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U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

# RESPONSE TO COMMENTS FROM THE U.S. NUCLEAR REGULATORY COMMISSION ON THE REPORT OF EARLY SITE SUITABILITY EVALUATION OF THE POTENTIAL REPOSITORY SITE AT YUCCA MOUNTAIN, NEVADA

102.8

JUNE 1993



ENCLOSURE 1

ENCLOSURE

RESPONSE TO COMMENTS FROM THE U.S. NUCLEAR REGULATORY COMMISSION, DEPARTMENT OF THE INTERIOR, STATE OF NEVADA, AND AFFECTED COUNTIES ON THE REPORT OF EARLY SITE SUITABILITY EVALUATION OF THE POTENTIAL REPOSITORY SITE AT YUCCA MOUNTAIN, NEVADA

# INTRODUCTION

Comments contained in this document were received by the U.S. Department of Energy (DOE) on the Report of Early Site Suitability Evaluation (ESSE) of the Potential Repository Site at Yucca Mountain, Nevada, (Younker et al., 1992, SAIC - 91/8000). Comments were received from the U.S. Department of Interior, the U.S. Nuclear Regulatory Commission, the State of Nevada, and several local affected governments in Nevada. No comments were received from members of the public. This document provides responses to all comments that were received as part of the formal, written review process.

The ESSE report was prepared by a team of scientists who provide technical support to DOE on the Yucca Mountain Site Characterization Project. The team was managed by Science Applications International Corporation, a DOE contractor. An independent Peer Review Panel was also convened to review and evaluate the validity of the technical conclusions reached by the ESSE scientific team. The ESSE report provides recommendations to DOE regarding the adequacy and sufficiency of available site characterization data to support suitability findings in the technical areas specified in 10 CFR Part 960; Parts 4 and 5 of DOE's General Siting Guidelines.

The ESSE was an interim evaluation (the first was conducted in 1986) to determine the current status of compliance with 10 CFR Part 960. It had two primary goals: (1) evaluate whether data obtained since 1986 either weaken or strengthen the technical basis for the 1986 findings; and, (2) develop and recommend a process for future evaluations.

With respect to the technical basis of the ESSE, DOE accepts the opinions of the Peer Review Panel that technical conclusions drawn from available data were adequate and sufficient, and that recommended findings were objectively developed. Based upon the recommendations of the ESSE Report, DOE will continue to characterize the Yucca Mountain site to establish its potential suitability for development as a repository. DOE regards the ESSE recommendations as useful input for prioritizing site studies, modifying the scope and direction of these activities, and as an aid in deciding when adequate site characterization data have been gathered.

For future site suitability evaluations, DOE may choose to use contractor-prepared reports without formal DOE acceptance of the suitability findings, or DOE may choose to formally accept selected suitability findings. As required by the Nuclear Waste Policy Act, DOE will make formal findings on all guidelines before deciding whether to recommend the site for repository development.

With respect to process, DOE intends to establish a mechanism for involving oversight groups, independent scientists, and other interested parties in future site suitability evaluations. Specific evaluation plans will be developed and milestones for future interim site suitability evaluations will be included in the baseline program schedule. An analysis of the appropriate interfaces between evaluation of site suitability and the process of complying with the National Environmental Policy Act is currently under way.

With respect to the selection of Peer Review Panel members, DOE is considering a process whereby panel members would be nominated by oversight groups and local affected governments, as well as by DOE. Selection of panel members would then be made by an independent third-party group of scientific experts.

Involvement of oversight groups and the public in the site suitability evaluation process will evolve. DOE Public Update Meetings in Nevada will continue to be a forum for discussing the status of any future site suitability evaluation. The new Director of OCRWM may also establish additional outreach mechanisms for communicating this information to the interested public.

NRC Comment 1

**Section 2.3.7.3.3 Conclusions and Recommendations for Future Postclosure Tectonics Activities**

**The treatment of engineered barriers for Postclosure Tectonics appears to be inconsistent with the intended application of the 10 CFR Part 960 Siting Guidelines.**

**BASIS**

**In 1984, NRC agreed to concur in DOE siting guidelines provided seven conditions were met. These conditions were stated in 49 FR 9650. NRC Condition 4 stated that the Commission would concur provided DOE "modifies the siting guidelines to make clear that engineered barriers cannot constitute a compensating measure for deficiencies in the geologic media during site screening."**

**In response to the NRC concerns, as well as the concerns raised by the U.S. Environmental Protection Agency, the States of Texas and Nevada, and some citizens groups, DOE provided a section 960.3-1-5, "Basis for Site Evaluation." Section 960.3-1-5 states ". . . engineered barriers shall not be used to compensate for an inadequate site; mask the innate deficiencies of a site; disguise the strengths and weaknesses of a site and the overall system; and mask differences between sites when they are compared."**

**In the discussion of Qualifying conditions on page 2-116 of the ESSE, it is apparent that DOE places importance on the design of the engineered barrier system (EBS) in making an evaluation against the siting guidelines. The ESSE states: "Ground motion is highly unlikely to cause damage to the waste canisters, assuming reasonable conservatism in the design of canister emplacement."**

**The findings in the ESSE for postclosure tectonics appear to be based on considerations of an EBS design that could disguise or compensate for weaknesses of a site.**

**RECOMMENDATION**

**Although the EBS design may provide for additional margins of safety in a licensed repository, DOE should evaluate the site against the siting guidelines without implying that the EBS is being used to compensate for a weakness of the site with respect to postclosure tectonics. The staff believes this is critical during the evaluation of the site's suitability so that the collection of data to identify site deficiencies is not precluded.**

**U.S. Nuclear Regulatory Commission, "Preliminary Decision Related to U. S. Department of Energy's General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories," Federal Register, Vol. 49, No. 51, March 14, 1984, pp. 9650-9661.**

**U.S. Department of Energy, "10 CFR Part 960, Nuclear Waste Policy Act of 1982; General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories," Federal Register, Vol. 49, No. 236, December 6, 1984, pp. 47714-47770.**

Response:

Comment 1 asserts that on the basis of one sentence in Section 2.3.7, Postclosure Tectonics Technical Guideline, DOE intends to place importance on the engineered barrier system to disguise or compensate for weaknesses of the site, in this case seismic ground motion. That meaning was not intended by the ESSE authors and was not the basis for their recommendations for the postclosure tectonics guideline. DOE is concerned with NRC's interpretation of the ESSE evaluation of DOE's siting guidelines. Because some intensity of ground motion must be expected and designed for at any location, ground motion must be acknowledged as one of the design criteria for waste package emplacement. The DOE does not believe that the selection of reasonably conservative seismic design criteria should be viewed as disguising or compensating for weaknesses in the site. A comprehensive site program is underway to evaluate the seismic hazards present at the Yucca Mountain site.

NRC Comment 2

**Section 2.3.4.3.2.1 Tectonic Models**
**Section 2.3.7.3.2.6 Probabilistic Volcanic-release Models**

**The analyses and conclusions provided within the referenced sections do not appear to reflect the conservatism required by 10 CFR Part 960.**

## BASIS

In developing bases for evaluating the ability of a site to meet the qualifying conditions of the guidelines, ". . . assumptions that approximate the characteristics or conditions considered to exist at a site, or expected to exist or occur in the future, may be used. These assumptions will be realistic but conservative enough to estimate the potential for a site to meet the qualifying condition of a guideline . . . (Part 960.3-14-2)

On page 2-102 of the ESSE, although the theories of Smith and others (1990) are discussed, they are generally dismissed with the statement "The Crowe and Perry (1989) analysis is considered to be more rigorous . . ."

In the discussion of probabilistic volcanic-release models on pages 2-114 and 2-115, DOE only presents numbers generated in various publications by Crowe with the general statement that "Numerous assumptions that are believed to be conservative underlie the probability estimates . . ."

One of the most obvious differences between the models of Smith and his coworkers and Crowe and his coworkers is the orientation assumed for the controlling features. As has been shown in such places as Sheridan (1992), if the other factors are held constant the change in orientation can cause about an order of magnitude difference in the results with the northwest orientation theorized by Crowe providing the least conservative results.

## RECOMMENDATION

DOE should consider alternative conceptual models and, based on presently available data, reevaluate the assumptions used in arriving at findings related to tectonics and volcanism to assure that they are conservative in accordance with the requirements of 10 CFR Part 960.

## REFERENCES

B. M. Crowe and F. V. Perry, "Volcanic Probability Calculations for the Yucca Mountain Site: Estimation of Volcanic Rates," in FOCUS '89, Proceedings of the Topical Meeting on Nuclear Waste Isolation in the Unsaturated Zone, American Nuclear Society, Las Vegas Nevada (1989)

M. F. Sheridan, "A Monte Carlo Technique to Estimate the Probability of Volcanic Dikes," in Proceedings of the Third International Conference, High Level Radioactive Waste Management, Las Vegas, Nevada, April 12-16 (1992)

**E. I. Smith, D. L. Feuerbach, T. R. Neumann, and J. E. Faulda, "The Area of Most Recent Volcanism Near Yucca Mountain, Nevada: Implications For Volcanic Risk Assessment," in Proceedings of the International Topical Meeting on High Level Radioactive Waste Management, Las Vegas, Nevada (1990)**

**U. S. Department of Energy, "10 CFR Part 960, Nuclear Waste Policy Act of 1982; General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories: Final Siting Guidelines," Federal Register, Vol. 49, No. 236, pp 47714-47770 (1984)**

Response:

This comment claims that ESSE Section 2.3.7 does not adequately address competing theories on volcanism and has failed to consider alternative conceptual models, using quotes of partial sentences taken out of context. We believe the content of this section (and of the peer-review record) clearly reflects a theme that emphasizes the importance of preserving the consideration of credible alternative models.

The basis for this comment appears to represent a misunderstanding of the content of the ESSE report. The following observations address the points presented as the basis of the NRC comment:

1) The partial quotation from 10 CFR Part 960.3-1-4-2 (Site nomination for characterization) discusses assumptions that are appropriate for evaluating the qualifying conditions of the technical guidelines. The ESSE evaluation of postclosure tectonics continues to support a lower level finding for the qualifying condition. This recommendation is conservative and consistent with the intent of 10 CFR Part 960. Given the current uncertainties in the evaluation of this qualifying condition, the ESSE core team concluded that available information does not support a higher level finding that the site is qualified with respect to this guideline.

2) The quotation from page 2-102 of the ESSE report is incomplete and therefore taken out of context. The complete statement is "The Crowe and Perry (1989) analysis is considered more rigorous, but further investigations are planned to examine the structural controls on basaltic volcanism." The theories of Smith and others (1990) were not dismissed. The text does, however, note that Smith and others (1990) did not use magma composition and tectonic setting as criteria in defining the area of most recent volcanism.

3) The quotation from page 2-115 is also incomplete. The complete quotation is "Numerous assumptions that are believed to be conservative underlie the probability estimates; evaluating the validity of these assumptions and their importance to the analysis is the focus of future activities that are described in Section 2.3.7.3.3."

4) Although the more important differences between the models (Smith vs. Sheridan) lie in the geochemical and structural bases, the assumed orientations (ignoring differences in their probabilities) provide an obvious difference. Although Sheridan's calculations do suggest that the probability of repository intersection is an order of magnitude greater for the northeast structural orientation, Sheridan states that the northeast orientation of Smith's model is less probable than Crowe's northwest orientation. The paper by Sheridan became available after the ESSE report was completed. His work will be considered in future evaluations concerning volcanism.

The core team did recommend a higher level finding with respect to the limited and focused considerations of the disqualifying conditions for the postclosure tectonics guideline. However, with respect to the more inclusive considerations and more stringent confidence requirements of the qualifying condition, the core team only recommended a lower level finding.

The ESSE report clearly recognizes the importance of alternative conceptual models. With respect to tectonic models of the site area, the following quotations support the core team's concern for the consideration of alternative models:

> "The framework for evaluating all of the technical issues is a set of credible tectonic models." (p. 2-89)
>
> "A set of observational, measured, and calculated data are required to support the development and evaluation of alternative models." (p. 2-90)
>
> "The geologic record for the Quaternary Period and current indications, such as seismicity, should be considered within the context of credible tectonic models . . ." (p. 2-93)
>
> "An important basis for the future understanding is confident definition of a set of credible tectonic models that are consistent with accumulating data and observations." (p. 2-118)

As shown in the above quotations, the core team recommends not only that alternative conceptual models should be considered, but should also be evaluated in view of the accumulating data and observations rather than only in view of presently available data, as recommended by the reviewer. DOE supports the recommended use of alternative conceptual models as proposed in the ESSE report.

NRC Comment 3

**Section 2.3.7 Postclosure Tectonics Technical Guideline**

**The higher-level suitability findings for the qualifying and disqualifying conditions appear to be inconsistent with the intent of 10 CFR Part 960.**

**BASIS**

**Part 960, Appendix III anticipates that only lower-level findings will be made prior to the start of significant site characterization activities. However, Appendix III states, "For both the disqualifying and qualifying conditions of any guideline, a higher finding shall be made if there is sufficient evidence to support such a finding." As site characterization continues and more data is gathered, it may be appropriate to make higher-level findings.**

**Part 960, Appendix IV specifies the types of information ". . . that DOE expects will be included in the evidence used for evaluations and applications of the guidelines . . ." at the nomination stage. For example, for tectonics, Section 960.4.2.7 of Appendix IV states the types of information needed to make findings, such as "Quaternary faults in the geologic setting, including their length, displacement, and any information regarding the age of latest movement."**

**The ESSE (Page 2-117) states that "Yucca Mountain and the surrounding vicinity have been intensely studied by means of geologic mapping, geophysical surveys, remote sensing, and geomorphic analysis." However, the Site Characterization Plan outlines data needs in a series of investigations to gather information such as the age, length, and displacement of faults at the proposed site and in the geologic repository operations area.**

**The NRC staff considers that data collected to this point and available for review is not sufficient to define the characteristics of Quaternary faulting at Yucca Mountain to the extent required to support a high-level finding. Significant uncertainties about the nature and rates of faulting and applicable tectonic**

**models exist at the Yucca Mountain site, such that higher level findings are not warranted at this time. This condition also appears to be true in the case of the high-level findings for natural resources and erosion expressed in the ESSE.**

**RECOMMENDATION**

**Higher-level findings appear not to be supported by the existing data and are not consistent with the intent of Part 960. Those findings should be re-evaluated based on the information provided in Part 960, Appendices III and IV.**

Response:

This comment explicitly states (and comment 2 strongly implies) that the ESSE report advocates higher-level findings for both the qualifying and disqualifying conditions for Postclosure Tectonics (Section 2.3.7). This section and the report conclusions clearly state that the core team continues to support only the lower level finding made in the EA on the qualifying condition, which is the more important of the two conditions because of the broad scope of tectonic processes that it considers and the stringent confidence that it requires. The comment also incorrectly represents that a higher level finding was recommended for the mineral resources technical guideline, whereas the ESSE text again continues to support the lower level finding for the qualifying condition.

In both NRC's transmittal letter and Comment 3, it is asserted that higher level findings cannot be made at this time according to the intent of 10 CFR Part 960, Appendix III. In our opinion, however, the wording of Appendix III encourages higher level findings when the information supports such findings. It should also be noted that DOE made higher level findings for other guidelines in the EA, as consistent with available data at that time.

Also, refer to the Introduction Section for further clarification.

NRC Question I

**Section 2.4.4 Steps Needed to Support Higher-level Suitability Findings for the Postclosure System Guideline**

**What is the relationship between the judgments regarding data needs expressed in the ESSE and the information needs identified through the performance allocation and issue resolution process, as documented in DOE's Site Characterization Plan (SCP)?**

**BASIS**

**The March 3, 1992, letter (Roberts to Holonich) transmitting the ESSE states that judgments made and expressed in the ESSE will be used to focus and prioritize future data acquisition activities and to aid in the resolution of the site technical issues.**

**Performance allocation is a formal process that provides the rationale for establishing particular site characterization activities to obtain the information DOE considers necessary to resolve the issues related to 10 CFR Part 60.**

**This process was applied by DOE in the generation of its plans for the characterization of the Yucca Mountain site (DOE, 1988). It is not clear to the staff how the judgments expressed in the ESSE are related to the identified information needs generated by the performance allocation process.**

**RECOMMENDATION**

**DOE should assure that the prioritization of future data collection activities based on judgments documented in the ESSE is consistent with the acquisition of that information considered necessary to resolve site issues, as generated by the performance allocation and issue resolution process described in the SCP, applied to site suitability and licensing, and implemented through the semi-annual Progress Reports.**

**REFERENCE**

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

Response:

The ESSE report was not prepared with the objective of redefining details of data and information needs. Rather, based on an evaluation of the degree to which the accumulated information changes judgments as to site suitability relative to those made in the EA, the core team sought only to identify broad areas of study that deserve emphasis.

The information needs generated by the performance allocation process of the SCP address compliance with NRC's regulations in 10 CFR Part 60 as well as Part 960. The ESSE focused on the data needed to evaluate compliance with DOE's siting

guidelines. Performance allocation for the SCP was completed in 1986-1987 using available site data and regulatory interpretations. Since that time, additional site data are available, and numerous interactions with the NRC have led to improved understanding of the basis for their regulations. This additional knowledge could lead to a need to revise some of the performance allocations presented in the SCP.

NRC Question 2

**Section 2.0 Evaluation of the Postclosure Guidelines**

**How were 10 CFR Part 960 "Favorable Conditions," and "Potentially Adverse Conditions" used to determine site suitability findings for either the qualifying or disqualifying conditions?**

**BASIS**

**An important requirement of 10 CFR Part 960 for each technical guideline is an evaluation of both favorable conditions and potentially adverse conditions. The ESSE does not appear to directly consider individual favorable and potentially adverse conditions in the evaluation of either the qualifying or disqualifying conditions.**

**The supplementary information section of Part 960 (Recommendation of sites for characterization, 960.3-2-2) states that " . . . standards of site suitability to be used by the licensing authority (NRC) are to be reflected in the guidelines so that siting and other program decisions will be consistent with these requirements."**

**The supplementary information section of Part 960 (IV.A.Structure of the Guidelines) states that "The inclusion of the favorable and adverse conditions is based on 10 CFR Part 60. These conditions can be used to predict the suitability of a site before detailed studies of the site have been performed. They provide preliminary indications of systems performance."**

**The supplementary information section of 10 CFR Part 960 (IV.A. Structure of the Guidelines) states that "Although favorable conditions need not exist at a given site for that site to meet the qualifying conditions, the existence of such conditions leads to an expectation that subsequent evaluations will yield enhanced confidence in a site's suitability. Similarly, the purpose of determining whether any potentially adverse conditions exist at a site is to provide an early indication of conditions that must be examined carefully before**

**judging the acceptability of that site. Such examinations must evaluate the effects of the other, possibly compensatory conditions of the site. Thus a site that has most of the favorable conditions may be presumed likely to meet the system guidelines, while a site with many potential adverse conditions may not meet them."**

**Part 960.3-1-5 states that ". . . for each technical guideline, an evaluation of compliance with the qualifying condition shall be made in the context of the collection of system elements and the evidence related to that guideline, considering on balance the favorable conditions and the potentially adverse conditions identified at the site."**

**RECOMMENDATION**

**Explain how favorable conditions and potentially adverse conditions were integrated into the ESSE evaluation of qualifying and disqualifying guidelines.**

**REFERENCE**

**U.S. Department of Energy, "10 CFR Part 960, Nuclear Waste Policy Act of 1982; General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories; Final Siting Guidelines," Federal Register, Vol. 49, No. 236, December 6, 1984.**

Response:

Part 960 "Favorable Conditions" and "Potentially Adverse Conditions" were not used explicitly in the guideline evaluations. This position was taken by the ESSE team on the basis of background information on page 47724, Federal Register, Vol. 49, No. 236, December 6, 1984, which explains that favorable and potentially adverse conditions "can be used to predict the suitability of a site before detailed studies have been performed. They provide preliminary indications of site performance." Because the ESSE report is a set of evaluations and recommendations to DOE, the core team was able to concentrate on what are considered to be the most pertinent site issues and information, within the context of Part 960 qualifying and disqualifying conditions. However, the ESSE report does review the positions taken by DOE in the EA, and the scientific considerations embodied in the favorable and potentially adverse conditions are implicitly included in the discussion wherever they significantly influence judgments as to site suitability or necessary areas of future study. In fact, the technical issues identified for each guideline embody the favorable or potentially adverse conditions in those cases where the Core Team believed they represented site-specific suitability concerns.