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SITING AND DESIGN SUITABILITY ISSUES

AT

BASALT WASTE ISOLATION PROJECT

MAY 1982

DIVISION OF WASTE MANAGEMENT

U. S. NUCLEAR REGULATORY COMMISSION

EXPLANATION

There follows a listing of siting and design issues for a possible high level waste repository at the Basalt Waste Isolation Project (BWIP). 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 BWIP site, NRC technical reviews of the site and consideration of the performance objectives and criteria of 10CFR60.

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 by the Nuclear Regulatory Commission during processing of the construction authorization application, when (if) such is submitted by the Department of Energy (DOE) for BWIP.

In other words, the issue list can be considered to be a forecast of licensing issues dealing with site and design suitability, upon which NRC will have to make findings. It should be noted that the issues are based on the provisions of Subpart E of draft 10CFR60. The list is not intended to cover all the subparts of 10CFR60. Also, the coverage of NEPA requirements is limited to scoping.

PURPOSE

It is the opinion of NRC that early-on 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 resolved 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 the issues at BWIP. In this fashion the site characterization activities at BWIP can be focused specifically on generating the bodies of information needed for evaluation by NRC of these issues in licensing--that is, information needed in the license application. At the same time, NRC's activities can be focused to expedite analysis of the SCR, when submitted in late 1982, and consideration of a later construction authorization application, when (if) submitted.

ORGANIZATION

It is recognized that an issue list can be of 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 BWIP 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 BWIP.

(b) For the purposes of organizing NRC's SCR review efforts, the issues are aggregated into five topical groups, which are discussed below. The groups are: radionuclide transport, stability, repository design, engineered barriers and institutional concerns.

(c) 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 BWIP.

TOPICAL GROUPS

The subject matter covered by the five topical groups is shown below. While the intent has been to establish topics with contents that are mutually exclusive, it is recognized that a certain amount of overlap remains.

1. Radionuclide transport. This topic is concerned with prediction of radionuclide releases, outside the underground facility over a 10,000 year period - including the effects of changes due to the presence of waste, human activities and natural conditions.

2. Stability. This topic is concerned with the probability and nature of changes over 10,000 years, that (a) are outside the underground facility, (b) are due to human activity, natural conditions, or the presence of waste and (c) may affect radionuclide migration.

3. Repository design. This topic is concerned with design and construction of the underground facility and the effects of these activities on radionuclide migration.

4. Engineered barriers. This topic is concerned with the barriers placed underground - waste package, backfill and seals - and the effects of these on radionuclide migration.

5. Institutional concerns. This topic is concerned primarily with site screening and selection procedures to assure that an adequate slate of alternative sites is available for NEPA assessments in connection with construction authorization.

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.

DATA ACQUISITION

For each issue herein, certain information and data will be needed by NRC to conduct a licensing review, make licensing findings and conduct performance assessments. 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.

SOURCES

A list of principal references used in issue preparation is attached.

A. Radionuclide Transport

Conditions Before Waste Emplacement

A-1 What is the accessible environment for application of the EPA standard on radionuclide releases?

A-2 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 water chemistry used to identify hydrostratigraphic units?

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?

A-3 What are the groundwater recharge and discharge locations, mechanisms and amounts for the Pasco Basin groundwater flow systems?

a. What is the water balance for the Pasco Basin?

b. What are the groundwater recharge locations, mechanisms and amounts for the Pasco Basin?

c. What are the groundwater discharge locations, mechanisms and amounts for the Pasco Basin?

d. What are the hydrologic parameters of each unit tested?

e. What boundary conditions are used to model the flow systems?

f. What is the basis for selection of the boundary conditions?

g. What is the ratio of vertical to horizontal permeability?

h. What information on groundwater movement is provided by the water temperature distributions?

i. What information on groundwater chemistry is provided by a study of water chemistry?

j. What information on groundwater movement is provided by the water age determinations?

A-4 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 retardation?

A-5 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 the contribution of the mineral phases to radionuclide migration?

A-6 What are the groundwater flow paths and travel times under present conditions?

a. How and to what extent do structural, stratigraphic and lithologic heterogeneities affect ground water flow?

Conditions After Waste Emplacement

A-7 What are the expected effects on groundwater flow paths, groundwater travel times and possible radionuclide releases of future, repository-induced changes?

A-8 What are the expected effects on groundwater flow paths, groundwater travel times and possible radionuclide releases of future, natural changes?

A-9 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?

B. Stability

B-1 What is the nature of changes that would affect groundwater flow due to repository construction and waste emplacement?

a. What is the effect due to repository construction?

b. What is the effect due to waste emplacement?

B-2 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?

B-3 What are the probabilities and nature of natural changes that would affect repository performance?

B-4 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?

B-5 What is the seismic hazard and risk to surface and subsurface facilities?

B-6 How does the value of mineral resources at the repository location compare with the values in other areas of similiar size within the geologic setting?

C. Repository Design

C-1 Are the repository design criteria and the functional description shown to be complete and accurate with respect to the performance objectives?

a. How do the design criteria accommodate the retrievability option?

b. How do the design criteria assure that rock stress will not significantly impact the long-term performance of the waste package?

C-2 Is the design shown to be consistent with the design criteria and the functional description and appropriate to satisfaction of the performance objective?

C-3 How is the conceptual design shown, by analysis, to accommodate mechanical and thermal effects due to construction and waste emplacement?

C-4 How is the conceptual design shown, by analysis, to accommodate high horizontal stress in the repository host rock?

a. What is the effect of the in situ stress field on (i) repository orientations, (ii) shape and dimension of openings, and (iii) mode of waste emplacement?

C-5 How is repository performance expected to be affected by construction of the Exploratory Shaft?

Note. Issues C-3, C-4, and C-5 can be viewed as subissues of C-1 and C-2 but are treated separately here, for emphasis.

D. Engineered Barriers

D-1 How are the engineered barrier components predicted to perform through the period of waste isolation?

a. What are the predicted repository conditions relevant to performance of each engineered barrier component?

b. What are the likely failure modes relevant to performance of each engineered barrier component?

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

Note. This issue will be analyzed separately with respect to waste form, waste package, backfill and seals.

E. Institutional Concerns

E-1 What was the decision-making process for selection of the candidate area and site including technical, institutional and environmental factors?

E-2 What other sites are under consideration for characterization?

REFERENCES USED IN PREPARATION OF BWIP ISSUES

1. Department of Army, Corps of Engineers, Review of RHO-BWI-ST-4, "Geologic Studies of the Columbia Plateau" and RHO-BWI-ST-5, "Hydrologic Studies Within the Columbia Plateau," Aug. 1981.

2. Department of the Interior, Bureau of Mines, Review of Report No. RHO-BWI-CD-35, "Nuclear Waste Repository in Basalt, Project B-301," April 1981.

3. Duguid, J.O. and Kowall, S.J., "Review of Geologic and Hydrologic Issues Related to Waste Isolation in Columbia River Basalts," Office of National Waste Terminal Storage Integration, Aug. 1981.

4. Reports by Golder Associates, Inc.:

   4a. Review comments on RHO-BWI-CD-38, Rev. 3, "Nuclear Waste Repository in Basalt, Functional Design Criteria", Feb. 1980.

   4b. Review comments on RHO-BWI-CD-35, "Nuclear Waste Repository in Basalt, Preconceptual Design Report", Nov. 1980

   4c. Review comments on RHO-BWI-CD-49, Rev. 1, "Test Plan for an Exploratory Shaft Test Facility in Basalt" and RHO-BWI-TP-007, July 1981, "Test Plan for Phase I of an Exploratory Shaft Test Facility in Basalt", May 1980.

5. Answers to questions by National Academy of Sciences Panel on the Waste Isolation System Study, Rockwell Hanford Operations, June 1981.

6. Nuclear Regulatory Commission Trip Reports:

   6a. July 1980

   6b. Dec. 1980

   6c. Sept. 1981 (includes NRC contractor reports)

7. Nuclear Regulatory Commission memorandum, "BWIP Document Review", Sept. 1981.

8. Reade, M.T., McKay, E.D., and Poggioli, R.S., "Conceptual Hydrologic Models of Groundwater Flow in the Pasco Basin, Columbia Plateau, Washington," CGS Inc. for Sandia National Laboratory, June 1981.

9. Rockwell Hanford Operations, "Hydrology and Geology Overview Committee Reports and Responses from the Basalt Waste Isolation Project," RHO-BWI-LD-50, Hydrology and Geology Overview Committee Members and BIWP Staff, Sept. 1981.

10. Sandia National Laboratory, "Repository Site Definition in Basalt: Pasco Basin, Washington," NUREG/CR-2352, March 1982.