

**SITING AND DESIGN SUITABILITY ISSUES  
FOR THE  
NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS  
AUGUST 1982**

**DIVISION OF WASTE MANAGEMENT  
U. S. NUCLEAR REGULATORY COMMISSION**

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### EXPLANATION

There follows a listing of siting and design issues for a possible high level waste repository at the Yucca Mountain Site . The list has been prepared by the staff of the Division of Waste Management, U. S. Nuclear Regulatory Commission (NRC). These issues were developed through review of existing published information on the Nevada Nuclear Waste Storage Investigations (NNWSI), NRC technical reviews of the site and consideration of the performance objectives and criteria of 10 CFR 60.

For the purpose of this document, an issue is considered to be a broad question that is critical to suitability of the site or to adequacy of the design. Such a question is one that needs to be closed out during site characterization. The results, then, need to be taken under consideration in preparing for and review of a construction authorization application, if such is submitted by the Department of Energy (DOE) for the Yucca Mountain Site.

In other words, the issue list can be considered to be a forecast of licensing issues dealing with site and design suitability. It should be noted that the issues are based on the provisions of Subpart E of draft 10 CFR 60. The list is not intended to cover all the subparts of

10 CFR 60. Also, the coverage of NEPA requirements is limited to scoping.

PURPOSE

It is the view of NRC that early identification of licensing issues, on a site-by-site basis, is beneficial to the progress of the national waste management program. This is one of the purposes of the Site Characterization Report (SCR). In the SCR, DOE is expected to describe the issues that have been identified at the site and the plans to resolve them during site characterization.

The present list is advanced as a basis for dialogue between DOE and NRC, with the objective of reaching a convergence of views on what the issues are for the NNWSI. In this fashion the site characterization activities at the Yucca Mountain site can be focused specifically on generating the bodies of information needed in the license application. At the same time, NRC's activities can be focused to expedite analysis of the SCR, when submitted during the first half of 1983, and consideration of a later construction authorization application, when (if) submitted.

ORGANIZATION

It is recognized that an issue list can be various forms, lengths and levels of detail, depending on the logic and principles of organization. The following principles have been observed herein.

- (a) Each issue is stated briefly, in broad terms that are applicable to the Yucca Mountain site and, perhaps, to other locations under investigation by DOE. For most issues, subissues are provided. These are intended to amplify or expand an issue or link it to the particulars of the Yucca Mountain site.
  
- (b) Some issues and subissues can be considered to be part of other, larger issues or subissues but are listed separately because of special significance at the Yucca Mountain site.

DATA ACQUISITION

To resolve each issue in the listing, certain information and data will be needed. The present list is not intended to cover such information

needs or the methods of data collection and analysis. Establishing what are specific information needs and appropriate methods of data collection is, of course, the primary focus of the SCR. For example, the following questions which are concerned with methods of testing analysis are not included in the list of waste form and waste package issues, however, they must be addressed as an integral part of achieving resolution of the issues listed under the waste form and waste package topic:

- o What are the methodologies/models used to predict conditions in the repository pertinent to determining engineered barrier component performance throughout the life of the repository?
  
- o What is the testing and data from the tests involved to qualify the methodologies and models used to predict performance of engineered barrier components relation to their respective potential failure modes.

These and similar questions could appropriately be taken up in workshops involving small groups of DOE and NRC staff.

ORDER

Where possible, an effort has been made to list more important issues, within each topic, ahead of the less important. However, many issues are of equal importance so the listing is little more than a crude indication of licensing priority.

SITING AND DESIGN SUITABILITY ISSUES  
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1. Groundwater Flow

Conditions Before Waste Emplacement

What is the accessible environment for application of the EPA standard on radionuclide releases?

What are the groundwater flow paths and travel times to the accessible environment under present conditions?

- a. What is the groundwater flux through the unsaturated tuffs at the Yucca Mountain site?
- b. What are the flow paths and travel times through the saturated zone?

- c. What are the hydrologic processes and important hydrologic parameters in the unsaturated zone?
- d. What is the effect of structural, stratigraphic and lithologic heterogeneities on ground water flow?
- e. Does the flow system in the tuffs at the Yucca Mountain site communicate with a deeper, regional flow system?
- f. What information on groundwater movement is provided by the water temperature distributions?
- g. What information on groundwater movement is provided by a study of water chemistry?
- h. What information on groundwater movement is provided by the water age determinations?

What is the basis for identification of the hydrostratigraphic units that are used for modeling and testing?

- a. How is the choice of units supported by data from lithology/stratigraphy, hydraulic parameters, and hydraulic heads?
- b. How is the choice of units supported by water chemistry data?
- c. What is the relationship between the hydrostratigraphic units and the units tested for hydrologic parameters?
- d. What is the relationship between the hydrostratigraphic units and the units used in groundwater modeling?
- e. How is selection of units used for modeling affected by the availability of models?

What are the groundwater recharge and discharge locations, mechanisms and amounts for the the groundwater flow systems that include the Yucca Mountain site?

- a. What is the water balance for these systems?

- b. What are the groundwater recharge locations, mechanisms and amounts?
- c. What are the groundwater discharge locations, mechanisms and amounts?
- d. What boundary conditions and assumptions are used in modeling the flow systems?
- e. What is the basis for selection of the boundary conditions?

Conditions After Waste Emplacement

What are the expected effects on groundwater flow paths, groundwater travel times and possible radionuclide releases of future, repository-induced changes?

- a. What is the thermal effect on groundwater flux through the unsaturated tuffs at the Yucca Mountain site?
- b. What is the thermal effect on groundwater flow paths and travel times through the saturated zone?

- c. What is the thermal effect on the hydrologic processes and important hydrologic parameters in the unsaturated zone?

What are the expected effects on groundwater flow paths, groundwater travel times and possible radionuclide releases of future, natural changes?

What are the expected effects on groundwater flow paths, groundwater travel times and possible radionuclide releases of future, human-induced changes, excepting repository-induced changes?

2. Waste Form and Waste Package

What is the expected useful life of the waste package?

What performance is predicted for the components of the waste form and waste package through the period of waste isolation?

What are the potential failure modes and/or functional characteristics for engineered barrier components that are limiting in meeting the performance objectives?

What is the predicted performance of the engineered barrier components relative to identified failure modes and/or functional characteristics?

3. Retardation

What are the effects of groundwater chemistry on radionuclide migration?

- a. What is the chemistry of the groundwater?
- b. What are the important radionuclide species to be expected in the groundwater?
- c. What are the solubilities of the expected radionuclide species?
- d. What is the capacity of the groundwater system to buffer Eh and pH?
- e. What is the contribution of particulates and colloids in the groundwater to radionuclide migration?

What are the effects of the host rocks and mineral phases on radionuclide migration?

- a. What are the principal mineral phases that are in contact with the groundwater?
  
- b. What is contribution of the mineral phases to radionuclide migration?

What is the effect on radionuclide transport of changes in chemistry of the engineered barriers as a result of waste emplacement?

What is the effect on radionuclide transport of changes in chemistry of the natural barriers as a result of waste emplacement?

4. Facility Design

What is the maximum expected radionuclide release rate from the underground system and is this rate in compliance with 10 CFR 60?

At repository depth and temperatures, what is the strength of the tuff and will the strength be adequate to maintain stable, mined openings?

Are the repository design criteria and the functional description shown to be complete and accurate with respect to the performance objectives?

- a. Are the design criteria shown to accommodate the retrievability option?
- b. Are the design criteria shown to assure that rock stress will not significantly impact the long-term performance of the waste package?

Is the design shown to be consistent with the design criteria and the functional description and is it appropriate to satisfaction of the performance objective?

Is the conceptual design shown, by appropriate analysis, to accommodate mechanical and thermal effects due to construction and waste emplacement?

What is the expected effect on repository performance of construction of the Exploratory Shaft?

What is the nature of changes that would affect radionuclide retardation due to repository construction and waste emplacement?

a. What are likely phase changes in the minerals that are in contact with the groundwater?

b. What are the kinetics of likely phase changes?

c. What are the cumulative effects of (a) and (b) on radionuclide retardation?

**What is the predicted performance of the backfill and seals through the period of waste isolation?**

- a. What are the predicted repository conditions relevant to performance of each component?**
  
- b. What are the likely failure modes relevant to performance of each component?**

5. Stability

What are the probabilities and nature of natural changes that would affect repository performance?

- a. What is the potential for volcanism that would affect repository performance?
- b. What is the potential for fault movement that would affect repository performance?
- c. What is the potential for seismicity that would affect repository performance?

What are the probabilities and nature of human-induced changes, excluding repository construction, that would affect repository performance?

- a. What are the probabilities and nature of groundwater withdrawals that would affect repository performance?

- b. What are the probabilities and nature of groundwater recharge that would affect repository performance?
  
- c. What is the potential for disruption of a repository at Yucca Mountain by weapons testing at the NTS?

What is the seismic hazard and risk to surface and subsurface facilities during repository operations?

How does the value of mineral resources at the repository location compare with the values in other areas of similar size within the geologic setting?

6. Institutional

What was the decision-making process for selection of the candidate area and site including technical, institutional and environmental factors?

What other sites are under consideration for characterization?