogy would allow the assessment of diagenesis within these features (keeping in mind the potential of fracture flow). There are reported differences in the zeolite distribution with stratigraphy in the Topopah Springs Member of the Paintbrush Tuff (the repository horizon) where zeolites range stratigraphically further in the fractures than they do in the matrix. We might surmise from these information the existence of a flux within the fracture system. However, there is a lack of comprehensive data to accurately assess transport paths and flux rates. The quantity of hydrated authigenics in fractures in the near-field are also a concern.

In addition, the transformation of glass to perlite can be modeled in accordance with studies completed by Doremus (1964) among other lines of study. No such modeling has been undertaken, however, for site characterization. The formation of smectites and zeolites from perlite is an issue of concern. The aqueous chemistry conditions can favor the formation of either a complex of phases, montmorillonite alone, or various zeolites such as heulandite, clinoptilolite, mordenite, etc.. Whether or not monimers, water-glass gels, and the accompanying cation compositions are produced, are complex issues which require attention. The ultimate problem with the DEA treatment is the inability to determine sorption as we have no handle on the authigenic phases which might be produced. The hydration of perlite and obsidian are dependent upon temperatures (Fick's Law), water flux, water chemistry, and glass composition. The vadose zone is the most likely candidate for hydration and vadose water chemistry has not been addressed. Without a comprehensive data bank on vadose flux and water chemistry, there is very little to offer on hydration rates. Experiments with J-13 water and tuff wafers certainly have not addressed this issue. White, et al. (1980), have looked into dissolution of glass with respect to Rainier Mesa and its effects on ground water. These information are not sufficient to understand reactions at Yucca Mountain, nor are these studies comprehensive enough to form a predictive baseline for Yucca Mountain.

Phenocryst behavior with respect to leaching and authigenic mineral precipitation has been sparsely studied. The potential production of ferrugenous and ferromanganiferous oxyhydroxides require attention and certainly mineral identifications (using micro-techniques) are required. It is important to know which iron and manganese phases are present because they have different sorption characteristics (ie./due to aging reactions and crystal field chemistry considerations). It is also important to assess crystal size and surface area more so than volume when considering sorption, diffusion, etc... Volcanic glass (perlite and obsidian) has been shown in the open literature to provide sorption, yet this potentially favorable reaction has not apparently been adequately addressed in the Yucca Mountain literature.

The geochemistry of water evolved from mineral and perlite dehydration is unknown; yet, this aqueous phase may either combine with free vadose water or react directly with the waste. Thus, we expect to see some variation in vadose water chemistry as a consequence of repository heating. These changes may be significant to waste leaching (changes in Eh), and far-field mineral stability and sorption. Data presented on distilled water, and J-13 wafer reaction with tuff, do not approximate vadose water chemistry.

The reversibility of zeolite and clay dehydration does not indicate that sorption characteristics will remain similar after rehydrating. The release of certain cation species and the entrapment of others (ion sieving) during dehydration may affect a significant change in supercage behavior with respect to re-hydration and sorption. General statements in the DEA concerning this issue simplify a complicated topic without considering the important aspects which may be responsible for driving the chemical reactions.

In addition to sorption, diffusion, and catalysis with respect to surface reactions, retardation of radionuclides is also dependent upon complexing and upon chemical reactions. The quantity of organic material, and the Eh of the water have much to do with inhibiting or promoting colloidal transport. Ogard and Kerrisk, (1984) report a fairly wide range in Eh for the ground waters of Yucca Mountain and nearby areas. They suggest that the Eh for vadose water should be greater than 400mV (oxidizing) with probable lower HCO_3^- content than most well waters. In addition, they suggest calcium will be higher and sodium lower relative to ground water. These predictions indicate that there could be significant differences in vadose waters from saturated zone water and that significant effects on radionuclide transport could result (as well as mineral stability). Garrels (1967) show that the initial CO_2 content of the surface waters and the extent of CO_2 conversion to HCO_3^- will have a very significant bearing on vadose pH. This, in turn, affects canister corrosion rates, clay and zeolite production, and overall sorption. The absence or reduction of soil cover due to construction activity should reduce plant coverage, soil-water reactions, organic concentration, etc... The results of these actions may be predictable from close system modeling, but as yet their significance is undetermined. Based on our field observations and literature reports, soil carbonates and caliche skins on fractures and matrix will also provide pH reaction control. The extent of these potential reactions are also undetermined. In particular, the ability of carbonate to complex radionuclides is critical in light of the abundance of carbonate fracture coatings. Consequently, it is difficult to assess the chemistry of the vadose system with such a void in baseline data collection.

We have serious concern about the integrity of the repository and vapor phase transport as gas and water vapor. Our concern stems from the potential of open fractures extending to the surface (bioenvironment), and from the potential for convective flux. We do not consider the present topography and structure as a closed system. We see it as potentially open. Noble gases released will have flux rates partially dependent upon repository temperatures. Tritium certainly is soluble in water vapor and is transported by this mechanism. The behavior of the other radionuclides remains to be investigated.

Simplistic statements (6-188) on this issue in the DEA detract from the competency of the document. Further, we expect the presence of a gas phase will influence reaction temperatures, kinetics, as well as potential radionuclide, cation and anion transport. We see this as a potential complicating issue in the determination of mineral stability, retardation, and vadose water chemistry.

In summary, based upon the available literature (Yucca Mountain Project and Journal literature), there is insufficient data to assess the sorption potential, retardation with respect to parameters other than sorption, and radionuclide transport rates and directions to the accessible environment. Our inability to make an assessment does not indicate that the Yucca Mountain site is inappropriate or appropriate for characterization. We do feel, however, that the DEA has not provided a conservative assessment. Further, it appears that some DEA conclusions are beyond the intent of the support literature.

We therefore suggest a revision of this section be made from a context of providing bounding conditions that will withstand nominal scrutiny by the scientific community. If a comprehensive data baseline is not available, it should be so stated.

D. EROSION GUIDELINE

6.3.1.5 Erosion Guideline (10 CFR 960.4-2-5) relating to Section 960.4-1. DEA page 6-204 paragraph 1:

> "The site should allow the underground facility to be placed deep enough to ensure that the repository will not be uncovered by erosion or otherwise adversely affected by surface processes."

DEA pages 6-204 through 6-214, specific comments on sections 6.3.1.5.1, 6.3.1.5.3, and 6.3.1.5.4.

We find that the erosion issue is adequately treated. However, related to this issue we find fracture access to the bioenvironment to be a potential problem which is inadequately treated in the DEA. In addition, we have questions about the western flank of Yucca Mountain as an area which does not allow the lateral extension of the repository block, which has the repository horizon cropping out and consequently could provide fault and fracture access to the bioenvironment.

E. DISSOLUTION

DEA Section 6.3.1.6 Dissolution (10 CFR 960.4-2-6).

"The site shall be located such that any subsurface rock dissolution will not be likely to lead to radionuclide releases greater than those allowable under the requirements specified in Section 960.4-1."

DEA pages 6-214 through 6-218.

Knauss, (1984) indicated solution changes in biotites and feldspars when the Bullfrog Member Tuff was exposed to J-13 water at 150° C for several months. Unidentified secondary authigenic phases also formed. We do not find similar experiments for the proposed repository horizon. Consequently, we do not know what solution reactions might occur. Further, we do not find experimental reactions with Yucca Mountain water from the saturated or vadose zone. Therefore, we are uncertain how close the Knauss (1984) experiments come to predicting the behavior of the repository tuff.

There are several pertinent considerations. Determination of mineral stability with respect to dissolution depends upon: (1) knowledge of reaction rates which tend to be exceedingly slow in the laboratory and in nature and (2) energetic configuration (atomic) of the silicates is complex and subtle. Consequently, the determination of the thermodynamics for silicates is difficult. Mineral stability as a function of solution greatly depends on the crystal chemistry of the mineral and the contact solution. Little if anything is known concerning the aqueous chemistry in the vadose zone. The absence of these information in conjunction with difficulties in characterizing the behavior of the minerals themselves provides a poor base for objective discussion of the dissolution of the host rock at Yucca Mountain.

Our primary concerns are the stability of secondary mineralogy in pores, perlitic debris, secondary mineralogy, and less stable phenocrysts in fractures. We have observed carbonates in pore fillings in the bedded sequence above the repository and as fracture coatings throughout the tuff sequences at Yucca Mountain. Changes in carbonate solubility might either provide increase or decrease matrix and fracture flow. The stability of clays and zeolites are of obvious concern. The repository matrix shows relatively low concentration of these authigenics, although their concentration in the fracture system may prove to be more abundant. We note also that perlitic debris below and above the Topopah Spring Tuff could be subject to dissolution. The potential significance of these reactions are again not determinable from the available data. The temperature of the reacting fluids and their alkali concentrations have much to do with the potential reaction rates.

The affect of potential changes in flux and water chemistry on dissolution are important issues at Yucca Mountain (see Lipman, 1965; Noble, 1967; Benson, 1976; White, 1979; Classen and White, 1979; and White and others, 1980;). The discussion in the DEA totally ignores the above authorities. The near-field emplaced repository does not offer STP conditions. Some minerals apparently stable or metastable under normal conditons experienced prior to near-field heating may no longer be in apparent equilibrium with the imposed changes in their environment (see Benson, 1976). Laboratory modeling of short duration may not be adequate to assess longer term reactions. Guzowski, et. al., (1983) report: "Experimental studies and field observations of ground-water compositions at Rainier Mesa suggest that the dissolution of glass in the Paintbrush Tuff and tunnel beds exerts a dominant control on ground-water chemistry (Benson, 1976; Classen and White, 1979; White and others, 1980)."

Consequently, we find that the host rock tuffs provide significant chemical interactions with the ground-water system, which greatly affects aqueous chemistry. Changes in aqueous chemistry are certainly related to concerns with respect to radionuclide transportation among a host of other issues.

Additionally, we presume that reactions occuring during the Quaternary Period were not necessarily influenced by proposed repository conditions. Consequently, the apparent absence of significant dissolution evidence from this period does not argue toward anticipated future conditions.

There is no evidence, based on our arguments and a review of the available literature to presume that dissolution of any significance will occur that would lead to radionuclide releases greater than allowable. Moreover, there has been insufficient data collected to assess the issue in a comprehensive manner. We do find that dissolution may be significant with respect to aqueous chemistry, mineral stability, sorption, and radionuclide transport.

We conclude that site characterization studies beyond those described are required to assess the issues in question.

F. TECTONICS

DEA Section 6.3.1.7 Tectonics (10 CFR 960.4-2-7).

"The site shall be located in a geologic setting where future tectonic processes or events will not be likely to lead to radionuclide releases greater than those allowable under the requirements specified in Section 960.4-1."

DEA pages 6-219 through 6-235.

There is an apparent relationship between the number of faults in the Yucca Mountain area by age group and the frequency of volcanic activity with time. On this basis, we anticipate some faulting to have occurred between about 700,000 and 240,000 years ago (as indicated by the potential volcanic fault correlation). With respect to frequency of volcanism we anticipate approximately two significant events in 1×10^6 years (as is the approximate pattern for the last 4×10^6 years). We note that spacing between the more recent basaltic events can be as close as 30,000 years. Since we have not seen any volcanism since the last 240,000 years and spacing has been as little as 30,000 years between events, there is some possibility that volcanic activity could occur within the immediate future.

The DEA (page 6-222) cites Crowe, et al., 1982, for the most recent probability calculation for basaltic eruptions at a site on Yucca Mountian, as: "..range from 4.7×10^{-4} to 3.3×10^{-6} for a 10,000 year period." The annual probability as calculated in USGS-OFR-84792 (1984) conforms to the cited calculations as 4.7×10^{-8} to 3.3×10^{-10}. The USGS (84-792) suggest that "These numbers can be used for probablity bounds where the worst - and best - case approaches are defined by the extremes of the probability ranges." The probabilities were calculated (USGS-OFR-84-792) in accordance with:

$$P(t) = \exp(-\lambda tp)$$

The rate of volcanic events = lambda, and was calculated as: (1) the annual rate of magma production and (2) by the number of volcanic cones using refined age data, (that is refined in 1982, by Crowe, et. al., updating data from Crowe and Carr, 1980). USGS-OFR- 84-792, page 831 states:

"(3) Understanding of triggering mechanisms or of the specific conditions leading to generation of basaltic magma is insufficient to predict future rates of basaltic activity."

"(7) Phreatomagmatic eruptions have occurred at four basalt centers in the Candidate area. Such eruptions are less likely at Yucca Mountain due to the combination of deep ground water, the apparent lack of perched ground water or local surface water, and the low flux of moisture in the unsaturated zone, (Crowe and others, 1983b). The principal condition that could lead to increased concern about future phoreatomagmatic activity could be the recognition of future development of perched groundwater."

We find our suggested reasonable possibility for alkalic basalt volcanic activity no more or less probable than the methodology used by Crowe and Carr, 1980; Crowe, et. al., 1982; and USGS-OFR-84-792. We concur with the statement #3, cited above, and note further that there is insufficient data to construct predictive models. However, we believe there is ample water in the saturated zone of the fractured tuff sequence at Yucca Mountain for phreatomagmatic activity.

IV. CORRELATING SPECIFIC COMMENTS SECTION

Topic:	Comment Sections (DEA):

Infiltration & Precipitation:

3 (10) first paragraph;
2.1 (2-5) third paragraph, last sentence;
3.3.2.1 (3-28) paragraph #2;
6.2.2.1.3 (6-104) paragraphs #3 & #4, sentence #2;
6.2.2.1.3 (6-104) paragraphs #3 & #4, sentence #3;
6.2.2.1.3 (6-104) paragraphs #3 & #4, sentence #4;
6.3.1.1.2 (6-117) table 15;
6.3.1.1.3 (6-121) paragraph #1;
6.3.1.1.3 (6-121) paragraph #4;
6.3.1.1.3 (6-129);
6.3.1.1.3 (6-129) paragraph #1;
6.3.1.1.4 (6-136) paragraph #2;
6.3.1.3.5 (6-189) paragraph #2, last sentence;
6.3.1.4.2 (6-190) paragraph #1;
6.3.1.4.3 (6-200) paragraph #4.

Evaporation:

2.1 (2-5) third paragraph, last sentence;
5.2.2 (5-36) last paragraph in section;
6.3.1.1.3 (6-129).

Dry Unsaturated Zone:

2.2.2 (5-6);
1.3.2.2 (1-19) first paragraph, third sentence.

Paleoclimate:

5.2.2 (5-35);

6.2 (15) second paragraph;

4.1.3.3 (4-21);

6.3.1.1.3(2) (6-121 to 122);

6.3.1.1.4 (6-130 to 132);

6.3.1.4.2 (6-190) paragraph #1;

6.3.1.4.2 (6-190 to 194);

6.3.1.4.2 (6-193) paragraph #3;

6.3.1.4.3(1) (6-194 to 195);

6.3.1.4.3(2) (6-195 to 200);

6.3.1.4.3 (6-196) paragraph #2;

6.3.1.4.3 (6-196) paragraph #3;

6.3.1.4.3 (6-197) paragraph #1;

6.3.1.4.3 (6-197) paragraph #4;

6.3.1.4.3 (6-198) paragraph #5;

6.3.1.4.3 (6-199) paragraph #2;

6.3.1.4.3 (6-199) paragraph #3;

6.3.1.4.4(1) (6-200) paragraph #2;

6.3.1.4.4(1) (6-200) paragraph #3;

6.3.1.4.4 (6-202) paragraph #3;

6.3.1.5.4(2) (6-212) paragraph #1;

6.4.2.5.1 (6-323 to 324) paragraphs #3 to #1;

7.2.1.4 (7-28) paragraph #3;

7.2.1.4 (7-31) paragraph #2;

7.2.1.4 (7-31) paragraphs #4 & #5;

7.2.1.4 (7-31) paragraph #8.

Host-rock Saturation:

6.3.1.1.3(5) (6-125) paragraph #1;

6.3.1.1.3(5) (6-126) paragraph #2;

6.3.1.1.3(5) (6-129).

Perched Water:

4.1.2.1 (4-13) paragraph #4;
6.3.1.1.3(5) (6-129);
6.3.1.1.3 (6-129) paragraph #2;
6.3.3.3.3(1) (6-279);
7.3.3.1.3 (7-107) paragraph #3.

Vadose Flux:

3(10) second paragraph;
6.2 (16) second paragraph, fourth sentence;
1.3.2.2 (1-19) first paragraph, last sentence;
2.1 (2-11) first paragraph, second sentence;
2.2.5 (2-45 to 46);
2.3 (2-52);
6.2.2.1.3 (6-104) paragraphs #3 & #4, sentences #5 & #6;
6.3.1.1.2 (6-114 to 115) table 6-15, condition 4;
6..1.1.2 (6-116) table 6-15;
6.3.1.1.2 (6-120) third paragraph, last sentence;
6.3.1.1.3 (6-121) paragraph #1;
6.3.1.1.3 (6-121) first paragraph, second sentence;
6.3.1.1.3(1) (6-121) second paragraph, first sentence;
6.3.1.1.3 (6-121 to 122) paragraph #4;
6.3.1.1.3(4) (6-124 to 125);
6.3.1.1.3(5) (6-126) paragraph #2;
6.3.1.1.3(5) (6-129);
6.3.1.1.3 (6-129) paragraph #2;
6.3.1.1.3 (6-130) paragraph #2;
6.3.1.1.5 (6-136);
6.3.1.1.5 (6-139) table 6-17;
6.3.1.1.5 (6-141) table 6-18;
6.3.1.2.3(4) (6-162 to 164);
6.4.2.2.2 (6-314) equation 6-10;
6.4.2.5.1 (6-324) paragraph #1.

Flux:

6.3.1.1.2 (6-114 to 115) table 6-15, condition 4;
6.3.1.1.2 (6-116) table 6-15;
6.3.1.1.4 (6-130 to 135);
6.3.1.1.5 (6-139) table 6-17;
6.3.1.1.5 (6-141) table 6-18;
6.3.1.2.2 (6-147) paragraph #2;
6.3.1.2.2 (6-147 to 148) sentence #1;
6.3.1.2.3(2) (6-151) paragraph #2;
5.3.1.2.3(4) (6-162 to 164);
6.3.1.2.3(5) (6-164) paragraph #3;
6.3.1.7.5 (6-233) paragraph #2;
6.3.1.7.6 (6-234) paragraph #4;
6.3.2.2.1 (6-248) paragraph #3;
6.3.2.2.2 (6-250 to 251) paragraphs #4 to #1;
6.4.2.2.2 (6-310 to 311) paragraphs #2 to #1;
6.4.2.2.2 (6-312) last paragraph;
6.4.2.2.2 (6-314) equation 6-10;
6.4.2.5.1 (6-324) paragraph #1.

Fracture & Water Flow:

2.2.5 (2-43) first paragraph, 3 - 4 sentences;
6.3.1.1.2 (6-116) table 6-15;
6.3.1.1.2 (6-117) table 6-15;
6.3.1.1.2(5) (6-126) paragraph #2;
6.3.1.1.1 (6-129) paragraph #1.

Uncertainties - Hydrology:

7.2.1.1 (7-10) paragraph #2, sentence #1;
7.2.1.1 (7-14) paragraph #2.

Guideline Geohydrology:

6.3.1.1.1 (6-112).

Uncertainties - General:

7.2.1.1 (7-11 to 12) paragraph #4.

Soil Surface - Disruption:

4.2.1.1.4 (4-24).

Water - Tracer/Construction Water:

4.1.2.2 (4-14) paragraph #4;
4.1.2.3 (4-15) paragraph #4;
4.2.1.1.2 (4-23);
6.3.1.1.3(5) (6-125) paragraph #1.

Geochemistry:

6.3.1.2.2 (6-147) paragraph #5;
6.3.1.2.3(2) (6-150 to 160);
6.3.1.2.3(4) (6-162 to 164);
6.3.1.2.6 (6-171).

Water Chemistry:

6.2(15) fifth paragraph;
6.3.1.2.2 (6-143) paragraph #2;
6.3.1.2.2 (6-147) paragraph #3;
6.3.1.2.3 (6-150) paragraph #2;
6.3.1.2.3 (6-150) paragraph #3;
6.3.1.2.3(2) (6-150 to 160);
6.3.1.2.3(2) (6-151) paragraph #1;

6.3.1.2.3(2) (6-151) paragraph #2;
6.3.1.2.3 (6-160);
6.3.1.2.4(1) (6-165 to 168);
6.3.1.2.4(3) (6-169 to 170);
6.3.1.3.4(3) (6-186) paragraph #2;
7.2.1.2 (7-16 to 20) paragraph 5.

Travel Time:

6.3.1.1.2 (6-114 to 115) table 6-15, condition 4;
6.3.1.1.2 (6-116) table 6-15;
6.3.1.1.2 (6-117) table 6-15;
6.3.1.1.4 (6-130 to 135);
6.3.1.1.5 (6-137 to 140);
6.3.1.1.5 (6-139) table 6-17;
6.3.1.1.5 (6-141) table 6-18;
6.3.1.2.3(2) (6-150 to 160);
6.3.1.2.3(2) (6-151) paragraph #2;
6.3.1.2.3 (6-158) paragraph 1;
6.3.1.3.4(3) (6-188) paragraph 4;
6.3.2.2.1 (6-248) paragraph 3;
6.3.2.2.2 (6-250 to 251) paragraphs 4 to 1;
6.4.2.2.2 (6-313 to 314) last paragraph;
6.4.2.2.2 (6-314) equation 6-10;
7.2.1.1 (7-10) paragraph 2, last sentence.

Geohydrology & Sorption:

6.3.1.1.6 (6-140 to 142);
5.3.1.2.3(2) (6-150 to 160);
6.3.1.2.3 (6-158 to 160);
5.3.1.2.3(4) (6-162 to 164);
6.3.1.2.5 (6-170 to 171);
6.3.1.3.4(3) (6-186) paragraph 2.

Sorption:

6.3.1.2.3(2) (6-150 to 160);
6.3.1.2.3 (6-152) paragraph 2;
6.3.1.2.5 (6-170 to 171);
7.2.1.2 (7-16) paragraph 3;
7.2.1.2 (7-16) paragraph 4;
7.2.1.2 (7-20) paragraph 2;
7.2.1.1 (7-20) paragraph 4.

Sorption Mineralogy:

6.2(15) third paragraph;
1.3.2.2 (1-19) first paragraph, last sentence;
5.2.2 (5-35) third paragraph, last sentence;
6.2.2.1.3 (6-104) paragraphs #3 & #4, sentences #5 & #6;
6.3.1.1.3(4) (6-124 to 125);
6.3.1.1.4 (6-131) paragraph #5, last sentence;
6.3.1.1.4 (6-133) second paragraph, sentence #5;
6.3.1.2.2 (6-143) paragraph #3;
6.3.1.2.2 (6-147) paragraph #1;
6.3.1.2.3(2) (6-151) paragraph #3 to 6-152 paragraph #1;
6.3.1.2.3 (6-152) paragraph #3;
6.3.1.2.3 (6-152) paragraph #4;
6.3.1.3.4(2) (6-185) paragraph #3;
6.4.2.1.2 (6-308) paragraph #4;
6.4.2.1.2 (6-309) paragraph #1.

Retardation:

6.3.1.2.3 (6-158) paragraph #2;
6.3.1.2.3(3) (6-161) paragraph #4;
6.3.1.2.3(5) (6-164) paragraph #3;
6.3.1.2.3(5) (6-164 to 165);
6.3.1.2.5 (6-170 to 171);
6.3.1.3.4(2) (6-184) paragraph #2.

Waste Isolation:

6.2(15) first paragraph;
6.2(15) second paragraph.

Porosity & Retardation:

6.3.1.1.4 (6-133) second paragraph, sentences #2 to 5;
6.3.1.2.3(5) (6-164 to 165).

Diffusion:

6.3.1.2.3(2) (6-150 to 160);
6.3.1.2.3(2) (6-151) paragraph #2;
6.3.1.3.4(3) (6-186) paragraph #3, last sentence;
6.4.2.5.1 (6-323 to 324) paragraph #3.

Zeolite Stability:

6.3.1.2.2 (6-147) paragraph #4, sentence #3;
6.3.1.2.3(3) (6-161) paragraph #1;
6.3.1.2.3(3) (6-161) paragraph #3;
6.3.1.3.4(2) (6-185) paragraph #3;
6.3.1.3.4(3) (6-186) paragraph #2.

Age of Authigenics:

6.3.1.2.2 (6-147) paragraph #4, sentence #1;
6.3.1.2.2 (6-147) paragraph #4, sentence #2;
6.3.1.2.3 (6-149) paragraph #3;
6.3.1.2.3 (6-149 to 150);
6.3.1.2.3 (6-150) paragraph #3;
6.3.1.2.3(3) (6-161) paragraph #2;
7.2.1.2 (7-20) paragraph #2.

Mineralogy:

6.3.1.2.2 (6-143) paragraph #1;

6.3.1.2.3 (6-149) paragraph #2;

6.3.1.2.3(3) (6-161) paragraph #2;

6.3.1.3.4(2) (6-185) paragraph #1;

6.3.1.3.4(2) (6-185) paragraph #3;

6.3.1.6.6 (6-218) paragraph #1.

Vapor Transport and Fracturing:

2.2.5 (2-43) first paragraph, 3 - 4 sentences;

2.3 (2-53);

5.2 (5-34);

5.2.9 (5-59);

6.2.2.1.3 (6-104) paragraphs #3 & #4, sentence #1;

6.2.2.1.3 (6-104) paragraphs #3 & #4, sentence #7;

6.2.2.1.3 (6-104 to 105);

6.3.1.1.4 (6-130 to 135);

6.3.1.2.2 (6-148) paragraph #2, sentence #3;

6.3.1.3.3 (6-178) paragraph #2;

6.3.1.3.4(3) (6-188) paragraph #2;

6.3.1.5.1 (6-204).

Fracture Access to Bio-environment:

6.3.1.3.3 (6-178) paragraph #2;

6.3.1.3.4(3) (6-188) paragraph #4;

6.3.1.3.5 (6-189) paragraph #2, last sentence;

6.3.1.5.1 (6-204);

6.3.2.2.2 (6-250 to 251) paragraphs #4 to #1;

6.4.2.5.1 (6-324) paragraph #2.

Thermal Behaviour of Tuff:

6.3.1.3.3(2) (6-181) paragraph #1, last sentence;
6.3.1.3.3(2) (6-181) paragraph #2;
6.3.1.3.4(2) (6-186) paragraph #1;
6.3.1.3.4(3) (6-186) paragraph #3, last sentence;
6.3.1.3.4(3) (6-188) paragraph #4;
6.3.3.2.4(4) (6-271).

Canister Corrosion & Dissolution:

6.2(16) second paragraph, second sentence;
6.3.1.2.2 (6-147) paragraph #3;
6.3.1.2.2 (6-147 to 148) sentence #3;
6.3.1.2.3(4) (6-162) paragraph #1;
6.3.1.2.4(1) (6-165 to 168);
6.3.1.2.4(3) (6-169 to 170);
6.3.1.3.4(1) (6-183) paragraph #2;
6.3.1.3.4(3) (6-188) paragraph #2;
6.4.2.2.1 (6-310);
6.4.2.2.2 (6-310 to 311) paragraph #2 to #1.

Retrievability:

5.1.3 (5-24);
5.2.1 (5-34) paragraph #1;
7.3.3.1.2 (7-103) paragraph #3.

Weapons Testing Danger:

6.3.1(17) second paragraph.

Heating Effects Repository, Impact:

5.2.1 (5-340 paragraph #1;
6.3.1.1.4 (6-130 to 135);
6.3.1.3.3(2) (6-181) paragraph #1, last sentence.

Site Characterization:

6.3.1.1.3(3) (6-122 to 124);
6.3.1.1.7 (6-142);
6.3.1.2.2 (6-147 to 148), sentence #2;
6.3.1.2.2 (6-148) paragraph #2, sentence #2;
6.3.1.2.6 (6-171);
6.3.1.6.7 (6-218).

Cross-Sections:

6.3.1.5.3(1) (6-208).

Lateral Placement Problem:

7.3.3.1.2 (7-103) last paragraph.

Tectonic Stability:

6.3.1.7.3 (6-223) paragraph #4.

Basaltic Eruptions:

6.3.1.7.3 (6-222) paragraph #1.

Reclamation & Restoration:
4.1.1.4 (4-7) paragraph #1.

Future Environmental:

6.2(15) second paragraph.
6.3.1.1.4 (6-130) paragraph #2.
4.2.1.6 (4-29 to 30);
5.2.8 (5-53).

Archaeology:

4.2.1.6 (4-29 to 30);
5.2.8 (5-53).

Political:

4.2.2.5(3) (4-34);
B.2.1 (B-3).

Water Rights:

3.3.3 (3-30) paragraph #1;

Flood Design:

4.1.2.1 (4-9) paragraph #1;
5.2.2 (5-36) paragraph #1;
5.2.2 (5-36) paragraph #2.

V. SPECIFIC COMMENTS SECTION

Section (Page) paragraph, sentence, author:

Executive Summary Chapter of the DEA:

2.2.2 (5-6) last paragraph, pg. 5 to top of pg. 6.

"The proposed repository horizon at the site is hydrologically distinct because it is in the dry unsaturated zone above the water table." This statement is inconsistent with data presented in section 6.3.1.1.3(5) page 6-125 to 6-126 and therefore should be corrected to read:

Suggested Correction:

The proposed repository horizon at the site is hydrologically distinct because it is in the vadose zone above the ground-water table.

3. (10) first paragraph.

"At Yucca Mountain, most precipitation apparently evaporates before it can infiltrate deep enough for ground-water recharge. The average annual precipitation near the site is about 6 inches per year; only a small fraction (3 percent or less) of that amount reaches the depth proposed for the repository."

Suggested Correction:

Ground water is recharged by the infiltration of precipitation and surface water. The mechanism of infiltration is unknown at present. The average annual precipitation near the site is about six inches per year. It is unknown how much of this reaches the depth proposed for the repository.

Winograd and Thordarson (1975) estimate that 3% of precipitation ultimately reaches the water table in the region. This figure is cited in the DEA. There is considerable uncertainty surrounding this figure (Winograd and Thordarson, 1975, p. 92) which is not conveyed in the DEA. The overriding question is whether this 3% value can be applied site specifically when the authors intended it only as a regional average for carbonate uplands. No direct measurement of recharge is available for Yucca Mountain, and precipitation - temperature records are only now being developed.

Unless specific data derived from Yucca Mountain proper have been collected with respect to precipitation and evaporation on a monthly basis, and these data are made available and support the statements contained in the DEA, the corrections suggested should be made. Further, unless there is DIRECT evidence from field data which have not been published (eg. field data from UZ-4), and can be made available, the nature of recharge and infiltration in the vadose zone at Yucca Mountain remains an unknown variable. If, in fact, this information is available for Yucca Mountain, it should be made into an appendix in the EA as no such data has heretofore been made available by the research project. A section should be added to support the statement of an annual precipitation of 6 inches per year at Yucca Mountain itself as opposed to Yucca Flat.

3. (10) second paragraph.

"The movement of ground water in the unsaturated zone is typified by a very low flux of water moving downward mainly through the intergranular pores of the tuff layers."

Suggested Correction:

Omit this entire section.

The DOE project at Yucca Mountain has not made any direct field data available concerning the nature of the flux in the vadose zone. The statement included in the DEA is therefore plagued by supposition and is unsupported by direct field evidence. Further, there is evidence from the distribution of secondary diagenetic minerals such as smectites and zeolites in the fracture assemblages that there has been at some unknown period after faulting sufficient water in the fracture assembleges to support perlitic hydration reactions to authigenic phases. These data are also supported by Hoover (1968). Nevertheless, even these data which strongly support aqueous transport in fractures in the vadose zone are insufficient to delineate the overall problem of water movement in the vadose zone. It appears that there are insufficient data to derive any meaningful conclusions concerning this topic. Accurate analyses of tritium in vadose water could assist in flux determinations. Montazer and Wilson (1984) indicate that there is a current lack of knowledge of the hydrology in the vadose zone.

6.2 (15) first paragraph.

Insert the word "may" before the word "contribute" in the first sentence.

6.2 (15) second paragraph, starting at the second sentence.

Omit remaining portion of this paragraph as there are no direct data available to support these statements. The quantity of water available in the vadose zone is presumed to be limited and is certainly less than that which would be expected in the saturated zone; however, the actual quantity of water is unknown (see your field data from UZ-4).

The nature and dynamics of the paleoclimatic regime at Yucca Mountain has not been thoroughly investigated. We find no available oxygen isotope data relating to this issue in the literature. Those data which are available (eg., packrat midden analyses) admit to other possible interpretations, consequently, paleoclimatic bounding conditions are presently unknown (refer to Climate Change section for further comments).

6.2 (15) third paragraph, entire paragraph.

"The probable occurrence of zeolite minerals along flow paths to the accessible environment would provide a barrier to radionuclide migration, because of the radionuclide-sorption capacity of the zeolites. The characteristics of the probable flow paths, coupled with the characteristics of the unsaturated zone, would substantially limit the movement of radionuclides."

This paragraph requires modification and should be corrected as follows:

Suggested Correction:

The probable occurrence of zeolite minerals along flow paths to the accessible environment may provide a barrier to radionuclide migration.

Comments:

Omit the next sentence as it is unsubstantiated. Unless there is detailed data made available concerning specific zeolite (eg. with known cation composition and Al-Si ratio) and specific radionuclide species sorption data relevant to that zeolite <u>and</u> within known vadose zone water composition (Not J-13), the nature and degree of sorption is unknown. A detailed discussion of zeolite stability and chemical behavior will be offered later in our comments. It is well known (See Breck, 1974) that zeolite sorption and temperature stability are related to their supercage composition and Al-Si ratio. It is also understood that their supercage composition is in part a function of the aqueous state they are in contact with.

Consequently, the chemical composition of the water in the vadose zone is directly related to the temperature of stability of the zeolites and to their sorption characteristics. It is unfortunate, but sorption studies on whole rocks in J-13 water do not address the sorption capacity of zeolites in the Yucca Mountain vadose zone.

6.2 (15) sixth paragraph.

"However, because the repository would be in the unsaturated zone and thus have little exposure to the ground water, the presence of the oxidizing ground water may not significantly affect the lifetime of the canister or the movement of radionuclides, even though they may be more soluble. In addition, many canister materials, when exposed to oxidizing conditions, form protective coatings that would prolong the lifetime of the canister."

<u>Suggested Correction</u>:

Omit the section starting from "However, because... and the last sentence.

The degree of exposure to water is unknown. The statement that because the repository is in the unsaturated zone and therefore would have little ground-water exposure does not indicate its potential exposure to vadose zone water. When metallic canisters oxidize and the oxide coatings are formed that extend their lifetime, we presume that their lifetimes are not extended beyond that where there is no oxidation experienced. This statement should be reworded as it is not clear. We also note that an increase in chloride over that concentration in J-13 water provides a significant increase in pitting action through the oxide coating (Turcotte and Wald, 1978). We note that J-13 water does not necessarily conform to vadose water chemistry and therefore, higher chloride concentrations are possible. Further, stainless steel, under pressure in the ocean environment has been shown to fail rapidly after it has been scratched (see literature on stainless steel submarines). We suggest that experimenting in this area should be performed especially considering potentially elevated pressures and temperatures after closure. Further, we note that the welds on the canister covers provide a containment problem.

The oxidation state of vadose water should be given. Bulk sorption experiments with wafers use J-13 water, because it is available and vadose zone water is not. They indicate that J-13 may be similar to vadose zone water. If this is so, then oxidation may certainly be a problem with respect to radionuclide migration and canister failure.

6.2 (16) second paragraph, second sentence.

If the rate of canister corrosion is unclear and there is a complete void in the field data on the chemical composition of the vadose-zone waters, it is difficult to understand how the laboratory experiments produce expected lifetimes which are not at least bounded by upper and lower limits in each of the environments reported. We suggest that this section be omitted and that laboratory experiments be run using upper and lower bounding conditions (highly oxidized to reducing waters). We also suggest sampling the vadose zone water and obtaining the hydrogeochemical data.

6.2 (16) second paragraph, fourth sentence.

"The timing of ground-water travel from the disturbed zone to the accessible environment is conservatively estimated to be more than 20,000 years and possibly as long as 4.7 million years."

Suggested Correction:

The time of ground-water travel assuming a pore flux without fracture transport from the disturbed zone to the accessible environment is estimated to be more than 20,000 years and possibly as long as 4.7 million years; however, the nature of the flux in the vadose zone is unknown especially since fracture flow is also feasible.

The main reference used by the DEA concerning this topic is Montazer and Wilson (1984) which is a conceptual hydrologic model for the vadose zone and states (page 4): "Many uncertainties remain to be resolved concerning hydrologic conditions and processes. As a result, most of the concepts presented are intentionally descriptive and conjectural, with little quantitative basis provided."

6.3.1 (17) second paragraph.

The potential danger to underground personnel during routine weapons testing requires elucidation here, as it is not understood what the nature of the danger is (eg. shock failure of the host rock). These factors have bearing on the potential disruption of the integrity of the proposed repository during construction and access periods.

Chapter 1 of the DEA:

1.3.2.2 1-19 first paragraph, third sentence.

Suggested Correction:

The site is in the vadose zone, above the water table.

first paragraph, last sentence.

Suggested Correction:

The Yucca Mountain site will rely principally on a very low water flux (assuming pore and not fracture flow) through the vadose zone in a desert environment, the natural ability of this type of system to potentially exclude flowing or standing water (at present unknown) from the repository, and the potential sorption of the minerals in the host rock (yet to be studied).

Chapter 2 of the DEA:

2.1 (2-5) third paragraph, last sentence.

Unless there is direct monthly data to support the evaporation rates, this sentence should be modified as it is unsupported. Most of the precipitation occurs during winter months, and the highest evaporation rates occur during the summer months. Annual averages of evapotranspiration and precipitation are inaccurate and misleading. Postulated extreme event/antecedent moisture conditions may be more meaningful than average precipitation/evapotranspiration.

2.1 (2-11) first paragraph, second sentence.

A statement should be included to indicate that the nature of the water flux in the vadose zone is presently unknown in time and space.

2.2.5 (2-43) first paragraph, 3 - 4 sentences.

We wish to point out that this letter from the USGS to USDOE suggests that there is a potential for fracture flow in the unsaturated zone, and if there was not, there would be no advantage to situate a repository within fractured media.

Although this concept has merits with respect to fracture flow in the vadose zone, it also brings a potential problem to surface - mainly out gas and vapor phase radionuclides have a direct access to the bioenvironment. The DEA mentions (pages 6-104-105) the behavior of krypton-85, xenon-133, iodine-129, tritium, and carbon-14 which we presume are potentially evolved from canisters that have failed.

Iodine-131 should also be mentioned.

Considering that I-129 has an extremely long life and that the noble gases and tritium have been vented at NTS (ERDA-155 - Final Environmental Impact Statement, NTS, Nevada), we are concerned about the current uncertainty of ceiling integrity of the proposed repository (eg. as a consequence of fracture pathways with access to the ground surface). Montazer and Wilson (1984, pages 34-35) state: "Vapor movement in the unsaturated zone occurs by both diffusive and convective processes." "Convective transport of vapor is likely to occur where thick fractured rock units occurs in the unsaturated zone, such as at Yucca Mountain." "The concept of vapor transport is discussed here principally to introduce the possibility of the occurrence of this phenomenon at Yucca Mountain and to stimulate further research in this area."

We suggest that the final EA speak to this issue, especially in the light of the following siting criteria:

<u>National Research Council - National Academy of Science</u>:

Sections: 3.1.1, 3.1.2, 3.4.1, 3.4.4, 3.2.1, 3.2.2

<u>N.R.C.</u>:

60.122(c)(2)
60.111(c)(4)
60.122(a)(3)(iii)

<u>International Atomic Energy Agency</u>:

Section 4.3.2
Section 4.4.2

Offices of Waste Isolation:

Criterion 1, 2, 5

DOE:

Section 5.1.1.2. Item 2
Section 5.1.1.2 Item 5

The primary purpose of a repository is to provide isolation. Any perturbation in the geologic or man-made containment barriers can lead to a breach and system failure. A system designed in highly fractured media such as the welded tuffs of Yucca Mountain provides, by the nature of the geology, a potential for direct interconnection between the geosphere and biosphere and as a consequence may not provide containment. It is therefore imperative that the EA address to this issue. We suggest that bounding scenarios at elevated temperatures be included in this discussion.

2.2.5 (2 - 45) last paragraph to first paragraph on page 2-46.

It would be informative to include the effects of heat in the ground-water travel time estimates, with respect to Licensing Criteria: 1. pre-repository criteria; and 2. post-emplacement criteria. If that is not possible in the final EA it would be advisable to discuss why.

2.3 (2 -52) Geohydrology (10 CFR 960.4-2-1(d)); Section 6.3.1.1

Suggested Correction:

Analysis of very limited field and laboratory data presumably indicates that prewaste emplacement ground-water travel time along most paths of potential radionuclide travel to the accessible environment could exceed 1000 years.

Suggested Correction:

Omit last sentence in first paragraph.

2.3 (2 -53) Erosion (10 CFR 960.4 - 2 - 5(d); Section 6.3.1.5).

Add a statement concerning fracture access to the ground surface from the repository. Although erosion is not apparently a factor with respect to the fracture issue, the intent of 10 CFR 960.4 - 2 - 5(d) Section 6.3.1.5 is clearly to provide isolation above the repository. Fractures, especially the numerous fractures in Yucca Mountain, place the isolation concept in question. Therefore, a discussion of this issue is required.

Chapter 3 of the DEA:

3.3.2.1 (3-28) paragraph #2

This appears to be poorly supported. We suggest that either there is strong data to back it or the first two sentences of this paragraph be removed or qualified.

A very important issue is the quantity of water available for percolation to the vadose zone. The Montazer and Wilson (1984) states that "probably less than 1mm/year percolates through the matrix..." It is an understanding that this has never been measured at Yucca Mountain and is consequently unsupported (it is also misquoted). Montazer and Wilson (1984, page 2) state: "Average annual precipitation at Yucca Mountain is estimated to be 150 mm per year, of which about 0.5 to 4.5 mm per year becomes net infiltration." Nowhere in Montazer and Wilson (1984) do they report 1 mm/year for infiltration or percolation. The 1 mm/year figure is net flux (matrix).

The statement that most of the annual precipitation is returned to the atmosphere needs to be supported with actual data (short term analysis of evaporation and precipitation). As this is an important issue which apparently reoccurs in the DEA, we suggest that actual field Yucca Mountain data be made available in an appendix of the EA. The source of that data should be cited. Montazer and Wilson (1984, page 52) state: "Many of the processes incorporated in the model are based on the presumed substantial difference between the relatively slow percolation rate in the Topopah Spring welded unit beneath the block and the relatively larger net infiltration entering the system. However, the net infiltration at Yucca Mountain principally is based on an application of regional analyses; thus, the rate is very uncertain. Further definition of this rate is required to assess the accuracy of the flow condition described by the model."

3.3.3 (3-30) paragraph 1.

"Water use during repository siting, construction, operation and decommissioning is expected to cause only a very localized drawdown of the regional water table."

This offers no specifics as to how much water will be needed for each activity nor where the water will come from. Does the Federal Government have existing water rights which can be used for Yucca Mountain?

Chapter 4 of the DEA:

4.1.1.4 (4-7) paragraph 1 after the listing.

The minimum expected activity should be stated for reclamation to ensure the best possible habitat restoration. Although it is understood that the system is dynamic and poorly understood, the term "adjusted" might be utilized in a less than favorable manner. Consequently, minimum values of restoration should be reported and these may be maximized at the discretion of DOE.

4.1.2.1 (4-9) paragraph #1

Since the exploratory shaft is to be constructed in Coyote Wash and would in all probability become an integral part of the disposal facility if it is built at Yucca Mountain, the use of the 100 year storm event to design flood protection is questionable. With a 100 year return period, that event has a 1 percent probability of occurrence during any given year. If that event or a greater event did occur during the proposed characterization period, it could result in negating the viability of the site through introduction of large quantities of water directly into the repository block.

It would seem prudent, given the significance of the proposed waste repository, to base the level of protection for the facility on the "Probable Maximum Precipitation" (PMP) concept which is widely used in hydrologic design, specifically when considering dam safety. It would appear that this potential site is at least as important as the numerous small dams throughout the country which are required to meet the "PMP" safety standard.

4.1.2.1 (4-13) paragraph #4.

If perched zone water is encountered as expected, a sample(s) should be collected for chemical analysis. Thus far, saturated zone J-13 water has been utilized for laboratory experiments and there is serious question whether it is representative of vadose water. All water encountered in the vadose zone should therefore be collected and analyzed.

On Sept. 17 and Sept. 20, 1984, our monitoring field notes indicate that vadose water was encountered in UZ-4 at a depth of 81 to 86 feet below the surface. Core sections recovered were saturated and log book notes indicated "water running in hole". This zone of perched saturation occurred near a thin layer of clay in the non-welded base of the Tiva Canyon Formation. We suggest that the chemical analysis of this vadose water be reported in the final EA.

4.1.2.2 (4-14) fourth paragraph.

"All water used in shaft construction, including the water used for making liner concrete, would be tagged with a suitable tracer."

Comment:

The problem of the suitability of the tracer needs further explanation to ensure that the tracer is not sorbed by the matrix.

4.1.2.3 (4-15) paragraph 4.

The suitability of sodium bromide as a tracer should be discussed relative to potential sorption characteristics of the host rock.

4.2.1.1.2 (4-23).

There is some concern that water used during construction will compromise the geochemical and hydrogeochemical testing. A detailed statement regarding this concern should be added to the text.

4.2.1.1.4 (4-24).

The disruption of the soil surface may affect the chemical composition of natural percolating waters into the vadose zone (see Garrels and Mackenzie, 1967).

This action may provide more acid waters to the natural system (higher in carbon dioxide). The results of these actions are unknown and this topic should be treated in the EA.

4.2.1.6 (4-29-30).

The concurrence and degree of interaction with State SHIPO's should be stated here, in addition to any memorandum of agreement with Interagency Archaeological Services and the National Register. In addition, sites that have potential for impact due to improved access probably should be salvaged to avoid the potential loss. This issue should be discussed with SHIPO and results reported in the EA.

4.2.2.5 (sub 3) 4-34.

"To engage in monitoring, testing, or evaluation activities with respect to site - characterization programs."

Comment:

The DOE policy adopted with the State of Nevada in December, 1984, has been to withhold State requested funds for the development of independent data on selected technical issues. The DOE DEA statement (adopted from the Nuclear Waste Policy Act of 1982) is inconsistent with DOE actions. In practice, the DOE has been characterizing the Yucca Mountain site since before 1982. The DEA references documents are good evidence for this when viewed from the perspectives of topic, required funding, and number of documents. The EA should be modified to reflect practiced DOE policy. Or better, the DOE policy should be made to conform to both the spirit and letter of the Nuclear Waste Policy Act of 1982. By conforming, the scientific tests of reproductibility of data and the multiple investigative approach to very complex technical questions would be served. There is pending litigation on the currently practiced DOE policy. If the State of Nevada prevails in this litigation, the final EA should be made to reflect the guidelines of the Nuclear Waste Policy Act. If the DOE prevails, the EA should reflect and explain currently practiced DOE policy.

Comment:

The use of the word negligible is misleading. Water-table elevations have fluctuated in response to climatic and other changes during the Quaternary, possibly as much as 130m. "Negligible" should be deleted or its meaning defined. Refer to the comments on section 6.3.1.4.3. (6-198) paragraph 20, and general comments on Climate Change.

5.2.2 (5-35) fourth paragraph, last sentence.

This statement is unsupported.

The nature and behavior of the potential natural barriers to radionuclide transport at Yucca Mountain are unknown, and therefore the degree of limitation of exposure during any period of time is unknown. The baseline data package is poorly developed for Yucca Mountain. The behavior of the hydrologic system in the vadose zone is essentially undocumented. Nor are the sorption characteristics of oxyhydroxides, smectites, and other minerals well known. In light of these deficiencies, preliminary assessment of either long or short term performance of a repository at Yucca Mountain has not been conservative.

There is no direct evidence that Yucca Mountain would not meet the requirements. Consequently, characterization could conclude that the site is suitable.

5.2.2 (5-36) paragraph 1

There is a different level of protection from flooding, i.e., 500 year and regional maximum flood, than during characterization period. The higher level of protection regional maximum flood, would also seem more appropriate for the characterization phase and exploratory shaft (see comment on 4.1.2.1).

5.2.2 (5-36) paragraph 2.

Has there been any quantification of the expected amount of runoff which would be channeled into evaporation ponds? What provision will be taken to prevent the evaporation ponds from becoming point recharge sources? The high ET rate is not effective during the winter months. The ponds should be lined or sealed by some commonly accepted procedure.

5.2.2 (5-36) last paragraph in this section.

"These liquids are not expected to infiltrate into the underlying formation because of the region's high potential evapotranspiration rate"

Comment:

Modify or omit this sentence. It is unsupported. The infiltration and recharge at Yucca Mountain has not been documented.

5.2.8 (5-53).

Add a section to describe the interaction between DOE and State SHIPO's on actions planned to manage the cultural resources of the area. If DOE and State SHIPO's are in disagreement over management techniques, detail Interagency Archaeological Services comments.

In specific, there is some concern about sites where potential impact could occur, and the planned mitigation activities.

We are not certain that only a 10% sampling is adequate for some sites. We would suggest that all sites be handled under the concept of 80% to complete excavation to maintain a full data recovery system where significance has been determined.

Significance should be stated in National Register Forms that should have been completed in accordance with Executive Order 11593.

5.2.9 (5-59).

A section is required to describe potential exposure as a consequence of vapor and gas venting through the natural fracture system (see Montazer and Wilson, 1984, vapor phase comments).

Chapter 6 of the DEA:

6.2.2.1.3. (6-104) paragraphs 3 and 4 (6-105). Sentence #1.

"Radionuclides released to the environment can potentially be transported by both liquid and gaseous transport mechanisms."

Comment:

Previous concerns have been outlined concerning gaseous transport release to the fracture system.

Sentence #2.

"At the Yucca Mountain site, surface-water transport mechanisms are not considered likely because of the aridity of the climate and the absence of surface water."

Comment:

Bowen and Egami (1983) states: "Severe weather in the form of high winds, heavy precipitation, lightning, and high temperatures will affect the construction and operation of the repository." (Bowen and Egami, 1983, page 68). In light of high potential overland runoff during heavy storms, it is suggested that surface-water transport mechanisms may be significant if radionuclides reach the ground surface. A full discussion of this problem should be included in the DEA and this sentence should be appropriately revised.

Sentence #3.

"The Yucca Mountain site is located in one of the most arid regions of the United States, with an average annual rainfall in the region of less than 150mm (6 inches) (Bowen and Egami, 1983)."

Comment:

These data, derived from Bowen and Egami (1983), are from Yucca Flat for a ten-year period of time (1962-1971) which average 5.73 inches. They also state (page 10, Table 1) that the average annual snow precipitation for Yucca Flat is 8.3 inches (greatest monthly precipitation - Feb., 1969). The greatest monthly rain precipitation was recorded at 4.02 inches (Jan., 1969) and the greatest daily precipitation was recorded at 2.13 inches (Sept., 1969).

Bowen and Egami (1983, page 67) state that "Wind, temperature, and precipitation depend on station altitude and local terrain." Yucca Flat is lower in elevation than Yucca Mountain, and since precipitation increases with increasing elevation one would expect, although there are no data available (see Montazer and Wilson, 1984), that the precipitation at Yucca Mountain is greater than Yucca Flat based on the data and discussion of Bowen and Egami (1983) and Quiring (1965).

Additionally, these references, together with Winograd and Thordarson (1975, pages C6 - C7), indicate that winter precipitation is fairly significant. Winograd and Thordarson (1975, page C8) show a precipitation map which indicates that Yucca Mountain might have an annual precipitation in the 8 to 10 inches per year range; nevertheless, there apparently is very little or no direct information on Yucca Mountain concerning precipitation. Montazer and Wilson (1984, page 5) state:

"Nearly three-fourths of the annual precipitation occurs during the cool season (October - April), generally as rainfall resulting from frontal systems moving through the region, and occasionally as snowfall." We suggest that the precipitation and evapotranspiration rates during the winter raise an important question as to the amount of recharge that may be occurring.

Montazer and Wilson (1984) state that data has been collected on Yucca Mtn. but are not significant since they have only been collected for a short period of time. Even a short record is better than no site specific information.

Sentence #4.

"The arid conditions allow very limited infiltration and recharge (Quiring, 1965; Winograd and Thordarson, 1975; personal communication from P. Montazer, 1984, USGS; data expected to be published in a USGS report by P. Montazer and Wilson and entitled Conceptual Models for Flow Through the Unsaturated Zone at Yucca Mountain, Nevada)."

Comment:

While the statement may well be true, each of the above cited references directly or by reference use 'indirect methods to obtain' estimates of infiltration and recharge which may have considerable error associated with them. We find, however, no such comments or suggestions in Quiring (1965) and Winograd and Thordarson (1975). These references are inappropriately cited here.

Winograd and Thordarson (1975, page C52), state: "Perched ground water may be found locally throughout the Nevada Test Site wherever aquitards compose ridges or hills that lie above the regional zone of saturation." "The occurrence of such water is erratic and depends largely upon the interconnection of the fractures within the aquitard and, in turn, their connection with the underlying aquifers." "Areal differences in precipitation probably do not cause these wide variations in vertical position of the perched water tables, because even at lower altitudes, where precipitation is at a minimum, fractures in the aquitards may be saturated nearly to the surface." (See your field data for UZ-4).

Winograd and Thordarson (1975, page C98) state: "The water in the Paleozoic carbonate rocks underlying the Test Site is in part recharged by percolation downward through tuff or through alluvium containing detrital tuff, or both" (data cited from Schiff and Moore, 1964, by Winograd and Thordarson, 1975, page C98).

Montazer and Wilson (1984, page 7) state: "Infiltration of water at Yucca Mountain probably occurs either directly into fractures within bedrock exposures or from surface runoff seeping into alluvium beneath the channels of washes." They (page 34) state: "Rapid infiltration rates, small matrix permeability, and small matrix moisture capacity enhance deep fracture flow." They also state on pages 36-37 that: "The ultimate source of water in the unsaturated zone at Yucca Mountain is precipitation on the mountain." "In fact, the quantity of annual precipitation is used as a basis for some techniques to estimate infiltration and recharge." "Measurements of precipitation at Yucca Mountain were initiated too recently to obtain reliable direct estimates of average annual precipitation at the mountain." They also state (page 37) that: "At Yucca Mountain, infiltration rate is both spatially and temporally variables," and that "Direct measurements of infiltration and recharge have not been made at Yucca Mountain," indicating a specific data gap to be filled.

They further provide on page 38 a summary of the recharge estimates made by others: Winograd (1981), Waddell (1984), Winograd Thordarson (1975), Eakin and others (1951), Malmberg and Eakin (1962), Rush (1970), and Czarneki (1984). They state that "None of these studies provides a reliable basis for estimating recharge at Yucca Mountain itself, ..."

This key element must be more thoroughly addressed with specific plans as to how this data gap is to be filled.

We suggest that this sentence be revised in accordance with the available data. Montazer and Wilson (1984) do suggest that the infiltration is probably small in light of probable low precipitation; but they also admit to not having appropriate data to derive meaningful conclusions concerning this topic. They have also inferred from the lack of evidence (Montazer and Wilson, 1984, page 37) for springs and seeps along the washes that interflow is probably of short duration. Their argument is moot since they are arguing from the negative evidence. This is a problem which arises when there is very little data available.

Sentences #5 and #6.

"Ground-water transport is not a reasonable release mechanism during the operation of the repository owing to the long ground-water travel time that is expected in the unsaturated zone." "The potential for retardation of radionuclides in the zeolitized tuffaceous beds of the Calico Hills beneath the repository, and the great distance between the site and a down-gradient population center where ground water is withdrawn."

Comment:

We presume sentence #6 is a continuation of sentence #5. Our comment therefore follows:

We suggest that this sentence be deleted as it is unsupported and misleading.

Ground-water transport is a reasonable release mechanism because the nature and flux of water in the vadose zone has not been characterized, and the potential for retardation is unknown.

Montazer and Wilson (1984) have assumed the net infiltration rate for Yucca Mountain is 4.5 mm/yr. On the basis of this assumption combined with a conceptual hydrologic model of flow in the vadose zone (which admits to revision due to the lack of real field data) they conclude that probably a 1mm/yr flux is transmitted through the Topopah Spring unit. The statement (sentences 5 and 6) in the DEA seem to treat the Montazer and Wilson (1984) data as a certainty. This problem plagues the entire DEA, except for sections in chapter 7.

DEA, page 7-14 states: "For Yucca Mountain, there are uncertainties about the moisture content, ground-water recharge, and ground-water flux in the unsaturated zone."

DEA page 7-10 states: "For the Yucca Mountain site, there are uncertainties about the effective porosity, moisture content, as well as ground-water recharge and flux in the unsaturated zone, and the mechanism of water movement in the unsaturated zone."

Consequently, it is unknown what the significance is of recharge rates and volumes via fracture flow and what the rates and volumes are via fracture/matrix or matrix flow.

The NRC siting regulations: 60.111(c)(4)(i), 60.122(a)(2), and 60.122(b) have not been met with respect to the knowledge obtained concerning moisture in the vadose zone. DEA page 7-10 states that only two wells were used to calculate ground-water travel in the vadose zone, and to our knowledge no vadose water has been analyzed. Data collected to date have not been comprehensive, as attested to by statements in the DEA and support literature (see Montazer and Wilson, 1984).

The second topic of these two sentences concerns retardation.

The potential for retardation is unknown because:

1. No data exists on the retardation potential of ferromanganese oxyhydroxides.

2. Very little data exists on the retardation of smectites and interlayered clays.

3a. Clinoptilolite stability with temperature is related to its sorption capacity (eg./super-cage dimensions).

3b. Clinoptilolite stability is related to its cation concentration, Tsitsishvili (1973), indicates an increasing thermal stability with potassium substitution for calcium. Hay (1966) and Minato and Utada (1971) report that the thermal behavior of clinoptilolite is based on the variety of exchange ions inside its structure. Other data are available.

3c. Clinoptilolite base-exchange composition is related to the ground-water composition it is in contact with. Exchange selectivities are available for clinoptilolite (Boles and Wise, 1976). These data suggest that ground-water chemistry can be approximated by use of zeolite chemistry.

3d. Vadose hydrogeochemistry program has not been effective and no water chemistry has been reported from the vadose zone.

3e. Therefore, clinoptilolite sorption capacity is partially dependent upon the chemistry of the aqueous state it is in contact with, and there are no meaningful information on the chemistry of the vadose water.

3f. The chemistry of the clinoptilolites vary with stratigraphy (as attested to by very careful analyses presented by Los Alamos publications); consequently, the sorption capacity of the clinoptilolites probably vary similarly.

4. By plotting obsidian occurrences and zeolite distribution in USG-2, G-3, G-1, and UE-25b-1 and a-1, three potential perched water zones and a paleo-water level have been recognized above the standard water level in Yucca Mountain. Each of these horizons contains variations in clinoptilolite composition. The paleo-water level parallels the present water level but is about 200 to 650 feet above it. This indicates a much higher water table sometime after faulting. The time of zeolitization can not be fixed based on the data presented. Consequently, we have no evidence that these higher water tables are Quaternary in age.

5. There is evidence from the clinoptilolite Al-Si ratios and cation composition that clinoptilolites below the analcite zone have remnant Al-Si ratios of predecessor zeolites. These data indicate that the pH of the ground-water has probably changed since zeolite formation.

6. Data presented in 3, 4, and 5 above indicate that: clinoptilolite is complex in its behavior; that it is related to ground-water behavior; and that sorption-studies

are needed on clinoptilolites of known composition. Further, matched water and zeolite samples are needed from the vadose zone to acquire selectivity data.

The potential for radionuclide retardation by sorption is an important issue. Bulk sorption chemistry with wafers in J-13 water do not speak to authigenic mineral sorption of radionuclides. Mineral and sorption studies are needed on the basis of specific species and with respect to changing environmental conditions including vadose water chemistry. The oxidation state of vadose water is unknown and yet it is a critical piece of information for sorption and radionuclide transport.

Coles and Ramspott (1981, page 1), state: "Ruthenium-106 has been observed to migrate at the same velocity as H-3 in groundwater from the site of an underground nuclear explosion to a pumped satellite well. This finding contradicts laboratory sorption studies using material from this site that indicate that RU-106 should migrate at a much slower rate than H-3. These field measurements raise doubts about the wisdom of relying on simple laboratory sorption measurements to predict field radionuclide migration. Field tests are needed for verification for nuclides that can exhibit complex solution chemistries."

In summation, we feel that the statements (sentences 5 and 6) are either unsupported or poorly supported by field and laboratory data. The nature of vadose flux is unmeasured and unknown as is the probability of sorption.

Sentence #7.

"The air pathway may therefore represent the most likely pathway of radionuclide travel during the period when gaseous radionuclides are present in the radioactive wastes."

Comment:

Given this consideration it is important to show the significance of fractures as transport pathways.

6.2.2.1.3 (6-104) last paragraph to top of page 6-105.

Radionuclide release rates are stated as flux dependent (6-320, table 6-45). The flux is unknown, therefore, release rates are unknown.

A discussion is necessary describing releases under elevated temperatures.

Cite reference for krypton-85 predicted release and method of calculation.

6.3.1.1.1 (6-112).

By admittance of the DEA this guideline has not been complied with, (see pages 7-10, 7-11, 7-14, 7-16, 7-20, 7-21). Insufficient data has been collected to draw conclusions concerning geohydrology.

6.3.1.1.2 (6-114-115) Table 6-15 Condition #4

Although these conditions are not applicable, the document indicates that the conditions are met to some degree. Condition i states the host rock (Topopah Springs) is low in hydraulic conductivity (< 1.0 mm/year). This is not correct. Core matrix samples show a geometric mean of perhaps 1 mm/year. However, the range of conductivities is over 3-4 orders of magnitude. In addition, bulk conductivity may be high, based on saturated zone testing of the Tonopah Springs at J-12 and J-13. Condition (ii) indicates that the gradient is downward in Topopah Springs, but these data are not reported in any supporting references. Condition (iv) indicates that the hydraulic gradient is low in the Calico Hills, however no data are presented on the gradient. Data is also presented in the references stating that the effective porosity, or portion of pore space contributing to flow under saturated conditions, may be as low as 1.6% by volume. This contradicts the value of 20% reported in the DEA.

6.3.1.1.2 (6-116) Table 6-15

Condition 5iv: "Free draining host rock." The DOE finding states that the host rock (Topopah Springs Member) is "expected to be freely draining". This point needs some clarifying. The Topopah Springs Member, based upon core analysis by Weeks and Wilson (1984), indicates that the rock matrix does not drain significantly even at high matric potentials (Figures 17-22, Weeks and Wilson, 1984). The free drainage concept may apply, however, to the fracture network in the Topopah Springs.

6.3.1.1.2 (6-117) Table 6-15 Condition #1

Those data do not necessarily indicate that increases in precipitation will decrease the travel time. The understanding of fluid movement in fractured rock is still in its infancy and is not at a stage where the cross-over point between matrix to fracture flow can be predicted in a heterogeneous fractured medium.

6.3.1.1.2 (6-120).

<u>Assumptions and data uncertainties</u> Bottom of first paragraph, last sentence.

Comment: Omit last sentence.

The extent of fracture flow is unknown; consequently, the assumptions and analyses made are not conservative and the conclusions drawn are speculative.

The issues of quantity and direction of flow are critical. Those data used for preliminary and final determination must be impeccable without significant uncertainties. The DEA admits to uncertainties and there are reasonable variations in the interpretation of those data presented. Authigenic mineralization of the fractures in the Topopah Spring Member, and statements by Winograd and Thordarson (1975) among other significant and meaningful observations suggest that fracture flow may play an important role in the vadose zone. The nature of that role is unknown.

6.3.1.1.3 (6-121) paragraph 1.

The likely flux through the repository of less than 1 mm/yr is not referenced in this section. The uncertainties in amounts of infiltration could cause many-fold changes in flux.

(6-121) paragraph 4 (6-122) paragraph 1.

The change in water-table elevation due to a climate change was based on work by Czarneki (1984) entitled "Predicted Effects of Climatic Changes of Water Table Position Beneath Yucca Mountain, Nevada Test Site." In that document, the recharge estimates were based on Rush (1970) using a technique developed by Eakin et al. in 1951. This technique as stated by Czarneki (1984) has been evaluated by others and been found to be only a very approximate estimate of recharge. This technique, although used extensively in Nevada reconnaissance studies whose purpose is quite general, was never intended to be an accurate site specific recharge estimating method.

The basis for the method (Eakin, _et al_. 1951) was to balance estimates of ground-water discharge for 13 basins in eastcentral Nevada against the then available estimates of precipitation to get recharge as a percentage of total basin precipitation. The recharge percentages were balanced by trial and error and were compared against those found by Maxey and Jameson (1948) for Las Vegas Valley and Fielder and Nye (1933) for a New Mexico basin. The precipitation map used was that prepared by Hardman _et al_. (1936), using few precipitation stations (Fordham and Stidd, 1967), most of which were located in valley bottoms. Therefore, recharge estimates based on the Eakin _et al_. method are tenuous and generalized, as are the predicted water-table changes cited in the DEA that rely on this method.

A second question is the impact of future climate changes (increased precipitation) on recharge through Fortymile Wash and therefore on future water-table elevation. The present day estimate of 0.41 m/ac. as obtained through trial and error procedures using a parameter estimation model by Czarneki and Waddell (1984). In their discussion on page 20 they state:

"The flux occurring as infiltration at Fortymile Canyon was set as a parameter; however, setting that flux as a parameter did not allow model convergence, because of significance correlation with parameter 3. Estimates of this flux were varied for individual runs until a minimum error variance was achieved" (Czarneki and Waddell, 1984).

This indicates that no real physical basis exists at present for that recharge value which could be highly significant in determining repository suitability. This value of infiltration to Fortymile Wash was then increased using some unspecified reasoning (Czarneki and Waddell, 1984, page 18, bottom) to reflect the increase in precipitation postulated. Czarneki and

Waddell (1984) state on page 21, "Changes made to fluxes from the northern boundary and Fortymile Wash had the greatest effect on the water-table position in the vicinity of the primary repository area."

Therefore, some more scientific basis is needed to estimate the expected increases in flux. A review of techniques for recharge estimation is presented in "Final Report, Regional Recharge Research for Southwest Alluvial Basins, 1980" by the Water Resources Research Center, University of Arizona. Chapters 4 and 5 discuss state-of-the-art thinking on mountain front and stream-channel recharge which could be incorporated into the modeling techniques used in the DEA.

6.3.1.1.3 (6-121) paragraph 1, sentence 2

"That discussion shows that, for the likely flux through the repository of less than 1mm/yr (0.04 in./yr), the estimated ground-water travel time to the base of the host rock is 5,000 years or more."

Comment:

This conclusion is based upon assumptions which may or may not be valid; it is, therefore, poorly supported. Montazer and Wilson (1984, page 4) state: "The current lack of knowledge is the result of: (1) Lack of data, because of the newness of the focus on the unsaturated zone; (2) inadequacy of the general state of understanding of the physics of flow in thick, fractured-rock unsaturated zones in arid environments; and (3) lack of well established techniques for testing and evaluating the hydrology of such unsaturated zones."

The sentence should be removed from the text.

6.3.1.1.3(1) (6-121) paragraph 2, sentence 1

The duration of the ground-water travel time unknown. Therefore, nature of the flux in the vadose zone is unknown. This sentence should be removed from the text. The basic information for determining travel times from possible flux rates are given in Montazer and Wilson (1984). These data are inconclusive.

6.3.1.1.3(2) (6-121-122).

Paleohydrological data for Yucca Mountain are limited. Zeolite and glass distribution indicate that a higher water table was present in the past (about 200 to 650 feet above present standard water level). These information loosely correspond to data obtained by Waddell (1982). However, estimates of time of zeolite formation and therefore the age of the elevated water table are unclear. The statement that if the presumed decrease in hydraulic head were to continue in the future, this would be a favorable condition for the repository appears equally valid with the statement that a change in climatic regime to that of the past would produce probable unfavorable conditions for the repository. Consequently, we find the conclusions to this section are <u>not</u> warranted from the support data presented. This entire section should be rewritten to indicate that there is insufficient data to draw any conclusions.

<u>Suggested Corrections:</u>

Omit the statement of "..... and a possible trend of increasing aridity." Increasing aridity is one explanation of the evidence from the geologic record. However, there are other explanations given in the literature. These should be listed or the statement omitted.

Further, the change in ground-water travel times should be given.

6.3.1.1.3(3) (6-122 to 124).

This section is confusing in the manner in which it is written. The conclusion that current data does not admit to reasonable certainty with respect to the geohydrologic system is understood. The fact that the future characterizations will provide these information with certainty remains to be seen.

The fact that this favorable condition is <u>not</u> present at Yucca Mountain compromises the certainty expressed in the DEA concerning the flux in the vadose zone and support previous comments made concerning this issue.

6.3.1.1.3(4) (6-124-125).

The nature of the hydraulic flux in the vadose zone is unknown and, consequently, those data presented are estimations based upon pore-flow with conceptual considerations (see Montazer and Wilson, 1984). This entire section should be rewritten as it is unsupported (specifically conclusions on page 6-125). In addition, there is reason to question the sorption characteristics of the host rock.

6.3.1.1.3(5) (6-125) paragraph 1.

It is indicated that <u>in situ</u> distribution of moisture contents for the vadose formations were obtained from boreholes UE-25 a#1 and USW-H1, which were drilled with either foam or mud. They further state that since these drilling fluids were used, the moisture content values are probably overestimated. It seems a mistake to try to determine the water content of a sample which has been placed in contact with moisture in the form of either of the drilling fluids used for these holes. A drilling method using air as the only circulating medium would be the acceptable method for obtaining samples from which moisture contents could then be determined. This technology is available.

6.3.1.1.3(5) (6-125-126) paragraph 2.

A mean saturation of about 65 percent with a range of 40 to 90 percent does <u>not</u> constitute a dry host environment. Therefore, these data should be reflected in statements in the DEA with respect to the vadose zone. The term "dry unsaturated zone" should be replaced by vadose zone in all sections of the DEA.

Evidence cited (section 6.3.1.4, page 6-190-204) does <u>not</u> indicate probable low and relatively long-term constancy of flux; rather, data is inconclusive to draw any meaningful conclusions concerning future flux from paleohydraulic information.

(6-126) paragraph 2.

Core sample taken from the Calico Hills units report saturation values of approximately 90% (Montazer and Wilson, 1984). Weeks and Wilson (1984) also report saturations in the bottom 10 meters of the Topopah Spring member of approximately 90%. In the vadose zone, one would consider these samples to be essentially saturated at zero pressure, with the remaining 10% of the void space filled with trapped air. Gupta and Swartzendruber (1964) report that 5-10% of the void space of "saturated" Banding Sand remained air filled during saturated hydraulic conductivity testing. Therefore, it does not seem unreasonable to say that the Calico Hills units and portions of the Topopah Spring member are at or near the total saturation that is possible under wetting conditions.

paragraph 3.

The last two sentences require revision based upon previous comments. Indirect evidence of fracture flow has been observed in the host rock (e.g., authigenic minerals in the fractures).

6.3.1.1.3(5) (6-129) paragraph 1.

"...the pulse of water would trap air in the upper part of the non-welded unit, thereby decreasing the permeability significantly." Under conditions of an air pressure build-up in the non-welded Paintbrush, air entrappment in the pores may not dominate. Instead, a condition found by Raats (1975) may occur, where the infiltration rate will decrease or stop until the air pressure is dissipated to allow the infiltration to proceed. Under these conditions, entrapped air is not in equilibrium with the infiltrated water and will diffuse. Under truly "entrapped" air conditions, the air bubbles are in quasi-equilibrium with the water around them and will not migrate and only slowly diffuse. In this case, the permeability will be decreased.

6.3.1.1.3(5) (6-129) paragraph 2.

Data on rock-mass permeabilities to air do fit with a fracture - matrix flux transport mechanism. Nevertheless, the DEA ignores fracture effects to aqueous - flux when it wishes to expose low flow yield rates to the accessible environment. However, in this case (an evaluation for free drainage) the DEA wishes to show that the transmittability is relatively large. A distinction is made for water fluxes greater than 1 mm/yr. This presumably would equate to a recharge rate greater than 4.5 mm/yr.

A distinction of saturated hydraulic conductivity and saturated matrix hydraulic conductivity apparently is made so as to best support repository favorability.

6.3.1.1.3 (6-130) first paragraph 130.

"Potential evapotranspiration was estimated by an empirical method reviewed in Rosenberg (1974) that uses a yearly heat index and mean monthly temperatures. Potential evapotranspiration for Yucca Mtn., corrected for actual sunshine hours, is about 630mm/yr. (24.8 in./yr.). Therefore, the average annual precipitation, about 150mm (5 to 6 in.), is about 20 percent of the annual potential evapotranspiration."

The statement is factual but misleading. Citing average annual evapotranspiration values like these gives the incorrect impression that no infiltration occurs after evaporation. The statement obscures the fact that short-term, high intensity summer storms, and winter precipitation as snow at Yucca Mountain clearly do produce infiltration, an unknown part of which is not later evapotranspired. This distinction is even more critical considering that the proportion of winter precipitation was probably greater during the full-glacial, while in the latest Pleistocene, torrential summer rains may have been more important that today (see Spaulding, et al., 1984, and general comments on paleoclimate in this report).

(6-130) second paragraph.

In the light of previous comments, this section requires revision.

"The highly fractured host rock provides free drainage for any water in excess of about 1mm/year (0.04 in./yr)." This statement suggests that the 1 mm/yr flow is based on matrix flow and that if water exceeds this in supply that fracture flow will dominate (see Montazer and Wilson, 1984).

Does this also mean that if more than 1 mm/year source is provided to the system than the ground-water travel time would be based upon fracture flow and not necessarily matrix flow and that this would significantly change the potential release rate to the accessible environment? Please discuss this issue and base the discussion on measured field data.

6.3.1.1.4 (6-130) second paragraph.

Add other changes, such as:

(4) Changes in the vertical distance to the zone of saturation and therefore in the estimated ground-water travel time to the accessible environment.

fifth paragraph, last sentence.

"The geochemical barrier provided by the Calico Hills nonwelded unit would still retard the transport of radionuclides, although their movement could be more rapid than during periods of less recharge."

Correction:

The DEA has not demonstrated that a geochemical barrier exists in the Calico Hills nonwelded unit. Therefore, the extent to which nuclide species may be retarded is unknown. Heat-flow characteristics vary with the physical properties of the tuffs and would be responsible for variable, and localized differences in authigenic mineral stability. Sorption as a function of mineral stability has not been addressed.

Heat flow is also a function of saturation conditions. Sorption as a function of heat flow and saturation has not been addressed. Sorption is also a function of ground-water geochemistry. The chemical composition of the vadose water has not been measured. Estimations using J-13 water do not take into account the potential oxidation state of vadose water; therefore, sorption as an effective agent for retardation is unknown. Sorption studies on whole-rock samples indicate that sorption potential exists at Yucca Mountain. It is unfortunate but the extent of that knowledge is minimal and has not addressed the pertinent geochemical issues concerning sorption.

6.3.1.1.4 (6-130-135) Potentially Adverse Conditions

In this section, the DEA deals with the expected changes in the fluid flow regime as a result of waste emplacement. Missing from this discussion is the effect of heat loading on the hydraulic gradient, conductivity, and water contents. The processes involved with non-isothermal fluid movement are poorly understood at best and may provide for nuclide pathways not discussed in DEA such as vapor transport, aerosol transport, dewatering of zeolite minerals adjacent to the repository and the resultant volume changes. These are questions which are important to the feasibility of a vadose zone repository but they are not addressed here. At present, there is insufficient evidence that no adverse conditions exist.

6.3.1.1.4 (6-133) second paragraph, sentence #2.

If the increase in effective porosity occurred after the vadose water acquired radionuclide concentrations, the free drainage factor would be an unfavorable characteristic because this contaminated body would access the environment sooner than anticipated.

Sentence #4.

"Retardation within the saturated zone probably would be minimally affected."

This concept is unsupported and should be removed from the text.

Sentence #5.

Under what conditions would these authigenic minerals form? The statement that:
..."fracture coatings (zeolites, smectites, and manganese oxides) have very reactive surfaces that greatly increase retardation." is probably accurate; however, it remains unsupported here. Please show how each of these authigenic products would form as fracture coatings and how each of these would retard radionuclide migration by sorption. Apply these information with respect to each of the radionuclide which might evolve from the repository, and since there are information with respect to the oxidation state of the saturated water column please include these information in your reactions. These information could be included in an appendix to the EA. In specific, we are very interested in the ferromanganese oxyhydroxide sorption data which apparently is available in order to arrive at the statement made here. We are interested to find out which of the minerals (eg. todorokite or possibly ramsdellite or birnessite) have been identified and what their respective sorption capacities are in relation to their aging, oxidation states, dehydration and possibly even internal rearrangements.

In addition to those ferromanganese data, we have not seen information concerning nontronite, interlayered smectites, etc... Please make these data available with respect to specific radionuclide sorption.

There is a suite of zeolites observed in the tuffs of Yucca Mountain. Since analcite has different sorption properties than a Ca - Clinoptilolite or a Na - Clinoptilolite, have studies related to the specific sorption capacity of these minerals on radionuclides been made? These data do <u>not</u> appear in the program reports and publications and they are important to the prediction of sorption.

In order to form zeolites, smectites, and ferromanganese oxyhydroxides as fracture coatings, there must be a source material (eg. obsidian - perlite). In order for these diagenetic reactions to be effective in the retardation of radionuclides, the authigenic minerals must form in the potential transport pathways. Please describe the conditions of formation of each of these minerals with respect to anticipated temperatures, glass and perlite availability, and water chemistry. Please describe the rates of glass hydration and diagenetic mineral formation for each of the minerals under the various scenarios of environmental conditions. If the suggested information were to be provided as support for this statement, it would also lend strong support for other similar statements in the DEA.

6.3.1.1.4 Potentially Adverse Conditions, (6-136) paragraph 2

"Less than 3 percent of the annual precipitation is expected to provide recharge for the ground-water system (Rush, 1970)."

Again, the basis for such a statement is tenuous at best and needs to be substantiated by actual site data.

6.3.1.1.5 (6-136) first, second, and third paragraphs.

Montazer and Wilson (1984, pages 40 and 41) indicate that: "..a discrepancy exists between the in situ potential measurements in borehole USW & UZ-1 and the matric potentials reported for borehole USW H-1." "Preliminary analysis of data from borehole USW UZ-1 indicates both upward and downward water fluxes occurs in the Paintbrush nonwelded unit. Estimates of flux range from 10 to 30 mm/yr, both in upward and downward directions when only vertical flow is considered."

There seems to be some question concerning the flux in the vadose zone as is reported in this section. If matrix saturation is reached with a low matrix flux it appears feasible that fracture flow will dominate. If fracture flow dominates, the flux would presumably significantly greater. The actual travel time could be much reduced and could potentially not be within the 1000 year expectations.

The scenario just described is possible and would fit with data presented. Montazer and Wilson (1984, page 1) state: "In this model, flow through fractures can occur at almost all stages of saturation,.." They also state (on page 1) that: "The authors recognize, and the reader should be aware, that the proposed model probably is not the only reasonable description that would be made at this point, and it certainly is subject to revision and quantification as more data becomes available."

This issue is plagued by unverified assumptions and poorly grounded models. Actual field data is needed to derive meaningful conclusions.

6.3.1.1.5 (6-137 to 140).

Travel time calculations in this section are based on assumptions of matrix flux and estimations concerning average saturated hydraulic conductivities. The assumptions and estimates are not conservative, and bounding estimates on hydraulic saturation are not offered. The section admits to: "In the absence of data on tuffs from Yucca Mountain pump test estimates were used to obtain effective porosities." As effective porosity could reasonably range over several orders of magnitude in the fractured terrane of the assumed travel path, this part of travel time calculation is also not conservative. Again, there does not seem to be reliable field data, and consequently, travel time estimates are inconclusive and not conservative in the manner derived.

6.3.1.1.5 (6-139) Table 6-17
6.3.1.1.5 (6-141) Table 6-18
6.4.2.2.2 (6-314) Equation 6-10

Each of these citations refer to the travel time calculation in the vitric member of the Calico Hills non-welded unit. In each citation, the flux used in the travel time is assumed to be limited by the flux coming from above (from the Topopah Spring Member), to be less than 4.5 mm/year by DOE. However, the saturation profile in the Calico Hills, if limited to the low flux and constrained by the conceptual model, should be in range of 40% (Peters, et al., 1984).

Instead, reported values of saturation in the Calico Hills are in the range of 90%. These values imply several possible conditions: 1) the unit is poorly draining, 2) the water table and/or capillary fringe is affecting the unit gradient hypothesis, or 3) flux is not limited to 4 mm/year. The first physical condition does not appear likely since the conductivity of the unit is quite high. The remaining options are plausible, but these data are insufficient to make a decision. By ignoring this information, the DEA has not been conservative in the travel time estimates since the vitric Calico Hills has been credited with 90% of the travel time in Case B, Table 6-19. Also, the favored conceptual model is challenged by the relationship.

6.3.1.1.6 (6-140 to 142).

The evaluation is unsupported and misleading. It should be rewritten to indicate that there are no information present that shows that it would not qualify. The absence of raw data does not indicate that Yucca Mountain would not meet appropriate conditions. It's absence does indicate that repository feasibility is still unknown.

The fact that Yucca Mountain is located in a desert environment does not assure that very little water will contact the radioactive waste. Paleoclimate data available do not specifically predict how much more infiltration will occur in the future. There is no enhancement of isolation potential provided by the information available.

The retardation capacity in the expected flow paths are unknown, unmeasured, and the statement with respect to them is unwarranted.

The conclusions drawn have not been documented. There is serious question concerning section 6.3.1.2. It does not document conditions as reported here. Analysis of ground-water flow time, ground-water flux, and radionuclide retardation point only towards insufficient data to draw any meaningful conclusions. "Therefore, the evidence does not support a finding that the site is not likely to meet the qualifying conditions for geohydrology..." is appropriate.

6.3.1.1.7 (6-142) Plans for Site Characterization, entire section

No mention is made of specific research on current infiltration and recharge mechanisms which would then serve as a basis for postulating future conditions.

We suggest that plans for site characterization be revised and that data be collected to focus on significant issues which may characterize repository behavior.

6.3.1.2.2 (6-143) paragraph #1.

We find, after review of the cited literature, very careful and excellent presentations and concur with the findings presented.

We would like to see more clay chemistry data above the standing water level, identifications of ferromanganese oxyhydroxides mineralogies, and zeolites, and other authigenic mineral data in fractures in the vadose zone.

Paragraph #2.

The water used to study the solubilities of waste elements was derived from J-13 well and should <u>not</u> be construed as Yucca Mountain water, which itself remains undescribed. Vadose-zone water from Yucca Mountain is required for these experiments. Although vadose zone water may have been encountered in the field, it apparently has not been analyzed. It is possible but as yet unknown whether the vadose water is more oxidizing than J-13 water.

Paragraph #3.

"The minerals in Yucca Mountain that contribute significantly to radionuclide sorption have been identified (Heiken, 1982)."

This statement is incorrect. Stratigraphic diagrams showing mineralogy and separate stratigraphic diagrams showing limited species of radionuclide have not determined which minerals are responsible for sorption (Heiken, 1982, pages 84-94). Heiken (1982, pages 92-103) show sorption as a function of tuff mineralogy. In this section, clinoptilolite (unknown composition) is shown as a sorption agent for 10 radionuclides. The location of the clinoptilolites are not given.

Heiken (1982, page 93) indicates no obvious correlation between zeolite abundance and sorption ratios for technetium, cesium, europium, and americium. They find no trends with increasing zeolitization (but high sorption ratios) for increased sorption of uranium, neptunium, and plutonium. They find trends and sorption ratio correlations for cesium, strontium, and barium (although the least square fits are not very good).

On page 93, they state: "Figure 33 shows the absence of any obvious trend for cesium when considering smectite alone in nonzeolitized samples. Similar plots for other nuclides, not shown, do not indicate any apparent correlations." On page 93 and 100, they state: "Evidently, the more random structure of analcime, compared to the open-cage structure of clinoptilolite, inhibits exchange of ions such as strontium, cesium, and barium." On page 100, they (Heiken, 1982) indicate that they were unable to draw any conclusions concerning mordenite.

In addition, wafer experiments on sorption did not report sorption as a function of mineralogy. Batch sorption experiments reported in Heiken (1982) did not investigate sorption as a function of mineralogy. Kd values are reported for clinoptilolite (no chemical analysis) montmorillonite (no chemical analysis), analcime (no chemical analysis), and glass (no chemical analysis). We find no other information in the citation used (Heiken, 1982) that indicates that the minerals in Yucca Mountain that contribute significantly to radionuclide sorption have been identified.

We find no information which is usable in the prediction of sorption behavior as a function of mineralogy offered in the reference. No chemical analyses were offered for the authigenic minerals. Most of that which was done indicated poor to very poor relationship between sorption and mineralogy. None of these data presented are sufficient to support statements in the DEA on page 6-133, (previously commented on).

Sorption ratios for batch samples indicate that the tuffs provide sorption potential in J-13 water, but do <u>not</u> indicate which minerals are responsible for that sorption <u>nor</u> the stability of those minerals. These data do <u>not</u> indicate batch sorption in the vadose zone.

The stability of the sorbing minerals require extensive investigation.

6.3.1.2.2 (6-147) paragraph #1.

The location of sorbing minerals have <u>not</u> been determined. The location of diagenetic minerals which may act as sorbing minerals under certain environmental constraints has been determined for a limited number of cores.

Characterization of fracture mineralogy has apparently been accomplished as a brief survey and is <u>not</u> a comprehensive study. Authigenic mineral distribution in the fractures is <u>not</u>

the same (stratigraphically) as in the matrix. Ferromanganese minerals have not been adequately identified.

Those data presented by Bish et al. (1984); Vaniman et al. (1984) among other reports from Los Alamos, appear to be comprehensive and well-documented studies. Considerably more efforts in this direction are required especially in mineral stability.

There is an apparent need to combine the mineralogy studies with the sorption geochemistry and mineral stability studies.

6.3.1.2.2 (6-147) paragraph #2.

"The flux of water through the unsaturated zone at Yucca Mountain has been estimated from several lines of evidence (see, Section 6.3.1.1)."

These data are inconclusive. Direct measurement was not among the methods. The water flux of the vadose zone is a critical parameter for site evaluation. It should be measured with accuracy.

Water chemistry also is an important parameter for site evaluation. Estimations of water composition are inconclusive. The potential for matrix diffusion to retard radionuclides requires a comprehensive data bank of information on Yucca Mountain authigenics and water chemistry. These data are unavailable, therefore diffusion estimates are inconclusive.

6.3.1.2.2. (6-147) paragraph #3.

The water used is inappropriately stated as "Yucca Mountain groundwater". Actually the water is J-13 water. Well J-13 not located on Yucca Mountain.

"The corrosion of the reference waste canister material (austenitic stainless steel) in the repository environment has been studied (McCright, et al., 1983)." This statement is incorrect. The chemistry of the vadose water is unknown and therefore the repository environment is unknown. Consequently, corrosion susceptibility of the waste canister material is unknown.

6.3.1.2.2 (6-147) paragraph #4, sentence #1.

This sentence requires clarification and support citations.

Sentence #2.

This sentence suggests that no authigenic mineralization occurs in Yucca Mountain at present, and that all of the clinoptilolite and mordenite were formed just after faulting.

1. Does this also apply to zeolites in the fractures?

2. Does this also apply to zeolites in the upper portions of the vadose zone?

If this suggestion is accurate, then, how does this effect statement made on page 6-133, paragraph #2.

Clarification of this statement is required.

Sentence #3.

This statement is unsupported. Cite appropriate literature or remove the statement from the text.

In particular, we are concerned about the differences in thermal stability between Ca - clinoptilolite, K -

clinoptilolite, and Na - clinoptilolite. Our concerns are similar for mordenite and heulandite.

6.3.1.2.2 (6-147) paragraph #5.

There are apparently significant assumptions made without supporting documentation. All of these assumptions require a basis and therefore should be supported in the DEA.

This section admits to revision. All assumptions require support.

6.3.1.2.2 (6-147 to 148) sentence #1.

This statement is incorrect. The maximum flux would be related to fracture flow. A fracture-flow flux was not used in the analysis.

Sentence #2.

This statement is incorrect. Water from Yucca Mountain has been chemically analyzed from the saturated zone for a limited number of samples. No vadose water has been collected or analyzed. The proposed repository is located in the vadose zone. Those data presented are misleading.

Sentence #3-4.

The rate of flow in the vadose zone is unknown. The geochemistry of the vadose zone water is unknown and unsampled. The assumptions are hardly conservative.

6.3.1.2.2 (6-148) paragraph #2, sentence #2.

This statement is inaccurate. There are a host of assumptions with respect to fracture analysis including aperture size and frequency. Apparently, there are very little information available concerning fracture parameters.

Last sentence.

Please consider vapor transport.

6.3.1.2.3 (6-149) paragraph #2.

"The alteration of glass to zeolites and clay is a favorable geochemical process because it increases the radionuclide sorptive capacity of the affected rock."

In order for this statement to be accurate, it is necessary to show the relationship between sorption of each radionuclide and each authigenic mineral (eg. Ca - vs. K - clinoptilolite). An assumption is made that zeolitization is not an ongoing process above the present water table. This requires a comprehensive discussion beyond data presented by Bryant and Vaniman (1984).

"Therefore, a zeolitization rate that was close to zero during the Quaternary Period may be the most favorable condition." This statement has not been appropriately documented.

"It provides a basis for predicting a similar zeolitization rate for the next 100,000 years". If this is so, please rationalize the statement made on page 6-133: "On the other hand, a decrease in effective porosity by the precipitation of minerals in fractures would be more than offset by increased sorption; fracture coatings (zeolites, smectites, and manganese oxides) have very reactive surfaces that greatly increase retardation."

In one case, there is a prediction that authigenic minerals will occur and in another case, there is a prediction that they will not occur. We are unclear of the position of the DEA on this issue.

6.3.1.2.3 (6-149) paragraph #3.

The geopetal data (Bryant and Vaniman, 1984) indicate early zeolitization after faulting for zeolites below the water table. Their work does not speak to zeolites in fractures and in potential perched water zones in the vadose zone. In addition, the argument that most of the glass below the water table was altered to zeolites after faulting is probably accurate (based upon those data offered); however, the geopetal data do not strongly indicate the time of the last zeolitization occurrence after tectonic stability. The zeolites above Topopah Spring Member were not investigated, nor were the zeolites below the Bullfrog Member of the Crater Flat Tuff. Therefore, there are very little data on the time of zeolitization in these horizons. It would be reasonable to assume that the zeolites below the Bullfrog Member are similar to those described by Bryant and Vaniman (1984). Bryant and Vaniman (1984, page 76) state: "These results suggest that the tuff was almost completely altered by the time most geopetal fillings were deposited, earlier than 11.3 m.y. ago. With so little unaltered glass remaining in the rock, zeolitic alteration rates since then must have been close to zero." Glass that was not altered during the early period of ground-water exposure after faulting may have altered between that time and the present day. Glass that is presently unaltered may alter if there is sufficient water contact to provide hydration. Zeolites may or may not be the authigentic products for glass hydration if the geochemical conditions favor smectite production over zeolite formation. Zeolite overgrowths (and larger crystals) may indicate that some zeolitization occurred after geopetal filling.

Those data presented by Bryant and Vaniman (1984) form an important and well-constructed analysis. They have clearly shown early zeolitization after faulting. Their data are inconclusive for predicting future zeolitization. Those responsible for constructing the DEA should review this study again and modify the statements made in the DEA.

Data presented by Levy (1984) indicate a separate episode of zeolitization for the Topopah Spring Member of the Paintbrush Tuff. We are not convinced from the data presented that the time of zeolitization represents the cooling period. Our analysis of the raw data presented by the Los Alamos group indicated a zeolite horizon parallel to the present water level but 200 to 650 feet above it. The parallelism suggests that the zeolite horizon coincides with a former high water table.

We also observe three potential zones of perched water above this paleo-water level based on further zeolite occurrences. Our interpretations from data are consistent with hydrogeologic parameters. They also conform with cation concentrations in clinoptilolites with respect to potential vadose-water geochemistry (there are stratigraphic-geochemical correlations in the clinoptilolites in the vadose zone which may represent vadose water chemistry - clinoptilolite fractionation - selectivities can be used to approximate vadose-water chemistry). For those patterns to occur, we conclude that vadose-zone zeolites formed after faulting, and as a consequence of hydration reactions with perlitic debris with the tuffs and associated vadose water. Further, we cannot determine the time of zeolitization (after faulting) with those data presented for our review. Finally, the concordance between the zeolite horizon and modern topography and water levels is compelling evidence for zeolitation after faulting. We would anticipate zeolite horizon displacements if zeolitization occurred prior to major tectonic activity.

It is our contention that zeolitization could occur at any time within the vadose zone as long as there is sufficient water and appropriate water chemistry to provide a gel from a glass - water reaction. We have no evidence that this is not occurring today, and we have no evidence that it is occurring.

6.3.1.2.3 (6-149-150).

It is doubtful that there is sufficient evidence to determine the time it takes to convert clinoptilolite - mordentite to analcime at Yucca Mountain.

At the analcite/clinoptilolite boundary, the clinoptilolites have Al-Si ratios that are anomalous to their cation concentrations. This apparently is an indication of zeolite transition and potentially indicates a pH change in the ground water. We have no indication of the timing of this reaction.

6.3.1.2.3(2) (6-150 to 6-160)

Precipitation of radionuclides in a natural environment is a very complex problem. The research to date is inadequate to answer if radionuclides will or will not be precipitated in any form. The discussion on page 6-151 only mentions pH and the actinides. While this is interesting, it has limited bearing the question of radionuclide precipitation. A complete evaluation is needed with both Eh-pH, dissolved ions, temperature, etc. Precipitation will only take place if the activities of the appropriate cations and anions are present supersaturation amounts. It is further proposed that this precipitation will take place in the vadose zone, from which there is no water chemistry. Therefore, the possible precipitation of radionuclides is clearly only a hypothesis in need of testing.

Radionuclide diffusion into Yucca Mountain tuffs is also an untested hypothesis. Certain analogies are made with studies in granitic terrain where general characteristics, such as porosity, are compared. The major question still remains as to how much diffusion will take place under conditions of fracture flow with velocities of several meters per day. The referenced Rainier Mesa tuffs are interpreted as having flow velocities several meters per day with minimal changes in water chemistry from the soil zone to the tunnels (Henne, 1982).

The study of sorption of radionuclides by Yucca Mountain tuffs possibly shows misplaced emphasis. An underlying research assumption for radionuclide sorption has been that matrix, not fracture flow is dominant. Fracture flow is ignored even though varying data supports fracture flow in Yucca Mountain tuffs. This is discussed more fully in the section related to the vadose zone. The apparent total lack of a multiple working hypothesis, which is basic to any scientific investigation, led to ignoring many possibilities. The one clear omission is an examination of the sorption capacity of minerals coating the fractures. If fracture flow is dominant, then the tremendous effort put into both sorption studies on crushed tuff will of limited value. The data presented in tables 6-21a through 6-22b is interesting but by no means definitive. Therefore, research on fracture mineralogy is urgently needed.

The formation of particulates, colloids, and inorganic complexes, which increase both the solubility and mobility radionuclides, is highly probable. Data on particulates and colloids are lacking but recent finds by Lawrence Livermore National Laboratory (LLNL) presented in their latest annual report suggest that colloids are common in ground-water systems.

Certainly inorganic complexes of various forms will most likely result when the radionuclides dissolve in the native ground waters. Uranium carbonate and bicarbonate complexes (ion pairs) will result and remain stable for long times and distances. The transport of radionuclides by particulates, colloids, and complexes is highly probable. The mechanisms proposed to remove these forms of radionuclides is questionable and not supported by the data presented. Ultrafiltration of the radionuclides is proposed but is based on many assumptions about the size of colloids and type of flow. The size of particles and colloids is still in question, as evidenced by a recent finding by LLNL where a 0.006mm filter was used to filter colloids. Matrix flow is assumed but not proven. In fact, fracture flow is strongly suggested. Under fracture conditions, perhaps no filtration would occur.

Formation of complexes is dependent on a great number of conditions, which are not well known at the present time. Since the DEA has no discussion on complexes, it is likely the authors agree that so little is known about complex formation and mobility that virtually anything could be possible. Clearly more research is needed on the subject of particulates, colloids, and complex formation and mobility. The conclusions presented on page 6-160 are simplistic and inadequately supported by the data presented. For example, it has not been proven that 1) radionuclides will be diffused to any degree into the rock matrix, 2) particulates and colloids will be filtered out of the water under fracture flow conditions, and 3) any substantial sorption of radionuclides will take place.

6.3.1.2.3 (6-150) second paragraph.

This apparently is a significant potential problem that requires extensive investigation. At present, there are no chemical analyses from the vadose zone. The reaction of precipitation with surface carbonates and vapor phase feldspars may be the most significant reactions in the upper vadose zone. These reactions should be investigated in addition to biochemical reactions which might take place.

Until these data are available, the role of sorption remains in question.

6.3.1.2.3 (6-150) third paragraph.

The conclusions are not warranted from the data available.

Authigenic mineral reactions occur, in the vadose zone. However, this process remains undocumented for Yucca Mountain. These reactions may be favorable in that they might provide additional agents for sorption, although the sorption relationship is unknown at present. In addition, these reactions may be unfavorable if they produce minerals that can dehydrate in response to near-field heating.

The volume of authigenics in the repository zone have not been addressed in the DEA. Consequently, it is unknown how much water could be evolved (especially zeolites in fractures in the Topopah Spring Member of the Paintbrush Tuff). Additionally, the evolution of water from authigenic minerals will affect vadose zone water chemistry, which in turn will affect sorption.

It appears that the geochemical problems involved are quite complex, possibly too complex to resolve.

6.3.1.2.3 (6-151) first paragraph.

This is an interesting discussion concerning ground water; however, it is less significant than a discussion on vadose water. Considering the repository is situated in the vadose zone, it is surprising that vadose water has not been collected, even though it has been encountered in drilling. What are the oxidation states of the vadose waters and how does this effect radionuclide solubilities?

6.3.1.2.3(2) (6-151) paragraph 2 (Diffusion).

The discussion indicates an agreement between data obtained from granitic rocks (as offered by Neretnieks, 1980) and data obtained from tuffs from Yucca Mountain. <u>If</u> the conclusions of this discussion are correct an important question is raised as to the true age of the Yucca Mountain ground water. The 14-C age data for Yucca Mountain ground water may therefore appear too old as a consequence of 14-C diffusion into the matrix. If we apply a similar analysis to the 14-C diffusion calculations as was completed by Neretnieks (1980) we expect that the ground-water ages will appear considerably older (up to two orders of magnitude) than their actual transport time from recharge to well sampling point. Although we do not expect the diffusion of 14-C effects to be as great as reported by Neretnieks (1980) for granite due to the apparent greater permeability of the tuffs and thus a greater flux rate, we do feel that <u>if</u> the discussion offered in the DEA is valid, the resulting transport times of water will have to be considerably elevated. Although under these conceptual considerations those radionuclides <u>not</u> affected by complexing will probably be effectively retarded by diffusion, we note that chemically oxidizing conditions of the ground water provide potentially adverse conditions which may result in certain radionuclide complexing and precipitation to colloids.

Colloidal transport of radionuclide complexes are for all practical purposes not affected by diffusion. Consequently, given the indication of rapid ground-water flux, nuclide transport to the accessible environment could be considerably less than 10,000 years. We admit, however, that carbon-14 diffusion, in light of carbon-13 and carbon-12 diffusion, does not seem to be resolved by Neretnieks (1980). Therefore, more investigation is clearly warranted.

6.3.1.2.3 (6-151) third paragraph, to page 6-152, first paragraph.

The term significant quantities of zeolites and clays requires definition.

It has not been sufficiently demonstrated that the zeolites are effective sorptive barriers. Sorption experiment are needed for Yucca Mountain clinoptilolites, mordenites, and heulandites with known cation concentrations.

6.3.1.2.3 (6-152) second paragraph.

Batch sorption studies using J-13 water do not conform to sorption studies on tuffs with actual Yucca Mountain water.

6.3.1.2.3 (6-152) third paragraph.

The first sentence is inaccurate (see previous comments). Smectite sorption data offered by the program documents are not sufficient to make statements concerning ion exchange. Sorption studies on clinoptilolites of unknown chemical composition comprise those data obtained.

What are the expected quantities of cesium, strontium, and radium in comparison to the other radionuclides which might evolve?

How does clinoptilolite stability with temperature effect sorption?

Does Ca - clinoptilolite sorb equally to Na - clinoptilolite?

We suggest that this paragraph be removed from the text unless specific data can be offered.

6.3.1.2.3 (6-152) paragraph #4.

Data offered in this paragraph are misleading. Oxygenation of the ground water and possibly the vadose zone water place sorption of these nuclides in question.

Anion-exchange materials are mostly hydrates which might have negative effects in the near-field environment. No such plans have been discussed elsewhere in the DEA. This should be removed from the text unless it is adequately treated in the DEA.

6.3.1.2.3 (6-158) paragraph #1.

These data do not take into account the potential of oxidizing waters. Fracture flow is a feasible mechanism of transport. More field data is required prior to assessing sorption capacity.

6.3.1.2.3 (6-158) paragraph #2.

It is <u>not</u> evident that sorption will provide any significant form of radionuclide retardation. There does not appear to be sufficient data available to draw conclusions at this time.

It is difficult to draw meaningful estimates of diffusion and precipitation without knowledge of water chemistry.

6.3.1.2.3 (6-158 to 6-160).

If fracture flow is more significant than is represented in the DEA, the transport of the actinide colloids will be different than described.

6.3.1.2.3 (6-160) Conclusions:

pH data are available for ground waters of Yucca Mountain, yet, these data are not offered here. Please explain the reasoning behind this.

Sorption of certain radionuclides are probably based upon data presented. It is unknown how the mineralogy affects sorption. Data on vadose-zone water is not available. Transport to the saturated zone must first be accomplished through the vadose zone. Nuclide reactions in the vadose zone are unknown. Overall retardation of radionuclides in the near-field is unknown.

Conclusions concerning sorption and retardation are unsupported and needs revision.

6.3.1.2.3(3) (6-161) paragraph #1.

Variations in conductivity in the tuffs indicate a complex response to the effects of repository heating. The potential dehydration of near-field mineral hydrates and the associated production of hydrate water will probably change the heat flow characteristics. Vadose water contents and variability are apparently unknown. The effects of repository heating on water movement in the vadose zone are unknown. The accompanying flux is therefore unknown. The effects of repository heating on authigenic mineral stability remains to be investigated.

The quantity of zeolites and other potential sorptive minerals which may be affected by repository heating is unknown.

There are not enough meaningful data produced by the project to come to any conclusions concerning authigenic mineral stability in either the near-field or far-field.

The third paragraph needs revision.

6.3.1.2.3(3) (6-161) paragraph #2.

The mechanism of obsidian hydration to perlite and the formation of authigenic products is not well known. Rates hydration are related to temperatures as well as the chemical composition of the aqueous and solid phases. The effect of elevated temperatures on the alteration of Yucca Mountain perlites to authigenic minerals has not been demonstrated. The diagenetic minerals which might occur are unknown. Consequently, the nature of sorption with respect to this issue is unknown and the paragraph requires modification.

6.3.1.2.3(3) (6-161) paragraph #3.

Authigenic mineral stability is partially a function of its chemical composition. These data have not been addressed and consequently, stability and accompanying sorption are unknown. This paragraph requires modification.

6.3.1.2.3(3) (6-161) paragraph #4.

The conclusions drawn are hypothetical and lack a conprehensive data base, and are therefore misleading and require revision.

6.3.1.2.3(4) (6-162 to 6-164)

"A combination of the expected geochemical conditions and a volumetric flow rate of water in the host rock that would allow less than 0.001 percent per year of the total radionuclide inventory in the repository at 1,000 years to be dissolved." This whole section is based on two fundamental and totally unproven assumptions. The first assumption is that J-13 ground water is the same as the water in the vadose zone under Yucca Mountain. No water analyses are available from the vadose zone. Therefore, before reliable calculations can be made on dissolution rates, numerous water samples must be collected and used for lab dissolution experiments.

The second assumption is the 1 mm/year flow rate which is a based only on matrix flow. This has yet to be convincingly demonstrated. The best analog available at the present are the tunnels in Rainier Mesa. As discussed earlier, some flow is in fractures with velocities of perhaps several meters per day. Again, all calculations are based on data that are not well established. To make meaningful calculations of the flux term, considerable research is still required.

6.3.1.2.3(4) (6-162) paragraph #1.

The arguments concerning model analysis require an analysis of model assumptions to be presented here. The last sentence is not clear and requires modification.

6.3.1.2.3(4) (6-164) paragraph #3.

The conclusions based on the assumption of matrix flux require modification and the inaccurate statements concerning the chemical environment which has <u>not</u> been sampled or analyzed.

6.3.1.2.3(5) (6-164 to 165).

Fracture flow has not been addressed. Vadose water chemistry has not been addressed as a factor in radionuclide transport. The conclusions, therefore, are hypothetical and require supporting documentation.

"Any combination of geochemical and physical retardation processes that would decrease the predicted peak cumulative releases of radionuclides to the accessible environment by a factor of 10 as compared to those predicted on the basis of ground-water travel time without such retardation." This statement is derived from the previous statements and the reservations presented previously all apply to this section. The peak concentrations may well be reduced but none of the factors presented substantiate this contention.

6.3.1.2.4(1) (6-165 to 168).

There is no evidence to assume vadose water is similar to J-13 water. This assumption is made because the program did not collect vadose water, but instead used the nearest well water available, that of J-13. This could prove to be a serious failure in the research program. The Eh of the vadose water could be distinctly different than J-13 water. This is a critical chemical parameter in radionuclide behavior.

J-13 water does not appear similar to other ground water obtained from Yucca Mountain (J-13 water is not collected from Yucca Mountain). There are significant differences in cation composition which would affect authigenic mineral stability accompanying reactions.

Variations in J-13 water chemistry with time should be reported. It appears that there are some meaningful chemical changes of well water with time.

Since the Eh of the ground water has been a potential problem, this should be mentioned in the discussion under potentially adverse conditions.

It is probable that the concentration of silica in ground water is not the same as silica in vadose water. If this were to be so, then the discussion on borosilicate-glass may not be usable in assessment.

The conclusions drawn do not follow from the information available and are not warranted based on the lack of data on vadose-water chemistry. This entire section admits to revision.

6.3.1.2.4(3) (6-169 to 170).

These data are required in the 6.3.1.2.4(1) section. The nature of the mineral reactions which might potentially change the water chemistry have not been investigated and should be investigated during characterization. At present, reference to those reactions should either be based on published work or removed.

6.3.1.2.5 (6-170 to 171).

A statement should be included to indicate the lack of knowledge of the relationship between sorption and authigenic mineralogy. Statements should be reviewed in light of previous statements.

6.3.1.2.6 (6-171).

Characterization of the water chemistry in association with authigenic mineral chemistry is required. Exploratory shaft localized characterization studies may not encounter a reasonable spectrum of vadose zone aqueous, geochemical, and host rock conditions. Parallel study objectives are warranted at other locations as well. Construction techniques as proposed may not be compatible with several stated research objectives.

6.3.1.3.3 (6-178) second paragraph.

The question of fracture/fault access to the environment should be addressed here, especially in the light of vapor and gas transport possibilities.

6.3.1.3.3(2) (6-181) first paragraph, last sentence.

This sentence does not follow from previous statements. It requires clarification.

Second paragraph.

The variability of thermal conductivity and mineral content have a bearing on thermal expansion. A discussion is required.

The presence of glass with perlitic fractures would be affected by heating. Describe the effects with respect to near-field conditions.

6.3.1.3.4(1) (6-183) paragraph #2.

Omit first sentence; it is unsupported and misleading. It conflicts with previous statements in the text.

6.3.1.3.4(2) (6-184) paragraph #2.

It has been stated that there are very few authigenic minerals in the near-field stratigraphy. Yet, in this section: "In spite of the possible decrease in thermal conductivity, such fracturing may be desirable because of the increased surface area available for radionuclide retardation." Please elucidate on this statement with respect to actual field data. Is this with respect to diffusion?

Paragraph #3.

It is also possible that fracture aperture might be increased as a consequence of glass hydration and volume expansion, which could potentially result in shorter water travel times.

6.3.1.3.4(2) (6-185) paragraph #1.

What is the concentration of authigenic minerals in the fractures? We understand that authigenic mineral distribution in the fractures is significant and that in the near-field this could contribute to undesirable effects. A comprehensive treatment of this issue is required.

Paragraph #3.

Reversibility of a dehydration reaction does <u>not</u> indicate that waste isolation will <u>not</u> be effected. Radionuclides sorbed by zeolites may be released during dehydration; therefore, retardation may <u>not</u> be accomplished. Chemical changes, especially for cations during dehydration and rehydration, affect the sorption capacity of the zeolites. Chemical changes of the aqueous state would be expected due to the thermal activity of the aqueous state and the host rock. Sorption is a function of the chemical composition of the aqueous state and of the sorbing agents. These issues have not been addressed and therefore waste isolation is unknown.

6.3.1.3.4(2) (6-186) paragraph #1.

The conclusions do not follow from those data available. This section needs revision.

6.3.1.3.4(3) (6-186) paragraph #2.

The use of J-13 water compromises the certainty of the results of the elevated temperature experiments. The actual reactions are unknown.

Paragraph #3, last sentence.

Support for this statement is required.

6.3.1.3.4(3) (6-188) paragraph #2.

This statement is unsupported. Discuss this issue with respect to statements made (on page 6-186) and with respect to tritium and associated radionuclides. It is probable that if there is an aqueous phase containing radionuclides, and it is vaporized, radionuclides will remain behind. It is <u>not</u> so probable that water vapor will <u>not</u> react with a solid waste form to provide convective transport of radionuclides.

This statement is misleading and inaccurate. Volcanic glass is present and subject to dissolution. Laboratory experiments have shown dissolution features on phenocryst minerals. Authigenic minerals exist in the fractures.

This section should be removed from the text or be revised to a qualified statement.

Section 6.3.1.4.2 (6-190) Data Relevant to the Evaluation, paragraph 1

"Percolation rates through the unsaturated zone of Yucca Mountain were estimated based on analysis of data and interpretations from Rush (1970), Waddell (1982), Rice (1984) and Montazer and Wilson (1984)."

Rush (1970) and Waddell (1982) used the Eakin et al (1951) methodology to calculate infiltration and therefore recharge. This approach is unsatisfactory for two reasons. First, the method applies in only a regional, not site specific sense. No direct field data for infiltration from Yucca Mountain exist. Second, the method overlooks the sudden nature of desert climatic events by taking monthly averages. Much, if not most, recharge may occur due to short-lived (on a scale of days or hours) snow melt or torrential summer downpours. The above methods are insensitive to these events. They, therefore, may fail to accurately predict infiltration after evaporation. Site specific moisture holding capacity and infiltration rates need to be measured, together with site specific daily preipitation and temperature changes.

The most realistic appraisal of infiltration and recharge a found in Montazer and Wilson (1984) as follows:

"Direct measurements of infiltration and recharge have not made at Yucca Mountain. Estimates of recharge have been made by using various indirect methods; these methods can be applied to estimate net infiltration. However, the spatial and temporal relationships between infiltration and recharge are complex, because of the hydrogeologic variability of Yucca Mountain. Some water that infiltrates returns to surface runoff by interflow, and another part is stored in the soils and rocks and returns to atmosphere by evapotranspiration. Interflow probably is of short duration and occurs only during intense storms. This conclusion is inferred from the lack evidence for springs or seeps along the washes. A small quantity that is not evapotranspired or discharged as interflow percolates deep into the unsaturated zone and becomes net infiltration. The quantity of net infiltration that percolates through different paths is quite variable; therefore, the average recharge does not represent percolation rates through specific flow paths. Nonetheless, it may be assumed that beneath the entire mountain, the present net infiltration into the unsaturated zone is an indication of expected future recharge into the saturated zone. Estimates of present recharge can then be used as an index to past net infiltration."

Yet there still are no hard values of or measurements to estimate present recharge rates as further stated in the DEA on page 6-193. "The relationship between precipitation and recharge to the water table beneath Yucca Mountain is not well understood."

6.3.1.4.2. (6-193) paragraph 3

"The mineralogy of the fine-grained portion of the matrix samples of the alluvium, taken from boreholes north of Frenchman Flat, reflects the stability of water-table levels during the Quaternary Period (Jones, 1982)." (SEE also 6.3.1.4.3., paragraph 21, 6-198)

Comment:

Jone's (1982) conclusions are summed up in his abstract, which states "...Although an abundance of zeolite and slightly expanded basal spacings in smectite clays suggest effects of increased hydration of material up to 50m above the present water table, these differences might also be related to provenance or environment of deposition. However, the relative uniformity of clay hydration properties on the 50m above the current water table suggests long-term stability near the present level, perhaps through most of the Quaternary." (our underlines). The wording of the DEA should be changed to reflect Jone's degree of expressed uncertainty. It should also be noted that Jones cites no precedents for use of uniformity of basal spacing of clays to define former saturation. In the absence of other accordant evidence (and the evidence from the zeolites and for basal expansion higher up in the core is in fact contradictory), it is possible that his method is insensitive. Moreover, Winograd and Doty (1980) present evidence for an elevated water table (>40m) during the early to mid-Pleistocene at Ash Meadows. Examination of cores from playas is potentially a powerful technique for estimating water-table fluctuations. The evidence presented, however, is not so compelling as the DEA would indicate.

6.3.1.4.3. (6-196) paragraph 3
(6-196) paragraph 2
(6-197) paragraph 1
(6-197) paragraph 4

COMMENTS:

See detailed comments on Spaulding's packrat midden evidence, comment Section III.

6.3.1.4.3. (6-196) paragraph 2

"Winograd and Doty (1980) hypothesize that a progressive and continued uplift of the Sierra Nevada and Transverse Ranges during the Quaternary may have led to a long-term trend of increasing aridity in Nevada." and " The rising ranges would have produced a rain shadow effect that would have modified the distribution and amount of precipitation in Nevada and resulted in increased aridity."

COMMENTS:

Winograd and Doty (1980) make no such statement. There are references to the effects of a rising Sierra Nevada in that document. Smith et al. (1983) do present evidence from Searles Lake for the rising Sierra Nevadas as a cause for increasing aridity. In a later paper, Winograd et al. (1983) do link the rise of the Sierra Nevadas with increasing aridity from evidence of deuterium changes in calcite veins. This is not contradicted by the evidence from the Lake Lahontan sequence for wet pluvials, contrary to what is stated in the next sentence of the paragraph. The older Lahontan shorelines are probably equivalent to isotope Stage 6 (Illinoisan) at the oldest. This represents a much shorter span of time (<200,000 years) than the 3.2 million year span of increasing Quaternary aridity in the Great Basin.

6.3.1.4.3. (6-198) paragraph 5.

"In central Frenchman Flat, 58 km northeast of Ash Meadows, the maximum water-table elevation in the carbonate aquifers probably did not exceed 30 m above the modern levels (Winograd and Doty, 1980)."

COMMENTS:

As noted in paragraph 21 of the same section and quoted from the above authors, the paleo-water table was a minimum of 5m higher during the early to mid-Pleistocene based on the distribution spring-related calcite veins at Ash Meadows. However, an estimate of the maximum probable rise is 30m above modern, but this is not based upon such geologic evidence.

Instead, Winograd and Doty (1980) apply theoretical pluvial precipitation values and modified aquifer transmissivities, and from that calculate a probable range of paleo-water table evlevations. A few limitations of this method are:

(1) There is no reliable way as yet of relating precipitation to infiltration, even in the modern arid setting much less during the full-glacial. As the authors note, vegetative cover (type and density) and possibly seasonality of precipitation was different during the late Wisconsin, with as yet unquantifiable effects. As a result, 100% greater precipitation (or any other value you choose) during the full-glacial might result in proportionally much greater (or less) infiltration, depending on the above-stated factors.

(2) The theoretical estimate is not based on any hard geological evidence, either for or against. An upper limit of 50m of fluctuation is implied by the elevation of the calcite veins. However, the area has not been carefully examined, based on the literature, for late Wisconsin deposits. Denny and Drewes (1965) and more recently Pexton (1985) mainly confine themselves to pre-Wisconsin fine-grained deposits. Hoover et al. (1981) describes the eolian and coarse-grained alluvial deposits in some detail, but gloss over the spring-related tufas and associated fine-grained deposits. Mehringer (1970) dated a Holocene sequence in the vicinity of modern springs. It is possible that late Wisconsin deposition was in fact very limited in the area. It is also possible that in the varied array of tufas and fine-grained deposits of many ages, they have gone unrecognized. More field work in this critical area seems justified, as a field check of Winograd and Doty's estimates for the late Pleistocene.

Moreover, Czarnecki's (1984) estimate of 130m of maximum watertable fluctuation predicts that flow was perennial in Fortymile Wash, just west of Yucca Mountain. This is an intriguing possibility which ought to be tested, since Winograd and Doty's and Jones (1982) estimates are for considerably less fluctuation and would not predict perennial flow in Fortymile Wash. Field reconnaissance suggests that possible late Pleistocene terraces are inset into the Fortymile Wash cut. Trenching and analysis of these and examination of packrat middens in the wash walls for riparian vegetation might provide information needed to distinguish between ephemeral and perennial flow. Coring in the area where Fortymile Wash debouches could also reflect on the nature of flow along the wash. Concentration of early type artifacts along Fortymile Wash could correlate with perennial flow or prolonged seasonal availability of water in the wash.

(3) The configuration of the regional ground-water aquifers may have been different during the Pleistocene. This criticism underlines the danger of basing conclusions on one portion of the ground-water system. An understanding of the nature and volume of Pleistocene discharge in nearby basins would help to better define the configuration of the former regional ground-water system.

6.3.1.4.3. (6-199) paragraph 2.

"Winograd and Doty (1980) reported that calcite veins in the Ash Meadows area has been estimated by uranium-thorium techniques to be 400,000 to 700,000 years old."

<u>Comment</u>:

The U-Th technique is only reliable back about 350,000 years. The DEA must be referring to the results of Winograd <u>et al</u>.

(1983) using the uranium-uranium technique, which is valid to about .8 to 1 million years. That publication also indicates a greater spread of ages on the calcite veins than is given in the DEA. This sentence should therefore be modified and updated.

Winograd _et al_. (1983) work therefore indicates that spring discharge has been occurring at Ash Meadows for at least the past 1.7 m.y. and possibly as far back as 3 m.y. ago. We agree with Winograd and Doty (1980) that this is a sound basis for estimating maximum water-table elevation for any time in the Pleistocene at Ash Meadows, and that, for whatever reason, this elevation has been decreasing with time. However, their work does not attempt to specify this value for the late Pleistocene except by theoretical means.

6.3.1.4.3. (6-199) paragraph 3.

"A long term trend of increasing aridity, if it occurred, could also have contributed to these changes." The change referred to is the downgradient migration of discharge points through the Pleistocene at Ash Meadows, as described by Winograd and Doty (1980).

Comments:

Increasing aridity is not given by Winograd and Doty (1980) a factor in the downgradient migration of discharge points Ash Meadows during the Pleistocene. They are linked by Winograd _et al_. (1983) and Smith _et al_. (1983).

6.3.1.4.4(1) (6-200) paragraph 2

The use of the "predicted" 130 m rise to state that this leaves a 40 m buffer before the repository becomes saturated is not based on direct geologic evidence. As previously noted, the existing and postulated recharge rates are questionable and not supported by hard data. Therefore, there is uncertainty surrounding the change of 130 m in water level. The evidence given does not support the conclusion given on page 6-201 that the proposed facility will remain unsaturated.

6.3.1.4.4 (6-202) paragraph 3

The statement that no substantial change in water-table elevation is expected in the next 10,000 years is not supported by any direct references. One may presume that the earlier statement on page 6-200, "further confidence is gained because a return to pluvial conditions is not expected in the next 10,000 years" is the basis for this, but the entire subject of climate change is subject to several different interpretations.

6.3.1.6.7 (6-218).

The statements made here do not conform with 6.3.1.6.6 (6-218) paragraph #1.

6.3.1.7.3 (6-222) paragraph #1.

The uncertainties of these probability calculations should be stated. Assumptions used should also be provided. Eruption probabilities for some Hawaiian volcanoes may be possible based extensive field data. We presume a similar data base for NTS does <u>not</u> exist.

6.3.1.7.3 (6-223) paragraph #4.

The conclusions are not well supported. Please revise in accordance with previous statements.

6.3.1.7.5 (6-233) paragraph #2.

Omit sentence on ground water. It does not belong in this discussion and only detracts from the arguments presented.

6.3.2.2.1 (6-248) paragraph #3.

State the water flux estimated for that point where proposed EPA release limits would be exceeded.

6.3.2.2.2 (6-250 to 251) paragraphs #4 to #1.

Omit the sentence starting with the word "Current ... to the end of the paragraph. There is insufficient support in the and available literature to draw these conclusions. These poorly constructed arguments detract from the DEA's presentations.

6.3.3.2.4(4) (6-271).

We anticipate that if the hydrologic regime becomes wet either due to the near-field heating or above anticipated vadose flux, the rock stability with respect to failure will degrade. A discussion of this is advisable.

6.3.3.3.3(1) (6-279).

The potential for perched water should be considered in the vadose zone above the repository.

6.4.2.1.2 (6-308) paragraph #4.

"Between the repository horizon and the water table, there are several zones containing highly sorptive minerals, particularly zeolites and clays."

Correct this sentence as follows: replace "highly" with the term: potentially. The DEA has not documented that these minerals provide sorption under the physical and chemical conditions that will exist.

6.4.2.1.2 (6-309) paragraph #1.

Sorption properties of the whole rock have <u>not</u> been sufficiently investigated for conditions above ambience. Under ambient conditions, it is unknown which minerals may provide retardation because:

1. Little is known concerning their chemistry (cation composition) with respect to their sorption.

2. Data have <u>not</u> shown that the clays are effective sorption agents. Clays below the water table are in part mixed layered and their sorption potential is questionable in comparison to pure smectites.

3. Water chemistry in the vadose zone is unknown, especially cation composition and oxidation state. It is therefore <u>not</u> known which radionuclide will be mobile. And the CEC response of the authigenic minerals to the vadose water affects their sorption capacity.

4. Water chemistry is known, in part, for the saturated zone. However, there seems to be wide fluctuations in chemical composition with time from single wells and significant variations in chemical composition within the stratigaphic streamlines in the water table itself. As very little detailed water chemistry data is available with reasonable stratigraphic controls, the nature of the authigenic mineral response with respect to retardation becomes uncertain. The retardation factor (Rf) is not the best measure of sorption. Retardation should be reported directly as a function of measured sorption capacity, diffusion, and precipitation. Additionally, all of these data need to reported as a function of Eh of the environment.

Consequently, the behavior of the natural-barrier system has been poorly studied and is not well known. Its potential for retardation remains to be investigated. This section should be appropriately rewritten.

6.4.2.2.1 (6-310).

It is questionable that the experimental analysis of the corrosion rate of 304L stainless steel in J-13 water represents a reasonable analogy of Yucca Mountan vadose zone. It would appear that this issue (corrosion of the canisters) is important relative to waste containment, yet there are <u>no</u> data reported for anticipated real-world conditions.

We have to conclude that until vadose zone water (which may more acidic and more oxidizing) is used in these experiments, the results are <u>not</u> definite. Therefore, the containment period is unknown. Further, scratched canisters may <u>not</u> react similarly to unscratched canisters, consequently, the analyses have <u>not</u> been conservative. Finally, the mechanism for sealing the canisters may be in serious question and may compromise canister integrity.

A discussion of over-packing may be important with respect waste-package lifetime. The effects of over-packing on heat generation need to be included.

6.4.2.2.2 (6-310 to 311) paragraphs #2 to #1.

The calculations concerning the quantity of water that could flow into the canister is plagued with uncertainties. The flux is unknown. Localized microenvironments within the repository due to construction may provide areas for water collection even with back-fill.

The release rate for the engineered barrier subsystem is unknown and poorly treated in this section.

6.4.2.2.2 (6-312) last paragraph.

This requires revision in light of previous comments concerning the vadose flux.

6.4.2.2.2 (6-313 to 314) last paragraph.

This section requires revision in light of previous comments concerning the vadose flux.

6.4.2.5.1 (6-323) Fracture Flow

This section is the first mention of the diffusion of fracture water into the matrix. Although a large gradient could exist between the fracture water and the matrix water, the hydraulic conductivity of the matrix is quite low and diffusion may be slow (Travis, 1984). There is also a contradiction here, since the DEA's conceptual model allows for saturated fracture flow to move completely through the Tiva Canyon Tuff without any matrix diffusion occurring. The data base for these scenerios is <u>not</u> sufficient for either statement.

6.4.2.5.1 (6-323-324) paragraph #3.

"Under the most extreme climatic changes considered possible at Yucca Mtn. during the next 10,000 years, increases in precipitation could increase percolation rates and recharge by as much as 50 percent above today's values. Such an increase is expected to have no significant effect on isolation in view of the current matrix flux values, which are estimated to be much less than 1 mm/yr."

Comments:

The sections in this review on Climatic Change and on Spaulding's work contain the basic criticisms we have for the preceding statement.

(1) 50% greater moisture in the Pleistocene comes from Spaulding (1983). He revised that to as much as 100% of modern in Spaulding et al. (1984). Neither figure may not represent a worst case in terms of effective moisture in the future, a parameter the EA seems to fail to recognize. Spaulding's above estimates apply to the late Pleistocene (10,000 yr. B.P.). Spaulding (1983) and other workers (see Climate Change section) interpret increased moisture (up to 70%) and cooler full-glacial conditions (18,000 B.P.). With a greater proportion of winter precipitation and less evaporation, effective moisture and therefore recharge probably was greater during the full-glacial than the late Pleistocene. This is supported by stratigraphic evidence from the Las Vegas Valley (Quade, 1983).

(2) Even with a reliable estimate of full-glacial climate (which as yet probably does not exist), the problem of translating that into recharge remains. That recharge figure is still unknown, as the DEA admits: "One exception may be

effect of increased recharge on the hydrologic system, but the magnitude of the increased recharge has not yet been quantified." (7.2.1.4) (7-31) paragraph 5.

6.4.2.5.1 (6-324) paragraph 1

As the chapter proceeds, the estimated matrix flux has decreased from "1 mm/year" to "much less than 1 mm/year." A deterministic flux value is not applicable to the spatially variable conditions of Yucca Mountain.

6.4.2.5.1 (6-324) paragraph #2.

A statement is necessary on release of tritium with respect to fracture pattern above the repository. Noble gases should also be treated.

Chapter 7:

7.2.1.1 (7-10) paragraph #2, first sentence

We concur with the statement made here, and suggest it be also made in the executive summary.

7.2.1.1 (7-10) paragraph #2, last sentence.

We would assume from those chemical data provided for ground water that more than one flow rate is possible for ground water in and near Yucca Mountain. Calculations based on two wells for the vadose zone seems to be very preliminary and more field data appears to be required.

7.2.1.1 (7-11 to 7-12) paragraph #4.

We agree with the statements made here and suggest that those be included in the executive summary and be referred to in each section dealing with these topics.

7.2.1.1 (7-14) second paragraph.

In addition to those uncertainties mentioned for Yucca Mountain, include vadose-water chemistry.

7.2.1.2 (7-16) paragraph #3.

The presence of clays and zeolites do not necessarily provide isolation capabilities at Yucca Mountain because very little data of any significance has been obtained by the project on sorption capacity of known zeolites and clays. In addition, other potential sorption agents such as ferromanganese oxyhydroxides are present and unstudied.

7.2.1.2 (7-16) paragraph #4.

Same comments as 7.2.1.2 (7-16) paragraph #3.

7.2.1.2 (7-16 to 7-20) paragraph #5.

These data should be included in the executive summary and in appropriate sections throughout the DEA.

7.2.1.2 (7-20) paragraph #2.

The possibility of heat-induced alteration exists for obsidian and perlite at Yucca Mountain and should be discussed. It has not been documented that zeolites will form by alteration, nor if they did, there would be effective retardation by sorption.

7.2.1.2 (7-20) paragraph #4.

It has not been documented that zeolites will provide sorption of radionuclides at Yucca Mountain.

7.2.1.4 (7-28) paragraph #3.

The statement concerning drainage systems as a geomorphic model of surface-water motion appears valid for the past, present, and potentially the future. This does <u>not</u> relate to ground-water or vadose-water flux.

Paleo-dune deposits, near Yucca Mountain - juxtaposed to UE25WT#3 and the C-wells, contain vegetation casts potentially indicative of a considerably wetter regime than today (DRI - field notes). The nature and source of the water flux at this site remains to be investigated (and other similar sites).

7.2.1.4 (7-31) paragraph #2.

It is uncertain whether these factors were minor or not. Those data available do <u>not</u> provide sufficient evidence for judgemental conclusions.

7.2.1.4 (7-31) paragraph #8.

"At Yucca Mtn., renewed glaciation would result in wetter conditions in the vicinity of the site. (Summer rainfall may have been up to 50 percent greater than at present.). Part of this precipitation would be lost by evapotranspiration and by runoff; the remainder would serve to increase the ground-water flux through the undersaturated zone... Because expected rate of flux is very low, estimated increases in flux (some fraction of increased precipitation) are not likely to have a significant effect on the hydrology system."

Comments:

See comments on 6.4.2.5.1 (6-323-324) paragraph #3.

7.3.3.1.2 (7-103) paragraph #3.

The reasons for rock bolting should be explained. These data need to be included in Chapter 6 in an appropriate section.

7.3.3.1.2 (7-103) last paragraph.

This statement should be added to the executive summary section.

7.3.3.1.3 (7-107) paragraph #3.

Add a discussion of potential perched water zones (see your field data on UZ-4).

B.2.1 (B-3).

It is interesting to note that the two salt sites provide considerably different statistical results and that the ranking sites each fall into a different category of rock types.

Where are their special constraints on the analyses that have not been reported in the DEA, such as an apparent (and rational) desire to have three completely different terrain sites so as to insure adequate options in decision-making if one or more terrain types prove to be unacceptable due to site characterization finding?

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