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Mr. David L. Meyer, Chief **Regulatory Publications Branch** Division of Freedom of Information and Publication Services Office of Administration U.S. Nuclear Regulatory Commission Washington, DC 20555

Draft Staff Technical Position; Investigations to Identify RE: Fault Displacement and Seismic Hazards at a Geologic Repository (56 FR 22022, May 13, 1991)

Dear Mr. Meyer:

The Nuclear Regulatory Commission (NRC) Staff Technical Position (STP) on Investigations to Identify Fault Displacement and Seismic Hazards at a Geologic Repository provides recommendations and guidance to the U.S. Department of Energy (DOE) on identifying and characterizing tectonic faults and the associated seismic hazard in the area at and near a geologic repository site. Since 10 CFR Part 60 (Criteria for Disposal of High-Level Radioactive Waste in Geologic Repositories) does not explicitly specify the approach or techniques to be used in characterizing a seismic hazard, the NRC has prepared this document in order to provide the DOE guidance for site characterization. As noted by the NRC in the STP, it cannot direct the DOE to adhere to this guidance; however, failure to do so could result in unnecessary expenditures and possibly in denial of a site license. Consequently, this STP is an extremely important document that will likely serve as a principal basis by which the risk from faults and related seismic hazards will be assessed.

This STP is a revised version of the draft STP, "Methods of Evaluating the Seismic Hazard Present at a Geologic Repository", reviewed by the Nevada Agency for Nuclear which was Projects/Nuclear Waste Project Office and comments provided to the NRC on October 23, 1989. In that review, we concurred with the

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basic principles proposed by the NRC. On February 4, 1991, the NRC issued a revised draft retitled "Staff Technical Position on Investigations to Identify Fault Displacement and Seismic Hazards at a Geologic Repository." The NRC did not solicit formal comment on the February 4 draft, but accepted informal comments at a February 21, 1991, NRC/DOE Technical Exchange meeting in Rockville, MD. In the meeting, we noted that the revised version contained significantly different language than the original draft, but that most of the principal concepts remained essentially unchanged. The subject of this letter is the May 13, 1991, revised draft and the additional concepts embodied in the revision. General comments on the subject draft are contained in this letter and specific comments are provided in the Attachment.

Definition of Geologic Setting

The definition of "geologic setting" is a new concept, not discussed in previous drafts of the STP. The geologic setting is defined as "the geologic, hydrologic, and geochemical systems of the region in which a geologic repository operations area is or may be located." The focus of this STP is limited to the faulting and seismicity components of the geologic setting. While we do not guarrel with the definition of geologic setting, we question whether this STP serves as an appropriate guide for an applicant to establish a cost effective and appropriate plan for characterizing fault displacements and seismic hazards for a geologic repository. The STP fails to define criteria or a reasonable process to determine what constitutes the "geologic setting" (or province or region or system) and the "components of the geologic system" acting within the "geologic setting." If the STP would provide such guidance criteria, then such issues as radius of investigation for fault studies, earthquake history, volcanic processes, and hydrologic effects, become much more tractable.

Section 3.1.1 of the STP attempts to provide guidance on how the DOE is to identify the region to be investigated based upon the "nature of the geologic setting." The guidance is very generic. It is unclear to this Agency what the "nature of the geologic setting" is. Equally as important as defining criteria or a process for determining the geologic setting, is an identifiable process or procedure that the applicant and other interested parties can use to determine whether the Section 3.1.1 guidance has been appropriately applied before proceeding to the next step in the STP (Section 3.1.2 -Initial Identification of Faults to be Considered for Detailed Investigation). We recommend Section 3.1.1 be amplified to include specific guidance on determining what constitutes the geologic setting and the components of the geologic system acting within the geologic setting. We note that the definition of "geologic setting" is that which was established in the DOE's Siting Guidelines (10 CFR 960), with NRC's concurrence. Also contained in DOE's Guidelines is a definition of "Geohydrologic system" which sets out an explicit means of determining the boundaries of that "system" for purposes of characterization. The STP could follow this example and establish a definition for determining the boundaries of the geologic system in which fault displacement and seismicity are to be considered.

Use of 10 CFR Part 100, Appendix A Methodologies

In the original 1989 draft STP, the NRC staff's position was that the methodologies contained within Appendix A of 10 CFR Part 100 were acceptable for investigating seismic and related faulting phenomena. In the revised STP, this position remains more or less unchanged, but Appendix A-type language and selected specifications have been deleted or modified. The use of the term "capable fault", for example, has been dropped, but a new term "susceptible fault" is defined which has similar specifications but which is more appropriate for pre- and post-closure tectonic assessments. Susceptible faults are defined in terms of seismic and structural-tectonic connections without dependence upon recency of movement. This approach obviates the need to rely upon arbitrary age criteria to determine fault activity or inactivity (such as the 40,000 year datum for capable faults), which is particularly important at Yucca Mountain because of the relatively long intervals associated with most faults. interseismic Similarly, the 5-mile site area defined for fault study by Appendix A is now replaced by a more generalized region designated for fault and seismic hazard study on the basis of structural-tectonic relations within the geologic setting. If faults outside of the repository controlled area have a tectonic connection to faults inside the controlled area or have a bearing on seismic hazard within the controlled area, they will also be individually investigated. We believe this is an appropriately conservative approach which ensures that all significant faults which define the seismotectonic setting of Yucca Mountain will be identified, and is, in fact, a more scientifically reasonable approach than utilizing the more restrictive language of Appendix A.

Use of Term "Susceptible Fault"

While this Agency supports the use of the term "susceptible fault" for determining the presence of a fault or seismic hazard for a geologic repository, the consensus of the scientific community for the term and its use should be solicited. The terms "capable fault" and "active fault", when used in the context of fault displacement hazard analysis, have been extensively debated in both the legal and scientific arenas, and thus have produced some level of resolution in the definitions and their use. Review of the term "susceptible fault" by the scientific community should be initiated, so that some resolution could be achieved prior to license application. To do otherwise could result in protracted debate during the application review on the definition of the term and its use.

Deterministic Approach

Although a deterministic analysis may in some cases be overly conservative, such criticism is outweighed by the need to maintain transparency (recognition of significant factors influencing the hazard) which the singular use of a probabilistic analysis does not provide. The identification in the STP of deterministic criteria which can be used as input for supplementary probabilistic analyses is well conceived. The NRC position that deterministic criteria are appropriate for the collection of data is scientifically sound given the complex seismotectonic setting of Yucca Mountain. The STP notes that probabilistic techniques for defining an approach to the investigation of fault displacement and seismic hazard have not been shown to be adequately developed for site licensing purposes. The more prudent deterministic approach is warranted by the presence of several active faults at and near the repository site.

The STP makes a clear statement that "A deterministic approach to investigations of fault displacement and seismic phenomena should be applied to DOE's site characterization program", rather than the probabilistic approach (i.e., the Cumulative outlined the Slip Earthquake Model) in DOE Site Characterization Plan for Yucca Mountain. With respect to the relatively low rate of slip associated with active faults in the Yucca Mountain region and the scientific community's general ignorance concerning the long-term mechanical behavior of earthquake faults in regions of low strain accumulation, uncertainties associated with any probabilistic approach are likely to be so large as to yield the probabilistic estimates of hazard or ground failure meaningless. This is confirmed in a recent article by J.C. Savage, U.S. Geological Survey ("Criticism of Some Forecasts of the National Earthquake Prediction Evaluation Council", Bulletin of the Seismological Society of America, in press) which questions the validity of the probability of rupture assignments for various segments of the San Andreas fault based on the log-normal distribution of recurrence times of characteristic earthquakes. He concludes that, based on the log-normal distribution of recurrence approach, the same method would have assigned only a 5% chance of rupture before mid-1993 to the southern Santa Cruz Mountains segment, the segment that failed in the October 1989 Loma Prieta Earthquake. Therefore, the probabilistic approach

may well underestimate the maximum hazard (e.g., ground failure or strong ground motion) that could occur at a site during a given period of time. The deterministic approach advocated by the NRC's STP is more conservative in the sense that the approach will likely result in a hazard assessment which accounts for the largest earthquakes and strong ground motions possible on the faults under consideration.

Fault Size as a Discriminator

We are concerned that the use of fault size (length) as a singular criterion for assessing the significance of susceptible faults may not be sufficient for the recognition and estimation of seismic hazard at and near the site. It is stated that assessments need only consider fault size in the determination of whether identified susceptible faults may affect repository design or performance. Fault length is one, but not the only, determining criterion in estimating seismic Maximum surface and subsurface displacements are hazard. equally, if not more, important criteria. Maximum fault displacement and length are both used to calculate seismic (M_o), an input value for precisely estimating movement earthquake magnitudes. This is a particularly important parameter at Yucca Mountain because of the growing body of principal faults indicating that the are evidence interconnected, and that rupturing events may be distributive in nature. In such events, fault length estimates would not be as important as net tectonic slip estimates made from summing the displacements on all faults.

Emphasis on Flexibility

On page 15, the STP states in a discussion of the region to be investigated: "Accordingly, DOE is afforded the flexibility to establish the areal extent of the investigations needed to fully characterize the hazards posed by fault displacement and seismic phenomena." This statement is a continuation of a previous discussion on page 14, regarding the staff's position on the acceptable methodology for the identification and characterization of fault displacement and seismic hazards, where the STP states that, "the process selected and the manner in which the effectiveness of that process is demonstrated are DOE management prerogatives." Further, on page 17, the STP states: "DOE is afforded the flexibility to determine the need for an examination of the pre-Quaternary record of fault movements."

The above quotations indicate a pattern of over-emphasis on encouragement of flexibility in how the applicant approaches the investigations of fault displacement and seismic hazards. Such statements reduce the effectiveness of the guidance provided by the STP. As with any technical position produced by the NRC, the applicant is free to present an alternative approach with appropriate justification to the staff. The statement on page 3, "Methods and solutions differing from those set out in the STPs will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission", appears to provide sufficient flexibility to the applicant and is consistent with NRC policy on technical position guidance. We recommend specific acknowledgements to "DOE flexibility" such as statements on pages 14, 15, and 17, be removed from the STP.

Relation to Other STPs

On page 2, the STP states: "Ultimately, data from these investigations provide input to the determination of the fault displacement and vibratory ground motion that need to be taken into account for the design of structures, systems, and components of a geologic repository, that are important to safety, containment, or waste isolation. Guidance on methods of analyses of fault displacement and seismic hazards will be provided in a companion document." The guidance document on methods of analyses of fault displacement and seismic hazards has not been provided to the State for review. Without the companion document, it is difficult to understand the context and significance of the investigative methodology provided in this STP. Because of the uncertainty in how the methodology will be applied in the analysis document, the State may choose to comment further on this STP after a review of the companion document.

Use of Terms "Material" and "Relevant"

The phrase "material and relevant" appears in the draft STP at six separate places (page 7, paragraphs 1 and 2; page 9, paragraph 2; page 10, paragraph 1; page 15, paragraph 5; and page 16, paragraph 1) and the word "relevant" alone appears once (page 6, paragraph 4). At four places (pages 6, 7, 9, and 10) the phrase "material and relevant" is used in the context of describing the process by which faults and seismic phenomena will be identified. These statements are:

<u>page 7</u> - (identification of) "faults outside the controlled area but within the component setting . . . to the extent that they are material and relevant . . ."

<u>page 7</u> - (An acceptable approach to) "determining which faults outside the controlled area are material and relevant . . ."

<u>page 9</u> - "determining which faults inside the controlled area continue to be material and relevant . . ."

At the three other places the phrase "material and/or relevant" is used in the context of the information that will be obtained. These statements are:

<u>page 15</u> - "information on the subsurface conditions outside the controlled area need(s) to be collected to the extent that it is material and relevant".

<u>page 16</u> - "Provides DOE with the flexibility to assess what information on faults outside the controlled area is material and relevant".

<u>page 6</u> - "identification of the component setting for fault displacement and seismic hazards should be based on . . . relevant field investigations . . . "

It seems obvious, based on the foregoing citations, that the staff had a definite purpose in mind by using the phrase "material and relevant" to provide guidance to the DOE through this STP. We assume that the staff was fully cognizant of the definition of the word "material" as used historically by the Commission when speaking to its responsibility under the Atomic Energy Act for protecting the public health and safety. However, the various contexts within which the term "material" is used in this STP makes us uncertain whether the ramifications have been completely recognized.

The different usages seem to present conflicting and, in one case, erroneous guidance. The erroneous statement occurs on page 16, where it is stated that DOE (is provided) with the flexibility to assess what information outside the controlled area is material and relevant. As will be subsequently shown, the decision as to whether or not information is material, and the weight to be accorded that information in the decision process for any site suitability determination, is, in the end, the job of the Commission, not the applicant. If the DOE is afforded the luxury of unilaterally deciding the materiality of information regarding which faults, fault systems, and seismic phenomena it will investigate at this stage of site characterization, the results could likely be what the Commission notes as ". . . imprudent expenditures and subsequent delays, and ultimately could result in denial of the application for the proposed site" (see STP 4/91 draft, p. 3, para 3).

The following summary discussion is provided primarily to support the above conclusion. The summary is also meant to benefit those who may not be familiar with the NRC's use and meaning of the word "material", or perhaps have not fully considered the possible ramifications insofar as developing the extent of information that will be used to determine site suitability.

Section 186 of the Atomic Energy Act of 1954 as amended (42 USC 2236) specifically provides, in part: "(a) Any license may be revoked for any material false statement of fact required under Section 182 . . ." Section 182 essentially sets forth the prescribed content and form of a license application. The first case in which an applicant was charged with violating Section 186 of the Act by making material false statements concerned Virginia Electric and Power Company's (VEPCO) four-unit North Anna Power Station. This case is important to the discussions here since the violations all concerned the materiality of geologic information. The lengthy history of the licensing proceedings on these issues is set forth in detail in the opinions of the Atomic Safety and Licensing Board, LBP-75-54 (1975); Atomic Safety and Licensing Appeal Board, ALAB-324 (1976) and the Nuclear Regulatory Commission final determination, CLI-76-22 (1976).

According to the Licensing Board there were two principal issues: the first addressed the responsibility of the applicant to disclose and supply material information to the Commission in a timely manner, and the second involved what constitutes a material false statement. The Commission in their finding stated the issue more succinctly in that "the case does not concern the safety of the North Anna site but rather whether VEPCO fulfilled its obligation to provide (accurate and full) information about the site."

Briefly, VEPCO was originally charged by the intervenors with nineteen counts of making material false statements to the Commission concerning the geology at North Anna. Sixteen of the nineteen specified allegations consisted of affirmative representations about the geology of the site. The following are examples of statements attributed to VEPCO's geotechnical consultants: the "nearest known fault is several miles from the site" or "faulting of rock at the site is neither known nor is suspected". Three of the nineteen specifications were of a different nature. They consisted of omissions, that is, complete failure to provide information. Two of the alleged omissions were failures to present evidence in the consultant's possession about suspected faulting, during the time that site suitability was decided. The third alleged omission was the failure to provide the staff with a report prepared by a consultant to their geotechnical contractor which had concluded that the suspected faulting might be reactivated. This alleged omission also dealt with the nondelegable duty to report material information. VEPCO decided not to forward the consultant's report to the staff after

being told by their geotechnical contractor that they disagreed with the conclusions and therefore the report lacked credibility.

The licensing board found VEPCO culpable on 12 of the 19 allegations including the three alleged omissions. The board summarized their findings as follows: VEPCO "violated Section 186 of the act . . . in that it knew, or should have known, of the presence of a geologic fault; knew, or should have known, that a seismic or geological fault guestion arising as to the suitability of the site was of major importance; knew, or should have known, that the Act, the rules and regulations of the Commission and the cases decided thereunder by the Commission required full and complete reporting of any information bearing on an application material for construction permits; knew, or should have known, of its nondelegable duty to report material information; and knew of its duty to conduct itself and its affairs with a high degree of care required of one conducting a business impacting on the public health and safety and yet knowing all of this, it failed to properly and fully report to the staff in a timely manner material information related to the presence of a geological fault (which at the time, may or may not have been 'active' or 'capable') . . ."

The Atomic Safety and Licensing Appeals Board disagreed with the Licensing Board only on the issue of omissions. The ASLAB concluded that an omission was simply not a "statement" and accordingly could not be punished as such, no matter how wrongful the omission might be. The Commission later reversed the Appeals Board on this issue and essentially affirmed the original Licensing Board findings.

A summary of those findings that are most germane to the subject STP is as follows:

- Section 186 of the Atomic Energy Act covers not only material false statements in a license application, but any "violation or a failure to observe any of the terms and provisions of the Act or any regulation of the Commission".
- A statement is "<u>material</u>" within the meaning of Section 186 of the Atomic Energy Act, if it has a natural tendency or capability to influence - not whether it does so in fact - the decision of the person or body to whom the statement is submitted. The principal criterion in determining materiality is whether a reasonable staff member would or should, consider the information in reaching a conclusion or determining a course of action; it is not important whether or not the statement ultimately played a role in the decision.

A statement may be "<u>false</u>" within the meaning of Section 186 of the Atomic Energy Act, even if it is made without knowledge of its falsity. The falsity and materiality of a statement submitted to the staff for its review hinges on the message which would likely be conveyed to a reasonable staff member by what was said or left unsaid.

The term "<u>statement</u>" as used in Section 186 of the Atomic Energy Act is not limited to affirmative representations; the omission of a material fact can be treated by itself, as a statement. Failure to include material information in a submission to, or a filing before, the Commission, can comprise a false and misleading statement. Anything less than full and accurate disclosure of information on which to base its review is unacceptable and "nothing less than candor is sufficient".

With respect to the matter of "timeliness", the Commission concluded that a "material false statement" results if, in the light of all the circumstances, an applicant fails to make a timely disclosure for the purposes of the review of its submissions. An situation results "incongruous" if applicant an responsible for disclosing material information fails to do so in a timely manner, and for one reason or another does not disclose the information until it becomes stale or relatively meaningless.

In regards to the responsibility for determining the materiality of information, the Commission stated repeatedly and without equivocation that the accurate and full disclosure by the applicant of all relevant information is vital if the Commission is to fulfill its primary duty to protect the health and safety of the public. Arguably relative data must be promptly furnished if the Commission is to perform its function. The weight accorded to relevant information is, in the end, the job of the Commission, not the applicant.

Although the foregoing discussion may seem protracted, we feel that it was necessary to develop support for the point that the decision regarding the definition of the geologic setting and consequent determination of which faults and seismic phenomena to investigate is not a trivial exercise. These decisions made now by the DOE could determine the course of the program for many years to come. If the program is to succeed, a reasonable consensus between all of the principal scientific participants (NRC, DOE, State of Nevada, etc.) must be reached early as to what constitutes the boundaries of the geologic setting surrounding Yucca Mountain. Once the geologic setting is agreed upon, the geologic system can be determined.

From the above discussion, the following modifications to the STP are proposed:

- The term(s) material and/or relevant should be retained.
- The statement on page 16 that DOE is provided "the flexibility to assess what information on faults outside the controlled area is material and relevant" should be removed or modified to reflect the ultimate responsibility of the NRC in this regard.
- The full definition for the terms material, relevant, false, and statement as used by the NRC in their regulations and guidelines should be added to the glossary in Appendix A.
- A discussion of the NRC requirements under Section 186 of the Atomic Energy Act and guidance on compliance should be added to the STP.
- A plan or procedure on how the NRC intends to routinely carry out their responsibility during the characterization phase in order to minimize the potential for violations under Section 186, needs to be added.

In summary, our concern is that the STP does not provide sufficient guidance to the DOE such that the site characterization program for Yucca Mountain would provide appropriate and acceptable information to effectively resolve two of the more critical geological issues, the effect of fault displacement in the repository and the design-basis earthquake(s) for both pre-closure facilities design and post-closure performance assessment. This STP does little to help meet the intent of the Site Characterization Plan to "provide a vehicle for early NRC, State, Indian tribal, and public input on DOE's data-gathering and development work so as to avoid postponing issues to the point where modifications would involve major delays or disruptions in the program" (NRC Reg. Guide 4.17, March 1987, p. vi). We appreciate the opportunity to review and comment on the subject STP. If there are questions regarding these and the attached comments, please do not hesitate to contact this Office.

Sincerely,

Robert K. Loux Executive Director

RRL:CAJ/njc

Attachment

cc: / Mr. Joe Youngblood - NRC

Dr. Dade Moeller - NRC/ACNW

Dr. Don Deere - NWTRB

Dr. John Bartlett - DOE/OCRWM

Mr. Carl Gertz - DOE/YMP

Mr. Steve Kraft - EEI

Mr. Dwayne Weigel - GAO

ATTACHMENT

Specific comments of the State of Nevada on the NRC Draft Staff Technical Position on Investigations to Identify Fault Displacement and Seismic Hazards at a Geologic Repository:

The following comments on the NRC Staff Technical Position (STP) are provided by the State of Nevada assist the staff in improving clarity and minimizing ambiguity in the text of the STP.

The third sentence speaks to the Page 1, second paragraph. "determination of the most severe displacement and earthquakes that can be associated with faults". We assume that this equates to establishing the maximum credible earthquake or the so-called design basis earthquake (DBE) for the geologic setting as defined and require by DOE General Design Criteria (DOE 6430.1A). According to DOE 6430.1A, the DBE shall, by definition, be equivalent to the Safe Shutdown Earthquake (SSE). We assume that because determination of an SSE is defined by the NRC only in 10 CFR 100, Appendix A, the same procedures would apply to the establishment of the DBE. This conclusion appears to also be supported by the DOE 6430.1A reference to LBL-9143 (Seismic Safety Guide) for direction on the methodology and procedures to be used in establishing the "maximum credible earthquake" (DBE) source. LBL-9143 (page 4-5) defines the maximum credible earthquake as the largest magnitude earthquake that appears possible within the known In 10 CFR 100, Appendix A (V) (a), the tectonic framework. earthquake which could cause the maximum vibratory ground motion at the site is designated the SSE. LBL-9143 further states that in determining the maximum credible earthquake, little regard is given to the probability of occurrence, except that the probability is great enough to be of concern. DOE 6430.1A states that the DBE shall be assumed capable of occurring at any time and shall have a ground acceleration of 0.1g or greater. Since there appears to be no significant differences between the DBE and the SSE or the recommended methodology by which the source for either is determined, it is suggested that a statement be added to the STP that acknowledges DOE 6430.1A and LBL-9143 by reference and accepts the DBE/SSE equivalence.

<u>Page 2, third paragraph</u>. The second sentence appears to be out of place in the context of this paragraph. It is suggested that the sentence be either removed or moved to the second paragraph on page 13. Also in the third paragraph, the same type of guidance is found here as contained in DOE 6430.1A and its referenced documents regarding determination of the DBE/SSE source. It appears this is further support for accepting the equivalence of DBE and SSE.

<u>Page 2</u>. Paragraph four makes a generic statement regarding candidate sites west of the Rocky Mountain front. The STP could be substantially improved if a more definitive statement could be made that focuses on what the NRC considers to be the geologic setting of the Yucca Mountain site as defined by the present SCP.

<u>Page 3. first paragraph. first sentence, third line</u>. It is suggested that the "or" be changed to an "and" in order to reflect the broader purpose served by the STP. In addition, it is suggested that reference be made to the scientific community at large outside the DOE (e.g., National Academy of Science committees, NWTRB, State of Nevada, etc.) who are also implicitly involved in the regulatory process and therefore could benefit from the guidance.

<u>Page 3, second paragraph</u>. The last part of the first sentence refers to avoidance of design and/or performance problems in the future. Avoidance of the problems at Yucca Mountain may only be possible by abandoning the site. The faults will always be there and there will always be a relatively high potential for earthquakes. It might be better to substitute the word "accommodated" for the word "avoided".

<u>Page 3. third paragraph</u>. The first sentence describes the informal process that is presently in place. This process has not proved satisfactory to all participants to date and its acceptance is unlikely to improve in the future. The last sentence appears to be a veiled threat that is unlikely to have any influence on the course of the repository program. We suggest that the sentence be removed and included in a separate memo from the NRC to the DOE or some other more appropriate place. The entire third paragraph

might be more appropriately placed somewhere in Section 4.0 on page 13.

Page 5, second paragraph. The first sentence gives the NRC staff's position that a deterministic approach should be applied to geologic repository investigations. A strong deterministic approach is in fact required before any probabilistic results would have meaning. The NRC may want to consider allowing for a primary deterministic approach supplemented by a probabilistic approach to the extent that DOE feels necessary. This is a common practice of the NRC in reactor licensing. However, the issue may be moot, since DOE 6430.1A (page 1-99) requires that the DBE (SSE) be established deterministically and the effects handled probabilistically.

<u>Page 6, Subsection 3.1.1, Item 2</u>. The boundary of the region to be investigated for fault displacement should be referenced to subsection 3.1.3 and the boundary of the region to be investigated for seismic hazards expanded and referenced to Section 3.3.

<u>Page 6.</u> Subsection 3.1.2. first sentence. It is suggested that the addition of the phrase, "or fault zones" after the phrase, "those faults" in the first line would clarify the intent. Also, such an addition would make the sentence consistent with the terminology used on page 10, Item (1)(a).

<u>Page 6, Subsection 3.1.2, Item 1</u>. It is suggested that by adding the phrase, "or fault systems, any part of which is" after the phrase, "all faults" in the first line would clarify the intent.

<u>Page 6, Subsection 3.1.2, Item 2</u>. It is suggested that adding the phrase, "or fault zones" after the word, "faults" in the second line would clarify the intent.

<u>Page 7, first line</u>. It is suggested that adding the word, "geologic" ahead of the phrase, "component setting" would clarify the meaning.

<u>Page 7. Subsection 3.1.3</u>. Section 3.1.3 states that faults that required detailed investigations are faults subject to displacement, affect design and performance, and provide significant input to models. We suggest adding a phrase in Item (1) to the effect that "all faults within the controlled area should be considered as candidates for detailed investigations" so as to be consistent with Section 3.1.2, or provide a reference back to Section 3.1.2.

Page 8. Section titled "Process to Identify "Susceptible" Faults". We suggest changing the title of this Section to read "Process to Identify "Susceptible" Faults that Require Detailed Investigation". Also, we suggest changing the title for Step 1 to read "Identification of Faults that Require Detailed Investigation".

The criteria on page 8 for identifying "susceptible" faults are of sound scientific basis. Significantly, the criteria do not preclude the detailed study of a fault for which evidence of Quaternary movement is absent. Such an approach is reasonable, given that Quaternary deposits may be absent along given faults.

In the description of this process, we suggest that the phrase "subject to displacement" be replaced with the phrase "that require detailed investigation" throughout.

In the second paragraph of Step No. 1 (first sentence), we suggest that the word, "are", after "such faults", be replaced by the phrase, "could be". Also, at the end of the second sentence we suggest adding the phrase, "exhibit any one or more of the following".

In the third paragraph (Item (a)), we suggest adding the word, "or" after the word "fault;".

In the third paragraph (Item (b)), we assume that the reference to displacement on one fault that could cause displacement on another includes the blind thrusts and detachments that could be present beneath the Yucca Mountain site area. A further clarification of a "structural relationship" may be required.

<u>Page 9, first paragraph, first line</u>. We suggest replacing the word "evaluating" with the phrase "providing the necessary information for evaluating". In addition, we suggest replacing the word "would" with "could" in the second line.

In Item (a), investigation of geologic conditions within the component settings is covered under Section 3.2. The process referred to in Item (a) is for all intents and purposes a screening. We assume that this step is intended to be essentially a first cut using existing information.

Under Item (c), it is suggested that the phrase "or fault zone" be added after the word "fault" in the second line.

Page 9. Step No. 2 -- Assessment of the Potential Effects of Faults Subject to Displacement. Step No. 2 encompasses "assessment of the potential effects of faults subject to displacement". The evaluation is to be deterministic and take into account the potential effects of fault size on the design and performance of facilities important to safety. It is stated that fault length is the critical parameter for evaluation and that the "DOE should develop a defensible approach to determine what size fault needs to be characterized in detail". Because earthquakes in the Great Basin have been associated with distributed faulting, the dependence of analysis on the assessment of potential fault length will be associated with significantly greater uncertainty than, for

example, along the strike-slip faults of the California plate boundary. The estimation of the maximum sized earthquake associated with the distributed nature of mapped faults in the Yucca Mountain region should also take into account the regional record of the largest historical earthquakes. Dependence solely on the mapped length of individual faults or fault segments in the region may well underestimate the maximum size earthquake that can be associated with the mapped faults. Also, an issue that could be addressed appropriately here is the collective effect on the hydrologic performance of the site if all of the small faults within the system are displaced due to an earthquake.

<u>Page 10, Subsection 3.1.4</u>. The first paragraph suggests that faults eliminated from further consideration "should" periodically be reconsidered. We suggest that the STP provide more specific guidelines on the framework for accomplishing this "reconsideration" and the decision process and criteria required for reconsideration.

<u>Page 10. Subsection 3.2</u>. The approach to investigating a faultdisplacement hazard appears reasonable, however, Items (a) through (e) are really information requirements and do not represent a scientific approach. We suggest adding the phrase, "or fault zone" after the word "fault" in Items (b), (c), and (d) for consistency with the wording used in Item (a). The last sentence regards "susceptible" faults with no surface expression but identified in

the subsurface. We assume that this is meant to include detachment faults and blind thrusts that are reasonably inferred from the geologic data.

<u>Page 11. Subsection 3.2</u>. Item (2) needs to more succinctly define what constitutes the "underground facility" and this definition added to the glossary. Does this include just the drifts or does it also include boreholes, shafts, and parts which constitute the disturbed zone?

Page 11. Subsection 3.3. The section outlines a viable approach to collecting data needed to assess the expected vibratory groundmotion hazard but does not indicate whether application of the data to ground motion assessment will follow a deterministic or probabilistic approach. There is an implication in this section that there exists an accepted earthquake size - source to site distance - strong ground motion relationship that may be used to determine which faults are capable of producing given levels of strong ground motion at the site of interest. The question will most certainly arise as to the validity of whatever relationship is used to estimate expected strong ground motions at the site.

In Item (3), we suggest adding the phrase, "within the geologic setting and immediately contiguous provinces" after the word "earthquakes" in the first line and replacing the word "affected" with the phrase "been felt at" in the second line.

<u>Page 12, Subsection 3.3</u>. In Item (5) the second sentence requires guidance on how and when "seismic source zones" should be established. In addition, the STP needs to provide guidance on what constitutes the differences if any between "seismic source zones" and "fault zones".

<u>Page 14</u>. In the second paragraph, the STP clearly states that probabilistic techniques for defining an approach to the investigation of fault displacement and seismic hazards have not been shown to be adequately developed for licensing applications for a specific site. This is in direct conflict with aspects of the approach of hazard assessment put forth by the DOE in the Site Characterization Plan for Yucca Mountain.

In the third paragraph regarding documentation, the STP needs to provide guidance on the form of the document and the timing for submittal relative to the results of the screening process used.

<u>Page 15, Subsection 4.1.1</u>. In the first sentence, we suggest adding the phrase "is the geologic setting and" after the word "investigated".

<u>Page 15, Subsection 4.1.2</u>. The last line in the first paragraph should refer to Subsection 3.1.2 <u>and</u> 3.1.3.

<u>Page 16, first paragraph, last sentence, last line</u>. The text should read geologic "component" rather than geologic "setting".

<u>Page 16.</u> Subsection 4.1.3. In the first paragraph, the last sentence states that "capable fault" is used as a site suitability tool. This statement is not entirely correct. There are no suitability tests in 10 CFR 100, Appendix A, nor are there any regulations that prohibit the construction of a nuclear facility on or near a "capable fault". The third sentence in the paragraph is a more accurate description of "capable fault". It is suggested that the third sentence be retained and the last sentence deleted.

<u>Page 17, second paragraph</u>. At the end of the last sentence, we suggest adding the phrase "outside of the controlled area".

In the third paragraph, the first sentence implies that the existing stress regime can be defined for the geologic setting in which a repository is proposed. For Yucca Mountain, it is presently an open question whether the existing stress regime can be defined given the complexity of the geologic setting. The clarity of this paragraph would be improved if the STP provided guidance on defining the geologic setting (i.e., its boundaries) within the context of existing stress regimes.

<u>Page 18, third paragraph</u>. In the second sentence, we suggest adding the phrase "individually or collectively if part of a zone or system" after the word "dimension".

<u>Page 19, second paragraph</u>. The last sentence needs to be rephrased. A technical position cannot be implemented. Technical positions are established by the NRC staff. The procedures outlined by NRC can be "implemented" by DOE if they so choose (e.g., see first paragraph, Section 1.2 on page 13).

<u>Page 19, third paragraph</u>. In the first sentence, it is suggested that the phrase "results of" be added before the word "investigations".

Page 20, first paragraph. By citing Section IV of 10 CFR 100, Appendix A, NRC implies that the requirements under Section IV (6) "correlation of epicenters or locations of highest intensity of historically reported earthquakes, where possible, with tectonic structures any part of which is located with 200 miles of the site" are to be followed. We agree. However, a more appropriate reference in the context of this STP statement might be Section V (a) (1) (i) and (iii) with the language changed to incorporate the phrases "geologic component and seismic component of the geologic setting".

<u>Page 20, second paragraph</u>. Regarding earthquakes that should be correlated with structures or associated with seismic source zones, we assume that the NRC would consider the Walker Lane Structural Zone, Nevada-California Seismic Zone and the East-West Seismic Zone as defined by the DOE in the Site Characterization Plan for Yucca Mountain and its references as the major seismic source zones that need to be considered for evaluating the seismic hazard at the Yucca Mountain site.

<u>Page 21</u>. The Reference list should be expanded to include DOE 6430.1A; LBL-9143; UCRL-53582; USGS OFR-84-854; OFR-88-560; and the version of the Site Characterization Plan for Yucca Mountain that is considered by the NRC staff to represent the current DOE position.

<u>Page 23</u>. The Bibliography needs to include a reference(s) that the NRC staff believes suitable as guidance in characterizing seismic hazards west of the Rocky Mountain front in addition to or instead of Bernreuther, D.L., et al., UCID 20421. Eagling, D.G., et al., 1983, "Seismic Safety Guide", LBL-9143; and Reiter, L., 1990, "Earthquake Hazard Analysis" are possible candidates.

<u>Page 28, definition of "Geologic Setting"</u>. The definitions given on Figure 2, page 26 that the "region is within the geologic setting" and on page 6, item (2) where "components of the geologic system (are) acting within the geologic setting" appear to be in

conflict with each other and the definition for geologic setting given here. The conflict might be resolved if the glossary was expanded to include the definition(s) for the various "systems", settings" and "components". In addition, although the "geologic setting" definition is cast in the concrete language of 10 CFR 60, this glossary offers an ideal opportunity to remedy shortcomings of the 10 CFR 60 language by expanding on that definition, particularly as it relates to the southern Basin and Range region that includes Yucca Mountain.

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<u>Page 28, definition of "seismic hazard"</u>. The statement is made that seismic hazard may be characterized in "either" deterministic . "or" probabilistic terms. This appears to be in conflict with the statements made earlier in the STP on page 5, paragraph two, that a deterministic approach only will be acceptable.

<u>Page 29</u>. An additional reference(s) for seismic source zones west of the Rocky Mountain front needs to be added to the definition of "Seismic Source Zone".