Department of Energy
Washington, DC 20585

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Division of High-Level
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Office of Nuclear Material
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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Linehan:

Enclosed are the Department of Energy (Department) comments on the Nuclear Regulatory Commission's (NRC) draft Technical Position on Methods of Evaluating the Seismic Hazard at a Geologic Repository, published for comment on August 24, 1989, (54 FR 35286). As previously expressed in our earlier comment letter transmitted to you on September 20, 1989, the Department believes that there are numerous disadvantages with the potential use of 10 CFR Part 100, Appendix A for development and evaluation of a geologic repository. This belief is based on: (1) in applying Appendix A, the draft technical position does not consider the different levels of risk associated with a passive geologic repository as contrasted to a dynamic nuclear power reactor; and (2) the terminology and concepts addressed in the regulation appear to be outdated, limiting the use of state-of-the-art concepts such as probabilistic seismic hazard evaluation; and (3) Appendix A provides insufficient guidance on concepts such as underground vibratory ground motion and postclosure tectonic scenarios. These concerns are expanded in the enclosed set of comments.

The Department suggests that a DOE-NRC Technical Exchange be scheduled in the near future to discuss our comments on this important subject. We believe that such an interaction will facilitate your understanding of our concerns. Additionally, we believe that it would be appropriate to re-issue this technical position as a draft document for comment, once the critical issues have been fully discussed and mutual understanding has been reached on the most appropriate methods for evaluating seismic hazards at a geologic respository.

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Please feel free to contact Mr. Steven H. Rossi of my staff on 586-9433 with any questions regarding this correspondence.

Sincerely,

Gordon Appel

Gordon Appel, Chief
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Enclosure: Comments On NRC Draft Technical Position on Methods of Evaluating the Seismic Hazard at a Geologic Repository

cc: R. Loux, State of Nevada
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COMMENTS ON THE NRC DRAFT TECHNICAL POSITION ON METHODS OF EVALUATING THE SEISMIC HAZARD AT A GEOLOGIC REPOSITORY

MAJOR COMMENTS

1. As the draft technical position points out, 10 CFR Part 60 does not rely on 10 CFR Part 100, Appendix A for guidance regarding provisions for dealing with seismic hazard. There are two reasons that this omission was deliberate. (1) The provisions of Part 100 were written with operating nuclear power plants in mind, not waste disposal systems. Disposal systems lack the active cooling systems and energetic physical mechanisms for dispersing contaminates, which nuclear power plants possess. (2) Appendix A to Part 100, written over 25 years ago, no longer reflects state-of-the-art professional practice in characterizing seismic hazards and developing seismic design bases. Its application has been found to be too prescriptive in some areas, too vague in others, and generally difficult to apply without creating considerable controversy. In addition, some of the methodologies in Appendix A may be particularly inappropriate for application in the Basin and Range Province, where recurrence intervals for earthquakes on particular faults are typically tens of thousands of years.

   For the reasons given above, the DOE strongly disagrees with the proposition that 10 CFR Part 100, Appendix A should be considered as general guidance for the characterization of seismic hazards and the development of seismic design bases for a geologic repository. If the NRC believes there are specific methodologies from Appendix A that are directly applicable to a geologic repository and are more appropriate than the studies described in the Site Characterization Plan (SCP), then those methodologies should be specifically identified in a "stand alone" guidance document without reference to Appendix A. This would eliminate many of the problems that are inherent in applying a rule designed for nuclear reactor regulation to a geologic repository.

2. <u>Page 4, Section 2.4</u>

   The technical position states that: "Appendix A sets an important precedent that needs to be considered when new types of nuclear facilities that require seismic hazard review are considered for licensing."

   We agree with this statement, however, there is no evidence that the other regulations which refer to Appendix A, (i.e. 10 CFR Part 72 and 10 CFR Part 40) or this draft technical position, have made that important consideration.

   10 CFR Part 100, Appendix A, appears to have been used in licensing other nuclear facilities in the United States principally because it is the only regulation for nuclear facilities that provides detailed instructions for seismic-hazard investigations.

The Department notes that a recent revision of DOE Order 6430.1A (U.S. Department of Energy General Design Criteria), which is applicable to non-reactor DOE facilities, incorporates state-of-the-art criteria for seismic design, including specific criteria for vibratory ground motion input and seismic engineering analytical methods. The approach described in DOE Order 6430.1A may be of sufficient scope and conservatism to meet the appropriate 10 CFR 60 requirements.

3. Page 10, Section 4.3

The TP states that "a primary reason for taking the position that Part 100, Appendix A is an appropriate methodology for investigating the seismic hazard at a geologic repository is that much of the technology presented in Part 100, Appendix A is generic in nature."

We disagree; Appendix A is not generic. If it were, why would it apply to only some cases? For example, according to 10 CFR Part 72 Appendix A applies West of the Rocky Mountain Front, but does not apply East of the Front. Likewise, Appendix A applies to massive water basin and air-cooled canyon types of independent spent fuel storage installations (ISFSI), but may not apply to other types of ISFSI designs, such as canisters, casks, or silos. It appears that Appendix A applies only where potential risk warrants. In our opinion, Appendix A should not apply to a repository at Yucca Mountain, in part, because the potential risks are lower than most other nuclear facilities.

Any design methodology must reflect the risks associated with the engineered facility, as well as the hazards posed by the Earth. Although design-basis methodology prescribed by Appendix A is appropriate for nuclear power plants, it is not necessarily appropriate for lower-risk facilities, such as a high-level waste repository, or generic to all tectonic environments.

Even this TP admits that nuclear power plants (for which Appendix A was written) pose a greater risk than a repository. The TP states that, "in contrast to a nuclear power plant, a geologic repository is not likely to have components possessing high energy driving forces capable of broadly dispersing the contained radioactivity. Even with a gross failure of those components of a repository involved in containment, a loss of containment integrity would not be as likely to have as significant a consequence for public health and safety as a nuclear power plant, because the systems would be passive."

The NRC staff uses the above statement to explain why the TP does not consider the Appendix A requirements for an operating basis earthquake. We agree this statement, and suggest that it also justifies rejecting the concept of the applicability of 10 CFR 100, Appendix A.

In addition to its biased (rather than generic) nature, Appendix A has been criticized by the NRC and industry. Appendix A was codified in November 1973, and was largely based on professional practice and state-of-the-art in the 1960's and early 1970's. Since that time, there have been numerous technical advancements in evaluating fault and earthquake hazards, particularly in probabilistic evaluations. It would be counterproductive to ignore these advancements simply for the sake of complying with an less than current regulation.

In the late 1970's, the NRC considered revising Appendix A because, even at that time, the regulation was considered outdated, complicated and the cause of licensing delays. The NRC staff summarized these problems as follows:

> Having geoscience assessments detailed and cast in Appendix A, a regulation, has created difficulty for applicants and the staff in terms of inhibiting the use of needed judgment and latitude. Also, it has inhibited flexibility in applying basic principles to new situations and the use of evolving methods of analyses in the licensing process. Additionally, various sections of Appendix A lack clarity and are subject to different interpretations and dispute. Also, some sections in the Appendix do not provide sufficient information for implementation. As a result of being both overly detailed in some areas and not detailed enough in others, the Appendix has been the source of licensing delays and debate, has inhibited the use of some types of analyses, and has inhibited the development of regulatory guidance (SECY-79-300, April 27, 1979).

More recently, at an October 1986 symposium on seismic and geologic siting criteria for nuclear power plants, the technical community renewed the drive to revise Appendix A. The symposium found a number of problems with Appendix A, but the most important was the need to incorporate probabilistic concepts into the regulation with an appropriate mix of deterministic criteria. At that time, the NRC staff stated that their management may not endorse a rule-making until 1987 (Lawrence Livermore National Laboratory, Summary Report of the Symposium on Seismic and Geologic Siting Criteria for Nuclear Power Plants, NUREG/CP-0087, June 1987).

Design motions, derived from Appendix A, can misstate the seismic hazards in some tectonic environments, because Appendix A specifies that design motions be estimated without specific consideration of the style of deformation particular to a tectonic environment. The Appendix A specification of the Safe Shutdown Earthquake requires a review of the historic distribution of earthquake magnitudes and intensities, the distribution of tectonic structures, and "capable faults". For an Appendix A site motion evaluation, the largest earthquake(s) would be placed at locations closest to the site on geologic structures or at seismotectonic boundaries. Where the largest historic earthquakes cannot be associated with a geologic structure, that earthquake will be located at the closest point within the tectonic province. For an application of Appendix A to a critical facility in the vicinity of a major fault, a "max .mum" earthquake magnitude is determined from historical correlations between earthquake magnitude and corresponding surface fault rupture. A common way to estimate maximum earthquake magnitude is to take a point estimate from a statistical distribution of empirical correlations between earthquake magnitude and the length of mapped surface fault traces.

Application of this methodology to active fault segments in the Southern Great Basin could lead to unconservative or uncertain design earthquakes because of the relatively complicated nature of faulting in an extensional environment, and the corresponding difficulty of estimating, a priori, maximum fault rupture lengths.

Yucca Mountain has been characterized as having a number of closely spaced (2-4 km) anastomosing normal faults (Scott and Bonk, 1984). Thus, estimating maximum fault length and correspondingly "maximum" earthquake magnitude for any surface rupture scenario is extremely difficult, and could easily be under or overestimated. This difficulty is compounded as a result of the paucity of instrumental seismicity to define continuity in a fault trace.

Given these problems with application of Appendix A, we disagree with its imposition for the repository. The SCP offers an approach and methodology, based on a Cumulative Slip Earthquake (CSE), that would better postulate a design basis earthquake.

A CSE is defined in the SCP to be a postulated earthquake that occurring every 10,000 years, would produce the observed or estimated average Quaternary slip rate on a fault. The CSE approach results in a design basis with a corresponding exceedance probability between 10-3 and 10-4 per year.

Preliminary information indicates that the CSE methodology will produce a sufficient seismic design basis for surface facilities important to safety during the preclosure period of repository operation. Specifically, preliminary analysis indicates the resulting seismic design basis would correspond to a postulated earthquake on the Paintbrush Canyon fault (an apparently normal fault located about 1 kilometer east of prospective surface waste-handling facilities) with a magnitude of about 6 to 6 1/2 and a peak ground acceleration at the site of about 0.5 to 0.6g. A recent analysis of alternative seismic design levels (SAND 88-1600, "Preliminary Seismic Design Cost-Benefit Assessment of the Tuff Repository Facilities") suggests that the accident risks associated with a seismic design level of 0.2g or greater for surface waste-handling facilities would be extremely small. Important factors which contribute to this finding are that the surface facility cells would be inherently "hard" against seismic loading, because of shielding requirements and the resulting thick shear-wall construction, the low probability of severe ground motion during the operating life of the facility and the lack of an energetic mechanism for dispersing contaminants during an accident. In addition, the target range of exceedance probabilities 10-3 to 10-4 per year) for the design basis has been found to correspond to the accepted design bases for a number of U.S. nuclear power plants (Reiter and Jackson 1983, NUREG-0967), lending further confidence that the CSE methodology will provide more than sufficient conservatism.

Before the NRC issues this TP, we would like an opportunity to build on the concept of a CSE and offer an alternative to Appendix A. Basically, we propose a more risk-based approach to assessing hazards where risk is the integrated product of event probability and consequences. Hazard would then be defined as the probability of exceeding a specified event magnitude.

Although it postdates Appendix A, there is nothing new about a risk based approach. The Environmental Protection Agency (EPA) Standards for geologic repository (50 FR 38066 September 19, 1985) translates an acceptable risk (1,000 health effects to a world population) into limits for cumulative releases and recommends a complementary cumulative distribution function to express the hazard (1 chance in 10 and 1 chance in 1,000) of exceeding multiples of those limits. More recently, the EPA proposed "National Emissions Standards for Hazardous Air Pollutants; Regulation of Radionuclides; Proposed Rule and Notice of Public Hearing" (40 CFR Part 61, 54 FR 9612 March 7, 1989). Here, the EPA proposes three levels of risk, each corresponding to a radiation dose. The final rule will codify one of these doses to limit the radioactive emissions from nuclear and non-nuclear industries.

This risk based approach has clear advantages over Appendix A. Collegial recommendations, such as those made by the International Committee on Radiation Protection, have established values for an acceptable risk. However, various licensing boards, as well as utilities, have never agreed to what constitutes the maximum earthquake that Appendix A expounds. Risk takes into account the nature of the facility and its site. Appendix A examines only the site and was written for nuclear power plant sites, not repositories. Finally, risk assessments can more equitably allocate the design precautions needed to protect the public health and safety. Appendix A would force an unnecessary (and expensive) design basis on a repository without a commensurate benefit to the public.

Unlike Appendix A, a risk-based approach would account for the reduced seismic hazards in areas, such as Yucca Mountain, where the deformation rate is low. The historic rate of seismicity in the Southern Great Basin (SGB) can be characterized by the average annual number of earthquakes of magnitude 4.0 and greater (denoted N4) per 1,000 sq km. For the SGB, N4 is approximately 0.01 events/1,000 sq km (Greensfelder et al., 1980). This rate of seismicity is extremely low compared to interplate seismotectonic environments, (i.e. southern California), where seismic hazards are common design considerations. Using a conservative value for N4 of 0.015 earthquakes per 1,000 sq km for the rate of seismicity in the Yucca Mountain area, this value of seismicity is about a factor of ten less than the Los Angeles Basin area of southern California. An example of the critical nature of relative deformation rates are comparisons of the preliminary probabilistic hazards between southern California and the Yucca Mountain vicinity. Preliminary estimates of the probability of exceeding peak ground motion indicates return periods an order of magnitude greater than that estimated for similar levels of motion for the Los Angeles Basin, a region that supports a variety of critical facilities. Preliminary geologic trenching data in the vicinity of the site also supports low deformation rates: apparent vertical slip rates on Quaternary faults are between 0.001 to 0.0001 cm/yr (SCP section 1.5.2.2). The pre- and postclosure design methodology should account for the tectonic deformation rate, otherwise an inconsistent design basis will occur. For example, a maximum earthquake magnitude cannot define the difference in seismic hazard between a fault that can produce a magnitude 7 earthquake in 100 years, and one that produces a magnitude 7 every 100,000 years. A consistent and defensible design basis must account for the level of hazard.

4. Page 13, Section 4.3.2

The TP states that "Section V(a)(1) [of Part 100, Appendix A] prescribes a set of specific steps to take in evaluating the data gathered through the required investigations, to arrive at the earthquake that produces maximum vibratory acceleration at the site above a threshold of 0.1g. This earthquake is termed the Safe Shutdown Earthquake (SSE). These basic procedures form the framework for establishing the determination of the maximum vibratory motion at any site at relevant times and are therefore considered to be appropriate to a geologic repository.

The underscored phrases have little meaning when applied to a repository that has been closed and decommissioned.

The TP states that the maximum vibratory ground motion would be predicted "at the site." Appendix A, in contrast, states that the motion would occur at each of the various foundation locations of the nuclear power plant structures at a given site" (10 CFR 100, Appendix A, Section V, (a)(1)(1V).
The repository site would be at least as large as the controlled area, which according to 40 CFR 191.12(g), encompasses 100 square kilometers and would extend underground. The foundation locations are smaller, more discrete and lie on the surface. Conceivably, Appendix A could be applied to repository surface facilities, but Appendix A could not be applied to a large mass of earth. Moreover, a closed repository has no surface facilities.

We disagree that Appendix A applies during time periods that are relevant to a geologic repository. Appendix A was written for nuclear power plants which have an operational life of about 40 years. Because of the relative short lifetime of the facility and the safety concern being addressed (ability to safely shut down the reactor), the Appendix A methodology relies on the concept of designing for a single, large event ("maximum credible event occurring on a specific fault. While this concept may ensure power-plant safety for 40 years, it is not suitable for evaluating repository performance.

Instead of Appendix A, we propose a more probabilistic methodology that would take into account not only the effects of single, but also the cumulative effects of multiple events that are reasonably likely to occur during the postclosure time period. We suggest that, if the TP is issued, the last sentence should be revised to read: "These basic procedures form the framework for establishing the seismic basis for determination of the maximum vibratory motion <u>at repository surface facilities during the operational phase</u> (Revisions are underscored.)

5. <u>Page 7, Section 3</u>

The TP states that "...it is the position of the staff that the results of Part 100 Appendix A investigations can generally provide input for probabilistic and other methods of assessing seismic and faulting hazards for the postclosure period."

Appendix A recommends an investigative methodology that is not appropriate for assessing seismic and faulting hazards for the postclosure period. The prescribed investigations gather information that hypothesizes the vibratory ground motion produced by the Safe-Shutdown Earthquake (SSE), which:

> "Produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional. These structures, systems, and components are those necessary to assure: (1) The integrity of the reactor coolant pressure boundary, (2) The capability to shut down the reactor and maintain it is a safe shutdown condition, or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential off site exposures comparable to the guideline exposures of this Part" (10 CFR Part 100, Appendix A, III. Definitions).

The terms and concepts included in the definition of the SSE do not exist at a repository that has been permanently closed. A repository has no "coolant pressure boundary"; a closed repository cannot be "shut down"; and there can be no "accidents" at a closed repository, because the operations have stopped.

COMMENTS

1. Page 1, Section 1

The introduction states that the technical position "...considers differences that may exist, during the preclosure, among the surface facilities and the underground facility." However, this consideration is not apparent in the remaining text of the technical position.

2. Page 1, Section 1

Section 1 states that the purpose of the technical position is to provide: "...regulatory guidance to the U.S. Department of Energy (DOE) on appropriate methodologies that address seismic hazard at a geologic repository."

Later, in the same Section, it is stated that: "this position does not address probabilistic seismic hazard analysis...[which is] ...addressed in other technical positions...."

Additionally, Section 3 (page 7) states that: "...the results of Part 100, Appendix A investigations can generally provide input for probabilistic and other methods of assessing seismic and faulting hazards for the postclosure period."

Based on such conflicting statements, we find it difficult to understand this draft technical position without understanding the NRC position on probabilistic seismic hazard evaluations, especially since the evaluations specified in 10 CFR Part 100, Appendix A are deterministic.

3. Page 5, Section 2.5

The technical position states that: "10 CFR Part 60 does not specifically rely on Part 100, Appendix A for guidance regarding provisions for dealing with the seismic hazard nor does it specifically require the development of a design basis earthquake. Instead, the performance objectives and siting and design criteria described in 10 CFR Part 60 establish the bases for considering seismic hazard for both the preclosure and the postclosure periods."

We agree, with the above statement and consider that the omission of references to 10 CFR Part 100, Appendix A was deliberate.

10 CFR Part 100, Appendix A was codified in the regulations and available for consideration at the time 10 CFR Part 60 was promulgated. However, as stated in the supplementary information to the proposed 10 CFR Part 60 rule on disposal of high-level radioactive waste in geologic repositories dated July 8, 1981 (46 FR 35280), the Commission considered their past experience and practice with other facilities and acknowledged that there were important differences between a repository and those facilities. We must conclude that if the Commission believed

Appendix A to be applicable to a geologic repository, it would have codified the Appendix in the regulation at that time.

Since 10 CFR Part 60 was promulgated more than eight years ago, the NRC has concurred on the DOE siting guidelines, commented on the DOE environmental assessments, and reviewed and commented on the SCP. On any of these occasions, the relevance of Appendix A to the repository program could have been raised, but was not. Moreover, the NRC staff agreed with the DOE that: "the need to consider specific pre-closure and post-closure events, processes, and phenomena should be based upon a consideration of their effects on compliance with the performance requirements of 10 CFR 60" (summary of the NRC/DOE meeting on seismic/tectonic investigations, December 3-4, 1985).

4. Page 10, Section 4.3.1

Since Appendix A details the required geoscience assessments, the use of evolving methods, such as probabilistic seismic hazard analysis (PSHA), which is a generally accepted procedure to describe the seismic hazard (National Research Council, 1988), is limited. State-of-the-art seismic zoning maps rely to some degree on probabilistic considerations to assess relative hazards at different sites. As described in the SCP, the DOE plans to use PSHA to assess the sensitivity of input parameters and examine uncertainties in ground motion estimates.

5. Page 11, Section 4.3.1(6) and Page 13, Section 4.3.2

Appendix A requires the correlation of past earthquakes with capable faults, tectonic structures and tectonic provinces. However, Appendix A does not specify a method for quantifying future rates of activity, including determining a maximum credible earthquake. We believe that more definitive criteria than that provided in Appendix A are needed to avoid conflicting interpretations.

6. Page 14, Section 4.3.2

The TP states that "...any guidelines [Section V(b) of Part 100, Appendix A] for surface faulting should be considered applicable to the underground facility of a geologic repository as well, since it is very unlikely that a fault that ruptures the surface above the underground facility would not also create a rupture within the underground facility."

We agree that surface faulting would be expressed underground, but disagree that guidelines for one should apply to the other.

The guidelines in Appendix A clearly apply to the foundations of nuclear power plants. There are no "foundations" underground. Moreover, Appendix A was never written for mines, and the NRC has recognized this. Otherwise it would have referenced Appendix A in 10 CFR Part 60, instead of the Federal Mine Safety and Health Act of 1977 and the mining regulations of Title 30, the Code of Federal

Regulations.

7. Page 14, Section 4.3.2

The technical position states that "...any faults discovered within the perimeter of the underground facility, through drifting or other means during site characterization, that cannot be associated with surface faults, require special investigation [given in Appendix A] similar to surface faults." It is not practical to investigate surface and subsurface faults in the same way. According to Section V(b) of 10 CFR Part 100, Appendix A fault traces "...are mapped along the trend of the fault for 10 miles in both directions from the point of its nearest approach to the nuclear power plant...." If a subsurface fault is not expressed on the surface, it cannot be mapped for more than a few feet.

8. Page 7, Section 3

The TP states that: "...the NRC staff will review those sections of the SAR (Safety Analysis Report) addressing Subsections 60.21(c)(1)(ii)(B) and C and Subsection 60.21(c)(3) of 10 CFR Part 60, in light of Appendix A of 10 CFR Part 100. In addition, the methodology outlined in this TP can be used in developing seismic and geologic bases for earthquake design criteria pertinent to Subsection 60.131(b)(1) of 10 CFR Part 60 and in assisting in demonstrating compliance with Sections 60.111, 60.112, and 60.113."

The underscored provisions require an assessment of repository postclosure performance. We fail to understand how these provisions could be reviewed "in light of Appendix A of 10 CFR Part 100" or how Appendix A could assist "in demonstrating compliance" with them.

Subsection 60.21(c)(1)(ii)(B) requires analyses of favorable and potentially adverse conditions as specified in 60.122. The right combination of these conditions will "provide reasonable assurance that the performance objectives relating to the isolation of the waste will be met" (10 CFR 60.122(a)(1)).

Note that the favorable and potentially adverse conditions are not related to repository construction and operation, but only to the "isolation of the waste". In contrast, the scope of Appendix A is to "provide reasonable assurance that a nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public" (10 CFR 100 Appendix A, II Scope.)

We submit that the scope of 10 CFR 60.21(c)(1)(ii)(B) differs from the scope of 10 CFR 100 Appendix A, and therefore, compliance with the former cannot be demonstrated in light of the requirements of the latter.

Subsection 60.21(c)(1)(ii)(C) requires "an evaluation of performance of proposed geologic repository for the period after permanent closure, assuming anticipated processes and events, giving the rates and quantities of releases of radionuclides to the accessible environment as a function of time; and a similar evaluation which assumes the occurrence of unanticipated processes and events." As stated previously, the criteria in Appendix A were written for an operating nuclear facility; not one that has been permanently closed and decommissioned.

Also, 60.21(c)(1)(ii)(C) requires an assessment of anticipated processes and events, while Appendix A requires an assessment of a seismic event (the Safe Shutdown Earthquake) that originates along a "capable fault." Anticipated processes and events are based on "those processes operating in the geologic setting during the Quaternary Period" (last 1.8 million years) (pages A-1 and A-2). Capable faults, defined in Appendix A, exhibit one or more of the following characteristics:

1. At least one movement in the past 35,000 years, or multiple movements in the past 500,000 years;

2. Instrumental seismicity that can be correlated to a fault; and

3. A structural relationship to a fault described by 1 or 2 such that the movement on one could reasonably result in movement on the other.

There may be faults on which "anticipated" events have occurred in the Quaternary, but which occur at such low frequency (less than 2 events in the last 500,000 years) that the faults are not considered capable. This discrepancy between anticipated events and events originating along capable faults is particularly significant in the Basin and Range Province where intervals between faulting events may be 200,000 years or more on some faults. Thus, the postclosure performance evaluations in 10 CFR 60.21(c)(1)(ii)(C) are not congruent with the evaluations of capable faults prescribed in Appendix A.

Subsection 60.112 requires that releases of radioactive material following permanent closure "conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency [EPA] with respect to both anticipated processes and events and unanticipated processes and events."

The deterministic criteria in Appendix A are of limited utility, if any, for demonstrating compliance with the EPA's probabilistic standards. To determine compliance with 40 CFR 191.13, the EPA recommends a complementary cumulative distribution function "that indicates the probability of exceeding various levels of cumulative release" (40 CFR 191, Appendix B).

These release probabilities will be derived from the probabilities of processes and events that cause the releases. The EPA states that the DOE may discount certain processes and events of low probability or if omission does not significantly affect the remaining probability distribution of cumulative releases.

In contrast, Appendix A would compel the DOE to assess the consequences of a "maximum earthquake," the "maximum vibratory ground motion," and the epicenters of earthquakes of "greatest magnitude" or the locations of "highest intensity." The superlatives: "maximum," "greatest," and "highest" loose meaning when signifying the types of events that may occur in the next 10,000 years. This would lead to extended debate of limited practical utility regarding what such an event might be. Also, the superlatives connote a deterministic methodology that is antithetical to the probabilistic analyses prescribed by the EPA. In other words, Appendix A advances worst case scenarios regardless of probabilities or consequences, while the EPA effectively dismisses scenarios when probabilities are low or the resulting consequences are insignificant.

Finally, we fail to see how the criteria in Appendix A could assist the DOE in demonstrating compliance with 60.113, which idnetifies objectives for the performance of the waste package, the engineered barrier systems, and groundwater travel time.

The purpose of the investigations required by Appendix A is to obtain the information needed to describe the vibratory ground motion produced by the Safe Shutdown Earthquake. A safe shutdown earthquake is defined by terms and concepts that do not relate to a waste package or an engineered barrier system. The waste package and engineered barrier system have no "coolant pressure boundary"; cannot be "shut down"; and they cannot cause "accidents," because, according to 60.113, these function after the repository operations have stopped.

Even more so, the Safe Shutdown Earthquake has no bearing on calculating ground-water travel time. The Safe Shutdown Earthquake provides a design basis, and ground-water travel time cannot be designed. Moreover, Part 60 constrains ground-water travel time calculations to present-day conditions. The occurrence of a Safe Shutdown Earthquake would not be typical of current-day conditions.

For the above-mentioned reasons, NRC should delete references to 10 CFR 60.21(c)(1)(ii)(B) and (C), 60.112 and 60.113.

9. Page 8, Section 4.1

Although data used in assessing the preclosure seismic hazard may very well be used to assess the postclosure seismic hazard, there are distinct differences. For example 10 CFR Part 100, Appendix A offers no guidance for assessing the seismic hazard for a subsurface facility, where vibratory ground motion appears to be of little or no concern and only faulting through the repository or the effect of tectonic processes on site or regional hydrology may affect repository performance. Such considerations need to be addressed in the technical position.

10. Page 13, Section 4.3.2

Regarding the determination of the Safe Shutdown Earthquake, the last sentence states that Appendix A provides for "...determination of the maximum vibratory motion at any site at relevant times...." We do not understand what is meant by the term "at relevant times." This implies that the Safe Shutdown Earthquake for nuclear power plants is applicable to the preclosure and postclosure periods of a geologic repository, even though it has different facilities, operating periods, and levels of risk. These differences in risk need to be addressed by the technical position.

11) Page 3, Section 2.2

The general design criteria of 10 CFR Part 50, Appendix A are applicable only to nuclear power reactors. Therefore, we suggest substituting "power" for "material" and "reactors" for "materials" in the first sentence.

12) Page 6, Section 2.5

The regulation referenced for input to the SAR [60.21(1)(ii)(B) and (C)] is incorrect. The correct citation is 60.21(c)(1)(ii)(B) and (C).

13) Page 16, Section 6

We do not believe it is appropriate for a technical position to contain a bibliography. The usefulness of these documents in providing guidance to the DOE is questionable. Only those documents directly referenced in the technical position should be listed.

14) Appendix A

Appendix A contains several minor errors that should be corrected to be consistent with 10 CFR Part 60. These include:

- Page A-1, Accessible Environment, insert "portion of the" between "the" and "Lithosphere."

- Page A-6, Important to Safety, insert "the completion of" between "until" and "permanent."

- Page A-7, Retrieval, insert "10 CFR Part 60" as the reference for this term.

15) Appendix B, Page B-9, 10 CFR Part 72

It is not clear as to whether sites east of the Rocky Mountain Front have a minimum spectral anchor of 0.2g (Paragraph (a)) or 0.25g (Paragraph (a)(6)(ii)).

16) References

There are various useful documents that address seismic hazard evaluation and 10 CFR Part 100, Appendix A that appear to have not been considered in preparing the draft technical position. We suggest that the NRC consider the following documents when evaluating these comments on the draft technical position. These include:

1. Bernreuter, D.L., Savy, J.B., Chen, J.C. and B. Davis, Seismic Hazard Characterization of the Eastern United States, Lawrence Livermore National Laboratory, UCID-20421, Vols. 1 and 2, 1985.

2. Electric Power Research Institute, Development and Application of a Seismic Hazard Methodology for Nuclear Facilities in the Eastern United States, RP-P101-29, Vols. 1-3, 1985.

3. International Atomic Energy Agency, Earthquakes and Associated Topics in Relation to Nuclear Power Plant Siting: A Safety Guide, No. 50-SG-S1, 1979.

4. National Research Council, Probabilistic Seismic Hazard Analysis, National Academy Press, 1988.

5. U.S. Nuclear Regulatory Commission, Geologic and Seismic Siting Policy and Practice for Nuclear Power Plants, SECY-77-288A, 1977.

6. U.S. Nuclear Regulatory Commission, Identification of Issues Pertaining to Seismic and Geologic Siting Regulation, Policy and Practice for Nuclear Power Plants, SECY-79-300, 1979.

7. U.S. Nuclear Regulatory Commission, Regulatory Analysis for USI A-40, "Seismic Design Criteria", NUREG-1233, 1988.

8. U.S. Nuclear Regulatory Commission, Summary Report of the Symposium on Seismic and Geologic Siting Criteria for Nuclear Power Plants, NUREG/CP-0087, 1987.