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JUN 13 1985

SEISMIC/TECTONIC POSITION PAPER

This letter transmits a copy of a Preparation Plan for completion of the NNWSI Project Seismic/Tectonic Position Paper. DOE Headquarters has assumed a management role in arranging a meeting with the NRC staff on the annotated outline which was prepared by the NNWSI Project and reviewed by DOE HQ, BWIP and Weston. Our plan to meet with the NRC staff in April has not been accomplished and we consider it necessary, to complete the SCP by March, 1986, to go ahead with the preparation of the position paper without benefit of an early interaction with the NRC staff. Our present plan calls for us to complete portions of the position paper in preparation for a meeting with the NRC staff that is scheduled for August 20-21, 1985. The enclosed preparation plan and minutes of a meeting between J. S. Szymanski, J. T. Neal and M. D. Voegele outline an approach to accomplish the goal of preparation for the forthcoming meeting. This material also addresses the question of dealing with both a generic and site specific version of the position paper.

It is our intent to reconvene the working group to which you have been requested to designate participants. Our plan is to meet on June 20-21, 1985 in Las Vegas and it is requested that the previously designated participants and any supporting staff judged necessary to complete the activities outlined in the attached material attend that meeting.

We further request your acknowledgement that you are in agreement with the approach described in the preparation plan and meeting minutes. We recognize that little time is allowed for your review of this material and therefore are requesting a written response only if you disagree with either the preparation plan or the porposed approach contained in the meeting minutes. The first order of business of the working session to be held on June 20-21 will be finalization of the preparation plan and we feel confident that we will be able to quickly resolve any minor points about the plan because it simply documents a process that we feel already has your implicit agreement.

Each of you, or your designated representative, will be contacted by J. S. Szymanski on June 17, 1985 to obtain your verbal comments about the plan and approach. As noted, if you find it necessary to object to the plan or approach, your written comments will be required at that time in order that we can revise the plan prior to the working session on June 20-21. We will

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operate on the premise that if we do not receive written objection to the plan or approach then it can be assumed that we have your concurrence.

If you have any questions on this matter, please direct them to J. S. Szymanski at FTS 575-1503.

Donald L. Vieth, Director
Waste Management Project Office

WMPO:JSS-1110

Enclosures:
1. Seismic/Tectonic Position Paper Preparation Plan
2. Meeting Minutes

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ENCLOSURE 1

Preparation Plan: Seismic/Tectonic Position Paper

1.0 Introduction

An annotated outline for a position paper on seismic/tectonic considerations for siting a repository for high-level nuclear waste at Yucca Mountain, Nevada has been prepared by an ad hoc committee comprised of members of the NNWSI Project participants. Invitation to participate in the development of that position paper was extended to all NNWSI Project participating organizations. The purpose of this preparation plan is to formally outline the preparation process and schedule for that position paper and to provide a vehicle for assigning organizational responsibilities subject to agreements and concurrences between the Project Manager and the participant Technical Project Officers.

The requirements of the position paper are reflected in the annotated outline of the position paper which is included as section 3 of this preparation plan; these requirements are summarized briefly in section 2 of this preparation plan. The implementation of the seismic/tectonic position paper involves a methodology wherein the content of the position paper developed by the Project is reviewed by external consultants who are reputable in the fields of seismicity, tectonics and seismic design. The position paper then will be used by the NNWSI Project as a basis for discussions with the NRC staff about proposed field studies described in detail in the SCP, their relevance to necessary design information, the evolution of design criteria, and the seismic/tectonic aspects of surface and subsurface design of a repository and its facilities at Yucca Mountain.

2.0 Requirements

The requirements for the NNWSI Project position paper on seismic/tectonic considerations for siting a repository at Yucca Mountain are to outline and document a methodology to demonstrate regulatory compliance with respect to seismic/tectonic considerations of 10 CFR 60, 40 CFR 191, 10 CFR 960 and other

identified requirements for both pre and post closure time frames. It is noted and emphasized that the primary purpose of this exercise is to provide a controlled approach to resolving licensing issues related to seismic/tectonic considerations. It is explicitly expected that, as information about the site becomes available through site characterization studies, certain aspects of the methodology will be redefined. The purpose of preparing a position paper describing the methodology is twofold: (1) the methodology described in the position paper provides a comprehensive description of the logic underlying the project approach to identifying and resolving seismic/tectonic issues that can be reviewed by external parties, notably the NRC staff; and (2) the position paper provides a mechanism for project management that enables a change control board to effectively integrate all studies relevant to seismic/tectonic issues and efficiently manage project direction in response to NRC interactions and new information that becomes available from field studies.

The strategy of the position paper on seismic/tectonic considerations is to identify all such considerations that are relevant to the demonstration of compliance with applicable regulations; implicit in this strategy is the identification of the applicable regulations themselves and the manner in which seismic/tectonic considerations are relevant. The manner by which the NNWSI Project identifies and tracks this information is through the use of an issue hierarchy. The position paper is intended to document the technical rationale behind the inclusion of seismic/tectonic related issues in the hierarchy; it is further expected that the position paper will aid in the definition of the parameters which comprise a specific issue or information need. The position paper is thus expected to provide documentation of the rationale that supports the inclusion of specific field programs in the NNWSI Project SCP. The position paper strategy goes beyond the SCP, however; it is also intended to outline the methodology whereby a demonstration that the risks of not meeting specified requirements and performance standards within acceptable limits can be accomplished.

The approach used in the position paper is based upon the use of performance assessment to identify pertinent processes and events and formulate impact scenarios that consider performance objectives and the behavior of the radionuclide migration field. Subsequently the probability of and occurrence of a

given scenario is evaluated and, if required, an assessment of consequences, in terms of quantities of radionuclides released to the accessible environment, is performed. Finally, the approach focuses upon an evaluation of the uncertainties involved in the preceeding assessments.

The desired attributes of the methodology outlined in the position paper are that it be complete, objective and scientifically sound. Further, it must be timely and acceptable to both NRC and DOE. In this manner, the position paper will help establish the basic requirements of the provision of reasonable assurance required for issue resolution.

3.0 ANNOTATED OUTLINE FOR POSITION PAPER: RATIONALE FOR SEISMIC/TECTONIC INVESTIGATIONS FOR LICENSING A NUCLEAR WASTE REPOSITORY

3.1 INTRODUCTION

- Purpose: To develop and articulate an approach to resolve seismic and tectonic issues that is consistent with the requirements of 40 CFR 191, 10 CFR 60, and 10 CFR 960.

- General Framework: The Site Characterization Plan (SCP) is the document that will define the information needed, and the approach to obtaining that information, for ultimate use in the demonstration of compliance. The applicable regulations provide a framework of concepts to be addressed in the demonstration of compliance with the regulations but do not provide specific guidance as to their implementation. The implementation of the regulations requires an analytic exercise wherein the post closure and preclosure aspects of the regulations are examined in light of possible scenarios, site characteristics and known data to determine, in a preliminary fashion, those aspects of the site which could impact the eventual compliance demonstration. This information is used in the development of plans to acquire data during site characterization. This information also provides the base for the ongoing reevaluation of the approach to demonstrate compliance. It is expected that, as data from site characterization become available, scenario probabilities will be defined and necessitate redirection of field activities. One aspect of the above described process is concerned with seismic/tectonic phenomena. This paper will provide an approach and rationale for the seismic/tectonic investigations to be described in detail in Chapter 8 of the SCP; the content of the paper will be incorporated in or referenced by the SCP. General requirements for site characterization will be included in Chapter 7 of this paper. The Safety Analysis Report (SAR) will demonstrate that the information obtained during site characterization and the methods and assumptions used to perform safety analyses reflect reasonable

assurance that performance objectives of 10 CFR 60 and radionuclide release standards of 40 CFR 191 have been met.

- o Approach: The approach to resolve seismic/tectonic issues must result in a repository site and design that is safe, environmentally acceptable, cost effective, and located such that credible seismic/tectonic phenomena will not degrade system performance below acceptable limits. Performance assessment, safety analyses, and repository performance confirmation monitoring are the means by which this is demonstrated. Specific distinctions should be made regarding the period of performance; repository preclosure considerations involve both surface and underground facilities during a relatively short operational period, whereas postclosure considerations involve only the underground facilities and geologic setting, but for a much longer isolation time frame. It is envisioned that early interaction with NRC will be required during the preparation of this paper to assure that the developed framework is acceptable.

3.2 APPLICABLE REGULATIONS AND DEFINITIONS

3.2.1 REGULATORY FRAMEWORK

This section will provide a discussion of, and establish the hierarchy for, the application of currently existing regulations relative to seismic/ tectonic considerations in the licensing process. The Nuclear Waste Policy Act (NWPA) will be included to establish the procedural baseline for the regulatory process. The three remaining regulations with direct applicability, 40 CFR 191 (draft), 10 CFR 60, and 10 CFR 960 (and other incorporated regulations), will be reviewed and summarized, with focus on citation of those sections containing seismic/tectonic criteria, or with seismic/tectonic implications.

3.2.2 DEFINITIONS

This section will provide a glossary of applicable definitions. Definitions that will be developed should be consistent with those already in existence, such as those found in 10 CFR 60, 10 CFR 960, and 40 CFR 191 (draft). If current wording is unclear for some definitions in existence (for example "active fault" in 10 CFR 960), an interpretation of the intent of the definition is necessary. Those definitions not found in the above regulations will be developed as appropriate. Inconsistencies will be identified and resolutions proposed.

A provisional list of definitions to be included follows:

Definitions

Accessible environment
Active fault
Anticipated event
Candidate area
Class I structure
Class II structure
Class III structure
Controlled area
Complementary Cumulative Distribution Function (CCDF)
Design earthquake I
Design earthquake II
Design event
Design ground motion
Design spectra
Deterministic analysis
Disturbed zone
Design UNE I (Underground Nuclear Explosion)
Design UNE II (Underground Nuclear Explosion)
Exceedance probability
Expected repository performance

Geologic setting
Hydrologic terms (to be expanded)
Important to safety
Likely consequence of failure
Maximum consequence of failure
Mean return period
Mitigation
Performance assessment
Performance objective
Postclosure earthquake (PCE)
Probabilistic analysis
Probabilistic safety assessment (formerly probabilistic risk assessment)
Reasonably forseeable events
Reasonable assurance
Response spectrum
Retrievability
Scenario
Seismicity
Seismogenic province
Significant tectonic event
Site
Subsurface facilities (shallow and deep)
Surface facilities
Tectonic Processes
Unanticipated event
Very unlikely events

For definitions which are not included in 10 CFR 60, 10 CFR 960, and 40 CFR 191, use will be made, to the extent possible, of equivalent geological, industrial, and mathematical terms.

3.3 CONCEPTUAL APPROACH TO SEISMIC/TECTONIC ASSESSMENTS FOR LICENSING

3.3.1 IDENTIFICATION OF SIGNIFICANT PROCESSES AND EVENTS

1. This section will address the identification of seismic/tectonic processes and significant seismic/tectonic events which may influence safety considerations for the HLW repository regarding its total life cycle. Seismic/tectonic processes which should be considered include: a) volcanism, b) faulting, c) folding, and d) regional crustal movements and related strain (stress) accumulation. Significant seismic/tectonic events are those events which, in light of tectonic history and other characteristics of the site, must be considered in evaluating compliance of the repository with the performance objectives of 10 CFR 60. This may include human-induced ground motion and seismicity. Pre-closure and post-closure performance objectives, with respect to near-surface and subsurface, will require recognition of different sets of seismic/tectonic processes and events.

2. This section will address the formulation of probability based criteria to be used for identifying significant seismic/tectonic events to be considered for pre-closure analyses. On a preliminary basis it will identify seismic/tectonic processes which may be important with respect to these analyses. It will provide the rationale as to why certain processes should be included or excluded, based on either probability or consequences. Further, it will evaluate the potential impact of the relevant processes on pre-closure performance objectives, identify relevant seismic/tectonic processes and events, and reevaluate impact on repository design.

3. This section will identify those seismic/tectonic processes that are indicated by preliminary analyses to be of importance with respect to the post-closure analyses. It will provide the rationale as to why some processes should be included or excluded. For each relevant process it will evaluate potential impact, both direct and indirect, of this process on each post-closure performance objective. This section will identify controlling

seismic/tectonic events including their magnitude, and reevaluate impact on repository design and performance.

3.3.2 IDENTIFICATION OF THOSE ISSUES THAT NEED TO BE RESOLVED

This section will identify key issues from the current understanding of site behavior which require seismic/tectonic considerations for their resolution. It will provide the rationale for including and/or excluding certain issues.

Using the established hierarchy, the section will identify the issues that may require seismic/tectonic input. This section is to include: a) performance assessment issues, b) design issues, and c) site characterization issues, and provide the rationale for including and/or excluding certain issues.

For each pertinent issue, the section will identify seismic/tectonic processes and events that must be considered in order to resolve the issue properly. It will provide the rationale and evaluate the potential design and performance impacts.

3.3.3 ISSUE RESOLUTION METHODOLOGY

The resolution of pre-closure and post-closure seismic and tectonic issues may require different experimental and analytical techniques because of the different health and safety concerns and the different time periods involved.

1. Pre-closure issues will involve health and safety during operations and retrieval over periods of time up to 100 years. This section will identify specific techniques used for safety analysis, including seismic safety analysis. It will identify specific seismic/tectonic events which, at this time, are considered for the analysis and identify uncertainties and assumptions used in analyses.

The approach to demonstrating compliance could include the following steps:

a. Identify the set of release scenarios for anticipated seismic/tectonic processes and events that might affect safety during operation and retrieval.

b. Conduct failure mode analysis of structures, systems and components important to safety, using event probabilities and seismic design parameters determined according to procedures outlined in Chapter 4.3 and 5.2.

c. Determine likely and maximum consequences of failure with respect to radiological safety, considering ranges of parameters that affect these consequences.

d. Analysis of (c) and degree of compliance with release limits.

e. Consideration of uncertainty involved in analyses and effect on (d). Evaluation of impact on design of structures, systems, and components important to safety, and implications regarding design of structures to resist failure.

2. Post-closure issues will involve health and safety concerns for a period up to 10,000 years. Significant post-closure releases arising from seismic/tectonic phenomena must be included in the total system performance assessment that leads to the construction of the empirical Complementary Cumulative Distribution Function (CCDF) described in draft 40 CFR 191. This approach to demonstrating compliance could include the following steps:

a. Identify the set of release scenarios, including scenarios involving seismic/tectonic events and processes for both anticipated and, as appropriate, unanticipated events.

b. Construct mathematical models of each class of scenario; the models predict cumulative release of radioactivity from each class of scenario for the first 10,000 years after closure.

c. Assign probability distributions to the uncertain parameters that appear in the models of the scenarios; these distributions should be based on data pertaining to site tectonics and seismicity as much as possible.

d. Combine mathematical models in a single model, capable of time-dependent simulation, that gives sample values of the total cumulative release to the accessible environment 10,000 years after closure.

e. Exercise the model formed in "d", above, to obtain statistics sufficient to construct the CCDF mentioned in draft 40 CFR 191.

Additionally, post-closure issues will involve other 10 CFR 60 performance objectives. These are groundwater travel time, release rates from engineered barriers, and life of waste package. Resolution of these issues may require seismic/tectonic consideration. The paper will identify those issues and corresponding seismic/tectonic factors. It will identify the analytical techniques to be used; specific seismic/tectonic events which, at this time, are considered in this analysis; and assumptions and uncertainties.

3.4 APPROACH FOR IDENTIFYING SIGNIFICANT SEISMIC/TECTONIC EVENTS

3.4.1 GENERAL

Preliminary scoping analyses should be performed to identify some or all of the significant seismic/tectonic events. The process for performing these scoping evaluations is described in the following sections.

3.4.2 SUMMARY OF EXISTING DATA BASE RELATED TO SEISMIC/TECTONIC EVENTS

This section will present a synopsis of the current data base; it will also present sets of field observations which a) are subject to alternative interpretations and/or b) may have a significant impact on waste containment and isolation. Included are the following topics:

1. Preclosure (10 CFR 960.5-2-11)

   a. Historical patterns of seismicity (including relationship to known surface features, indications of stress state).

   b. Relief and accumulation of tectonic stress and its effect on emplacement or retrieval operations.

   c. Fault displacement and its effects on: surface and subsurface facilities judged important to safety; operations; and retrieval.

   d. Effects of vibratory ground motion, natural or man induced, on surface or subsurface facilities that are judged important to safety.

2. Postclosure (10 CFR 960.4-2-7)

   a. Tectonic stress (its nature, i.e., tectonic, remnant, residual and gravitational components; orientation and magnitude; temporal and spatial variability);

   b. Fault displacement (location, length of surface rupture, movement style and history, amount of slip, secondary effects);

   c. Vibratory ground motion; acceleration and response spectra; time history; relationship to (a) and (b);

d. Volcanism (composition, volume, time-space trends, tectonic setting, relationship to seismicity, geophysical data, eruptive mechanisms, secondary effects);

e. Human induced seismicity and ground motion (size and characteristics of the effect from UNE testing, fluid injection, fluid withdrawal, impoundment, and mining);

f. Secondary effects of seismic/tectonic events (ground-water movement, secondary slip and fracturing, landslides, liquefaction, and erosion);

g. Regional crustal movements and effects on waste isolation (folding, subsidence, uplift, diapirism).

3.4.3 ASSESSMENT OF SIGNIFICANCE

Based on professional judgment, including case histories from the region, and performance assessment calculations if available, this section will evaluate significance of the above topics in the context of each performance objective of 10 CFR 60. It will consider the pre-closure time-frame, i.e., operational releases and retrievability; and post-closure, i.e., compliance with 40 CFR 191 release standard, travel time, life of waste package and release rates from engineered barrier.

For the post-closure time frame considerations may include:

1. Relief and accumulation of tectonic stress and its effects on fracture conductivity, permeability, and pore pressure, waste-package integrity, and possible deterioration of seal performance.

2. Fault displacement and its effects on permeability, fracture, conductivity and pore pressure, waste-package integrity, and disruption of seals.

3. Effects of vibratory ground motion on permeability, fracture conductivity, pore pressure, and water movement.

4. Magmatic intrusion or extrusion into the repository proper.

5. Magmatic intrusion or extrusion into the hydrologic system up and down-gradient of the repository and its affect on compliance with 10 CFR 60 performance objectives, and compliance with 40 CFR 191 release standards.

3.4.4 UNCERTAINTY CONSIDERATIONS

Assessments of safety must consider the extent of uncertainty that exists throughout any analysis and determine its effects on the conclusion reached in that analysis. Potential sources of uncertainty arise from: understanding of basic phenomena; formulation of constitutive relationships and conceptual models of features events and processes; formulation and execution of mathematical models; and data and data analysis. This section will address, in the following arrangement, the manner by which uncertainty will be reduced:

1. Conceptual uncertainty.

   Reduce conceptual uncertainties (i.e. fidelity of models to physical reality) through consensus opinion and through consideration of alternative hypotheses, if significant effect on results is shown.

2. Natural uncertainty.

   Reduce numerical uncertainties through the use of site-specific data and consensus opinion. Appropriate numerical and analytical models will be used.

3. Interpretative uncertainty

Discuss how interpretative uncertainty can be reduced by carefully checking and validating formulae and codes; this is the focus of software QA programs advocated by NRC and DOE.

3.4.5 RELEVANCE OF EXPECTED EVENTS DURING PRE- AND POSTCLOSURE TIME FRAMES AND IMPACTS ON REPOSITORY DESIGN AND PERFORMANCE.

A comparative evaluation of the significant effects will be provided to offer a perspective on the most important aspects with respect to radiological safety and cost.

3.5 STRATEGY FOR ISSUE RESOLUTION AND/OR MITIGATION

3.5.1 GENERAL

This section will describe the licensing strategy to be employed in resolution of issues related to seismic/tectonic characteristics of the site. It will consider: a) procedures to be used in developing the seismic design parameters; b) engineering design measures; and c) recognition and integration of uncertainties. These measures involve in-depth consideration of possible means of adding confidence in the resolution of issues.

3.5.2 SEISMIC DESIGN PARAMETERS

This section will address procedures used to develop seismic design parameters;

Pre-closure - Identify procedures which are judged to be proper for use in developing seismic design parameters. The section will consider vibratory ground motion and surface rupture. It will discuss implementation of the scheme or procedure for classification of

structures, systems and components deemed important to safety, and consider complimentary earthquake approaches acceptable for other nuclear facilities. The section will discuss the rationale, alternatives and procedures used for equivalent considerations in other industries.

Post-closure - This section will ascertain the sensitivity of the closed repository to vibratory ground motion and fault displacement, including secondary effects. It will consider sealing, waste package, and other engineered and natural barriers. It will present procedures which could be used to develop seismic design parameters for post-closure.

3.5.3 ENGINEERING

For certain seismic/tectonic processes and events, a demonstration of compliance with some performance objectives could be achieved through conservative engineering design. This section will identify, in a preliminary fashion, these processes and events and the performance objectives corresponding to them. With respect to mitigation of undesired effects of each seismic/tectonic process and event it will identify available technology, engineering strategy and cost considerations. The discussion will consider allowable thermal loading and relate it to the size of the disturbed zone, mode of emplacement, clearance for tunnels, shafts and emplacement boreholes, etc., location of surface facilities, and design parameters for vibratory ground motion, including support considerations. The section will discuss the iterative aspects assessing compliance and refining design.

3.5.4 RECOGNITION AND MITIGATION OF UNCERTAINTIES

This section will discuss the manner in which the following topics are treated:

1. Assessment of uncertainties in event scenarios, conceptual models, mathematical models, and data.

Sources of uncertainty in each category will be identified as considered in analyses, because these will detract from the demonstration of reasonable assurance.

2. Enhance understanding of potentially adverse and favorable site conditions.

   The extent to which potentially adverse and favorable site conditions exist will be evaluated with respect to safety, environment, and cost. The reasonable assurance concept will be employed in judging if sufficient information exists to make decisions leading to licensing. Where information is shown to be inadequate, additional site characterization will be required.

3. Cost impacts as a function of variability.

   An assessment will be performed to evaluate the impact of variability in the estimated or calculated value of seismic loadings on the total cost of the repository. This section will consider appropriate variability of frequency and response spectra within an acceleration range; high frequency and low frequency ground motion will be considered. This section will also consider the cost increments for designing and constructing surface and underground facilities against failure induced by surface rupture.

4. Institute conservatism in operating procedures.

   This section will identify and discuss the operating procedures that may be developed to mitigate the impacts of seismic/tectonic hazards. It will evaluate the effectiveness of these procedures.

5. Institute Performance Confirmation Monitoring Program. This section will describe the monitoring and evaluation for specific performance parameters that will validate conclusions and assumptions made in the SAR. It will discuss how results will lend confidence to decisions, especially the possible requirement for retrieval.

3.6 SEISMIC/TECTONIC EVENTS AND RADIONUCLIDE RELEASE SCENARIOS

3.6.1 GENERAL

For each significant seismic/tectonic event as determined in Chapter 4, and with reference to the corresponding performance objective, present results of preliminary performance computations and plans for the final performance assessment. It will consider both preclosure and postclosure time frames.

3.6.2 PRECLOSURE

For pre-closure the analysis shall include:

1. Scenario identification and analysis;

2. Failure Mode Analysis and design sensitivity;

3. Likely and maximum consequence determination;

4. Analysis of safety and compliance with release limits;

5. Uncertainty assessment.

3.6.3 POSTCLOSURE

For post-closure, the analysis shall include:

1. Scenario identification and analysis, emphasizing all aspects of hydrology and radionuclide travel;

2. Likely and maximum consequence determination;

3. Analysis of compliance with release limits;

4. Uncertainty assessment.

The identification of postclosure-release scenarios involving seismic/tectonic phenomenon should proceed by examining the effects of such phenomenon on three things: the hydrology and radionuclide transport aspects of the site; the integrity of the waste package; and the integrity of the engineered-barrier system.

The magnitude and consequences of the effects identified above should be used to further screen release scenarios; this may require calculations of likely and bounding consequences in terms of release from the barriers (waste package, engineered-barriers and the site) to establish their significance.

Special-purpose mathematical models of the significant classes of scenarios identified above should be constructed and combined with the model for expected releases to form a total systems model that can be used to simulate the behavior of the site/repository system under all anticipated, significant events and processes for the next 10,000 years.

3.7 REQUIREMENTS FOR SITE CHARACTERIZATION INCLUDING METHODOLOGY AND CRITERIA APPROPRIATE FOR RESOLUTION OF SEISMIC AND TECTONIC ISSUES.

3.7.1 TYPES OF ISSUES AND RELATIONSHIP TO REPOSITORY DEVELOPMENT SCHEDULE

The complete set of characterization issues for the project has been derived from considerations of performance and design (10 CFR 60) as

well as consideration of siting criteria in 10 CFR 960. This issues hierarchy is an essential prerequisite in identifying data and information needs to be provided during the site characterization process. The site characterization plan (SCP) is being developed to be compatible with the data and information needs. The data and information must be obtained in a timely manner in order to meet the DOE repository development schedule as required by NWPA.

Within the overall issue hierarchy, some issues specifically address seismic/tectonic concerns, an example is Mission Plan Issue 4.5 relating to the tectonic compatibility of the site with repository construction, operation, and closure. Conversely, there are a number of issues in which the influence of seismic/tectonic processes or events is indirect but is important to resolution.

This section will identify data and information needs related to seismic/tectonic processes or events which, at this time, are judged to be required for satisfactory resolution of each pertinent issue. It will consider all aspects of the issue resolution process, including: a) site characterization; b) engineering design; c) performance assessment; and d) performance confirmation monitoring.

For each issue requiring seismic/tectonic considerations identify when, in relation to the DOE's repository development schedule, evaluation of this issue should be completed.

3.7.2 DATA AND INFORMATION NEEDS

1. Site Characterization

Seismic/tectonic data and information needs to be satisfied during the site characterization process pertain to three broad categories. These are: a) for each seismic/tectonic process, estimates of probability of occurrence of a given tectonic event; b) impact of this event on containment and isolation; and c) parameters, i.e.,

physical properties and boundary conditions, which are required in order to quantify impact of this event on a given performance objective. This section will identify data and information needs as they pertain to these categories and each applicable site characterization issue, considering both pre-closure and post-closure performance objectives.

2. Performance Assessment

The performance assessment aspect of the issue resolution process will require its own set of data and information needs related to seismic/tectonic conditions. These may be related to a) evaluating significance of a given tectonic process to waste containment and isolation, e.g., phenomenological understanding of impact of basaltic intrusion and/or faulting on ground-water travel time and/or post-closure releases of radioactivity; b) identification of parameters, i.e., properties and boundary conditions, required for quantification of impact of a given tectonic process with respect to a given performance objective; c) evaluating relationship between impact and size of a given seismic/tectonic event; and d) constitutive relation and model validation. This section will identify data and information needs for each pertinent performance issue considering both pre-closure and post-closure time spans and performance objectives.

The process is iterative in that preliminary models, codes and scenario are used to identify information needed for licensing; as data becomes available from site characterization, models will be refined, codes will become more sophisticated and scenario probabilities will be defined. This could lead to the redefinition of information needed from site characterization. The process results in a defensible performance assessment of the site which forms the basis for demonstration of compliance with the applicable regulations.

3. Design

This section will identify elements of conceptual design which require seismic/tectonic consideration and identify the range of design options and discuss licensing and cost implications. It will identify data and information needs related to seismic/tectonics and which are required in order to demonstrate that a given design decision is adequate. This decision may include: design parameters, method of construction, location, and material. The section will consider pre-closure and post-closure aspects of repository design and performance.

3.8 CONCLUSIONS AND RECOMMENDATIONS

Based on analysis and interpretations performed in order to develop this position paper, this section will identify perceived seismic/tectonic events or processes, if any, which represent areas of significant concern in the licensing process. It will also recommend areas and methods of investigation leading to resolution.

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4.0 Preparation Sequence

The formal recognition of a need for a seismic/tectonic position paper can be traced to a recommendation of a meeting on Geotechnical Activities and Repository Design held in Las Vegas on January 11, 1985 (WMPO:MBB-585). An initial working group meeting was held on February 8, 1985 also in Las Vegas: each Project participant was requested to designate up to two key representatives. From the assembled working group informal ad hoc committee assumed responsibility to prepare an annotated outline for review by the working group. Several drafts of the AO were prepared and provided for review to NNWSI Project participants, DOE/HQ, Weston, and representatives of other projects. Upon receipt of comments provided at an April 3, 1985 workshop attended by NNWSI Project participants and representatives of Weston, DOE/HQ, and BWIP a site specific annotated outline was finalized and provided to DOE/HQ, Weston (WMPO:JSS-811) and the NNWSI Project (WMPO:JSS-1562). The distribution to the NNWSI Project was accompanied by a request to identify a single individual from each participant organization to serve on the working group to prepare the position paper. These individuals are: J. Neal, SNL; B. Crowe, LANL; D. Emerson, LLNL; B. Myers, USGS (observer only); and M. Voegele, SAIC. This AO was reviewed with Ālan Jelacic and a generic outline prepared that was acceptable to DOE/HQ. At his request, this AO was furnished to the other projects for review (WMPO:JSS-845). At that time (April 19, 1985), it was the objective of the NNWSI project to meet as soon as possible with the NRC staff to discuss the AO. It was the desire of the HQ staff, however, to meet and discuss generic aspects of the position paper or an actual generic paper prior to the meeting of the NNWSI Project and NRC staffs. Problems in arranging meetings and other DOE/HQ commitments have effectively led to a loss of two months in the originally proposed preparation sequence. The significance and importance to the SCP of the expected content of the position paper dictates that a new preparation sequence be defined and that work on the position paper begin without benefit of an initial interaction between NRC and NNWSI Project staff. It is the purpose of this section of the preparation plan to document that production sequence and its associated schedule. Project acceptance of this preparation plan connotes agreement with the following sequence of events and dates for completion of activities.

1.	Distribution of preparation plan for Working Group to prepare seismic/ tectonic position paper	June 10, 1985
2.	Approval of preparation plan, to be accomplished by notifying J. S. Szymanski by phone. Any objection will be addressed prior to Working Group meeting	June 17, 1985
3.	Working session to be attended by designated representatives, personnel requested by designated representatives, and members of consultant panel. The working session will discuss section responsibilities and content and prepare a tentative outline for first NRC presentation (Las Vegas)	June 20-21, 1985
4.	Working session (same attendees) to review results of work to date and formulate presentation to NRC at workshop (Las Vegas)	July 22-23, 1985
5.	Transmit material to NRC for review prior to workshop	August 1, 1985
6.	NRC Workshop (Silver Spring)	August 20-21, 1985
7.	Working session to assess results of NRC Workshop, reassign and redefine work elements as necessary to complete position paper (Forrestal or Weston)	August 23, 1985
8.	Draft material for final position paper due to SAIC for editing and production	September 30, 1985
9.	Transmit draft position paper to HQ, Project, and consultant panel for review	October 15, 1985

10.	Comments on position paper due	October 22, 1985
11.	Final seismic/tectonic position paper available	October 31, 1985

5.0 Preparation Responsibilities

Assignment of responsibility to prepare individual sections reflects the overall responsibilities of the individual participants in the NNWSI Project. Acceptance of this preparation plan to prepare the Seismic/Tectonic Position Paper connotes agreement with the following assignment of responsibilities to prepare individual sections of the position paper. The section numbers indicated are keyed to the annotated outline contained in Section 3 of this preparation plan.

1.	Introduction	SAIC
2.	Applicable Regulations	---
2.1	Regulatory Framework	SAIC
2.2	Definitions	SAIC
3.	Conceptual Approach	---
3.1	Significant Processes	USGS
3.2	Issues to be Resolved	USGS
3.3	Resolution Methodology	USGS
4.	Identification Approval	---
4.1	General	USGS
4.2	Data Base	USGS
4.3	Significance	USGS
4.4	Uncertainty	USGS
4.5	Relevance	USGS
5.	Strategy	---
5.1	General	SNL
5.2	Seismic Design	SNL
5.3	Engineering	SNL
5.4	Mitigation	SNL
6.	Release Scenarios	---
6.1	General	SNL
6.2	Preclosure	SNL
6.3	Postclosure	SNL

7.	Site Characterization Requirements	---
7.1	Issues	SAIC
7.2	Data and Information Needs	SAIC
8.	Conclusions and Recommendations	ALL

Additionally, it is expected that LANL will identify appropriate sections and provide relevant input on volcanic disruption, and geochronology. LLNL will identify appropriate sections and provide relevant input on waste package considerations and USGS will identify appropriate sections and provide relevant input on faulting and in situ stresses. The information supplied for SCP preparation regarding information need outlines will be used to complete section 7.2. SAIC will provide production support to prepare the position paper.

ENCLOSURE 2

Meeting Minutes: June 6, 1985 Meeting on Seismic/Tectonic Position Paper

A brief spontaneous meeting was held on June 6, 1985 at the SAIC offices, 2769 So. Highland Drive, at which future activities related to preparation of the NNWSI Project Seismic/Tectonic Position Paper were discussed. J. T. Neal, SNL, J. S. Szymanski, WMPO and M. D. Voegele, were in attendance. There were three topics of discussion:

1. Scope of Presentations at August 20-21, 1985 NRC Workshop

   The discussion noted that there were two bounding cases: a) present the completed Seismic/Tectonic Position Paper; or b) present the AO and explain the rationale. Realistically, the project cannot complete the position by that time; further, it would be a tactical mistake to complete the position paper without meeting with the NRC staff to obtain feedback on the approaches described in the paper. It was also noted that HQ is formally transmitting the AO to NRC on June 21, 1985 and that the NRC staff has informally expressed a desire to meet with the NNWSI Project staff during the preparation of the paper. The recommendation of the group was that the project be prepared to present a review of progress that concentrated on those aspects of the position paper most sensitive to interpretation. By doing so, the project could get the NRC staff feedback necessary to complete the paper. The group sugestions as to the most critical aspects of the paper are as follows:

   a) Definition of terms. The project should be prepared to provide to the NRC at the August 20-21 meeting a set of definitions of relevant terms. As it is the definitions of such terms that really define the scope of the problem of developing a consistent seismic/tectonic position, it is logical to use these definitions as a starting point for discussions with the NRC.

b) Understanding of regulatory requirements. A common interpretation of regulatory requirements is required for a viable seismic/tectonic position. The project should be prepared to present material on the regulatory framework in terms of the seismic/tectonic aspects. The workshop discussions could then be used to identify areas of dissimiliar interpretation and to provide a forum for discussion on the topic.

c) Role of Performance Assessment. The project should be prepared to present material on the manner by which performance assessment is used to identify significant processes, events and their consequences, to assess compliance, and to address uncertainties.

2) Project activity for preparation of position paper.

Discussions on this topic were concerned with scheduling a working group meeting as soon as possible to discuss the presentations to NRC on August 20-21, 1985. It was suggested that the meeting attendees include the review panel described in the working group charter as well as the designated participants and other staff as requested by the designated participants. With such a group assembled it would be possible to develop much of the initial material for the August Workshop through group discussions. The working session would also lead to assignments to complete the material needed for the August workshop as well as providing a basis for initiating preparation of the remainder of the position paper. A working session with open discussion would also ensure that all participants involved in the preparation of the position paper were working to a common understanding of the intended content of the position paper.

The topic of HQ involvement and preparation of a generic position paper were discussed. It was noted that the three elements proposed for preparation for the NRC workshop are, in fact, the bulk of the generic portion of the position paper. The group suggested proceeding with development of presentations for the NRC workshop. Several

options exist for completing a generic position or carrying the generic portion through to completion of the site specific position. A decision is not, however, required at this time.

3) Section responsibility for preparation of the seismic/tectonic position paper.

Discussion on this topic referred to the working group Preparation Plan which contains a preliminary suggested assignment of responsibility for section preparation. It was expected that some reassignment of the section responsibilities could be required. It was suggested that a working group meeting would be an appropriate forum for resolving difficulties with the section responsibility assignments. Also, it was recognized that during discussions in the working group, it could become apparent that the intent or requirements of the position paper AO were such that additional responsibility assignments should be made.