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REVIEW COMMENTS ON SITE CHARACTERIZATION PROGRESS REPORT: YUCCA MOUNTAIN, NEVADA— NUMBER 11

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ABSTRACT

A technical review has been conducted of the "Site Characterization Progress Report: Yucca Mountain, Nevada—Number 11" [Site Characterization Progress Report (SCPR) No. 11]. This progress report documents the progress and results of the U.S. Department of Energy site characterization activities conducted during April 1, 1994, to September 30, 1994. The scope of the review reported herein is limited to the sections and subsections relevant to the Repository Design, Construction, and Operations Program Element. Some of the technical and design reports that have been referenced in this progress report have recently been or are being technically reviewed by the Center for Nuclear Waste Regulatory Analyses. These reports include: (i) Strategy to Seal Exploratory Boreholes in Unsaturated Tuff, (ii) Initial Summary Report for Repository/Waste Package Advanced Conceptual Design, and (iii) Controlled Design Assumptions Document. During the reporting period of SCPR No. 11, the U.S. Department of Energy has conducted planning activities for the program approach. Thus, this SCPR does not contain any significant information on the implementation of program approach. No objections are raised in this report, and the general concern discussed in this review is the lack of detailed technical information on the activities conducted during this period.

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1 INTRODUCTION

The Nuclear Waste Policy Act, Section 113(b)(3), and the Nuclear Regulatory Commission (NRC) regulation in 10 CFR 60.18(g) require that the U.S. Department of Energy (DOE) should prepare a report once every 6 months that discusses the progress and results of its site characterization activities, as well as any changes to the DOE site characterization program. Site Characterization Progress Report (SCPR) No. 11 documents the progress and results of the DOE site characterization activities conducted during April 1, 1994, to September 30, 1994. This review has been conducted in accordance with the NRC "Review Plan for NRC Staff Review of DOE Site Characterization Plan Progress Reports," August 10, 1990 (Nuclear Regulatory Commission, 1990).

The scope of this review is limited to the review of the sections and subsections of the SCPR relevant to the Repository Design, Construction, and Operations Program Element. The sections of the SCPR No. 11 reviewed herein include: (i) 3.10 Surface Characteristics; (ii) 3.11 Thermal and Mechanical Rock Properties; (iii) 4.1 Configuration of Underground Facilities (Postclosure); (iv) 4.3 Nonradiological Health and Safety; (v) 4.4 Preclosure Design and Technical Feasibility; (vi) 4.5 Seal Characteristics; (vii) 6.1 Waste Retrievability; (viii) 6.2 Public Radiological Exposure-Normal Conditions; (ix) 6.3 Worker Radiological Safety-Normal Conditions; (x) 6.4 Accidental Radiological Release; (xi) 6.11 Higher-Level Findings-Postclosure System and Technical Guidelines; (xii) Chapter 7-Exploratory Studies Facility Design and Construction.

This report contains both specific and general concerns. Both specific and general concerns have been presented in a standard format consistent with previous NRC submittal of concerns provided to the DOE (Nuclear Regulatory Commission, 1989). This standard format includes objections, comments, and questions. The definitions of objections, comments, and questions are given in Chapter 2 of this report.

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2 CATEGORIZATION OF CONCERNS

In this chapter, the major categories of concern used for the review of the SCPR No. 11 are summarized. These major categories consist of objections, comments, and questions and are defined and used consistent with other submittals of concerns from the NRC to DOE in the high-level nuclear waste (HLW) program.

2.1 OBJECTIONS

An "objection" is a concern with the DOE program related to either:

(i) Potentially adverse effects on repository performance

(ii) Potentially significant and irreversible/unmitigable effects on characterization that would physically preclude obtaining information necessary for licensing

(iii) Potentially significant disruption to characterization schedules or sequencing of studies that would substantially reduce the ability of the DOE to obtain information necessary for licensing

(iv) Inadequacies in the Quality Assurance program that must be resolved before work begins

Objections are reserved primarily for concerns with activities, tests, and analyses that, if started, could cause significant and irreparable adverse effects on the site, the site characterization program, or the eventual utility of the data for licensing (programmatic fatal flaws). Due to the irreparable nature of activities associated with objections, the NRC would recommend that the DOE not start work until the objections are satisfactorily resolved.

2.2 COMMENTS

A comment is a concern with the DOE program that would result in a significant adverse effect on licensing if not resolved, but would not cause irreparable damage if site characterization started before resolution. The DOE program could be modified in the future, with some risk to not having the necessary information for licensing; the adverse effects would be primarily related to the program schedule. Therefore, for these concerns, the DOE would start work at its own risk before resolving such concerns with the NRC. The NRC would recommend timely resolution of comments. If resolution is not achieved in a timely manner, comments could be elevated to the higher category of objections described above (i.e., potential significant disruption of schedules that would reduce the ability to obtain information necessary for licensing).

2.3 QUESTIONS

A question is a concern with the presentation of the DOE program such as missing information, level of detail, contradictions, and ambiguities that preclude understanding a part of the DOE program, thereby preventing the staff from being able to comment. The NRC would recommend a timely response by the DOE to such questions. If a question is related to a potential objection, satisfactory resolution should be accomplished before work begins. If the question is not related to an objection, then the DOE could choose to proceed with work at its own risk, and resolve the question in future reports.

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3 GENERAL CONCERNS

3.1 OBJECTIONS

None.

3.2 COMMENTS

None.

3.3 QUESTIONS

QUESTION 1

Technical information provided in most sections/subsections of SCPR is insufficient to conduct a detailed review of DOE site characterization activities performed during the reported period.

Basis:

In many sections or subsections, it has been mentioned that studies have been conducted, but neither technical information of the studies nor the references containing the technical information have been provided.

Recommendations:

The DOE should provide more technical information in the SCPR.

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4 SPECIFIC CONCERNS

4.1 OBJECTIONS

None.

4.2 COMMENTS

Chapter 4–Repository Design/4.1.15 Design Activity 1.11.5.2–Long-Term Subsidence Control Strategy

COMMENT 1

The DOE considerations on long-term subsidence are insufficient, which may actually overlook the potential long-term deformation.

Bases:

- This section states: "...ground surface subsidence is usually caused by collapse or failure of the pillar and the collapse or failure of the drift roof." This statement is insufficient. All types of underground rock excavations disturb the *in situ* state of stress in rock masses. As a result, deformation and, in some cases, fracturing occur around any underground openings. Therefore, it is the process of stress adjustment around the openings that causes ground movement, including the postclosure ground movement. In most cases, gradual ground movement often occurs without obvious failure or collapse of pillars or drift roofs, as long as the process of stress adjustment around the opening continues. Although this process is more significant in soft rocks, it should not be neglected in hard rocks, such as tuff. Theoretically speaking, any rock can creep under stress over a sufficiently long period of time.

- The progress report also states: "Current repository layouts are based on a conservative excavation extraction ratio of 30 percent within the waste emplacement areas. This value corresponds to a drift spacing such that parallel drifts are barely subjected to the stress effects of adjacent drifts, which limits the stress in the pillars." A concern was raised on the potential long-term deformation and deterioration of the pillars during the review of Initial Summary Report for Repository/Waste Package Advanced Conceptual Design, Volumes I & II (Center for Nuclear Waste Regulatory Analyses, 1995). This concern says: "The proposed extraction ratios of 30 percent may be considered overly conservative for conventional mining, but they may not be appropriate for use in evaluation of the stability of the emplacement drift area." This concern is particularly true when backfill is not used and the openings will remain open for a long time.

- Although the extraction ratio may result in "relatively low pillar stress," thermal loading may significantly change this "low stress" profile in the pillars.

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Recommendations:

- Systematic monitoring of ground movement, including closure measurement, should be conducted. Also, numerical modeling should be conducted to study long-term ground behavior around the openings, taking into account both the openings and major geological structural profiles.

- The DOE should address previous concerns on long-term deformation around the openings.

Chapter 4–Repository Design/4.5–Seal Characteristics

COMMENT 2

In Sections 4.5.3 and 4.5.4, the major concerns and general comments on the Sandia report by Fernandez et al. (1994) were provided to the NRC in a letter report by Manteufel et al. (1994). The technical review of this Sandia report (Fernandez et al., 1994) concentrated on: (i) conceptual comprehensiveness of the sealing issues, (ii) technical comprehensiveness of sealing issues, and (iii) technical soundness of proposed approaches and methods. Major NRC concerns raised in review of the report included:

- Lack of a field testing plan aimed at assessing long-term seal performance

- Lack of acknowledgments and consideration of previous NRC guidance and NRC-sponsored research relevant to sealing

- Lack of integration of analyses supporting the development of borehole seal strategy and other relevant aspects of the DOE HLW program, such as Total-System Performance Assessment and Site Characterization Activities

- Lack of justification for selection of specific seal performance measure/goal for restricting vertical flow through boreholes

- Superficial treatment of potentially important issues to the development of the seal strategy

Basis:

Some of the DOE laboratory and *in situ* tests to evaluate the performance of candidate sealing materials (DOE Study 1.12.2.3) as well as the development of a sealing and backfilling strategy for the Exploratory Studies Facility/Repository openings (DOE Design Activity 1.12.4.1.) appear to rely on recommendations provided by Fernandez et al. (1994). Some of the concerns raised by the NRC, namely the justification for selection of seal performance measures/goals as well as the important issues addressed in the development of the sealing strategy, have direct relevance to these two DOE activities specifically with regard to overall performance of the sealing system for exploratory boreholes.

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Recommendation:

In the next progress report, the DOE should consider the NRC concerns in its seal testing program and advanced conceptual design for sealing. The NRC raised its concerns in its review on the Sandia report by Fernandez et al. (1994).

4.3 QUESTIONS

Chapter 3-Site Programs/3.11.3 Study 8.3.1.15.1.13-Laboratory Determination of Mechanical Properties of Intact Rock

QUESTION 1

The conclusive statement by the DOE on the creep behavior of tuff is ambiguous.

Basis:

DOE states in this section on the creep behavior of tuff that "...very little primary or secondary creep is exhibited by these welded tuffs under these repository-type conditions." This statement means very little as some of the important test conditions, such as the actual test duration and strain rates, are not provided. Insufficient technical information is provided in the SCPR to support the DOE conclusion on the creep behavior of tuff.

Recommendations:

To make such a conclusive statement, the DOE should provide more supporting information.

Chapter 6-Performance Assessment/6.4-Accidental Radiological Release

QUESTION 2

The DOE has conducted a preliminary probabilistic risk assessment study for accidental radionuclide releases initiated by either a rock fall or waste transporter accident. However, no details are provided related to this study. It is not clear if this study was conducted on the Multi Purpose Canister (MPC).

Basis:

Waste packages design is changing, and even the latest proposal includes a different number of assemblies in each MPC.

Recommendation:

To better evaluate the DOE study, more detailed information about the probabilistic risk assessment study to predict performance of the waste containers under different conditions should be provided.

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5 SUMMARY

Site Characterization Progress Report: Yucca Mountain, Nevada, Number 11 (SCPR No. 11) has been reviewed. This report reflects the DOE SCPR conducted during April 1, 1994, to September 30, 1994. The general approach proposed in this report appears to lack the required programmatic approach. Several areas in the reported studies have not been given sufficient technical discussion. These areas with insufficient discussion include the creep behavior, the causes of subsidence and its potential on long-term deformation, issues related to sealing, and accidental radiological release. There are other areas in which no comments are made due to the lack of technical information provided on the progress in that period.

In brief, the review of SCPR No. 11 indicates that the technical materials presented in most sections of the subject progress report are insufficient for a reasonable review. The technical information in SCPR No. 11 does not meet the overall requirements proposed by the NRC (1990). The NRC Review Plan for Site Characterization Plan Progress Reports states that in the DOE 6-month progress report, the DOE should "...Discuss the progress and results of its site characterization activities, as well as changes to the DOE site characterization program resulting from the information obtained." It also says that "the DOE should not merely state that some particular work has been completed, but should also include significant results, at least in summary form. In addition, references to details of the results, including data developed, analyses done using those data, and conclusions reached, should be cited in the progress reports." The DOE should respond to these particular requirements in preparing future progress reports.

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6 REFERENCES

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