

MAY 05 1993

Mr. Lake Barrett, Acting Director
Office of Civilian Radioactive
Waste Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Mr. Barrett:

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF COMMENTS ON SITE
CHARACTERIZATION PROGRESS REPORTS 6 AND 7

On December 10, 1992, the U.S. Department of Energy (DOE) transmitted the "Progress Report on Site Characterization: Yucca Mountain, Nevada, Number 6" (PR) to the U.S. Nuclear Regulatory Commission. DOE transmitted PR Number 7 to the NRC on December 31, 1992. In the interest of time and resources, the NRC staff conducted a review of both PRs simultaneously, concentrating its major efforts on Number 7. The staff's review was conducted in accordance with the guidance delineated in the "Review Plan for NRC Staff Review of DOE Site Characterization Plan Progress Reports," issued August 10, 1990. As a result of the NRC staff review, we have identified no objections, as defined in the PR Review Plan. However, the staff has identified several comments, questions, and observations that are discussed later in this letter and in the enclosures.

In previous letters transmitting the NRC staff's reviews on PRs (letters from R. Bernero to J. Bartlett, June 25, 1990, and October 27, 1992) it was requested that DOE address progress on Site Characterization Analysis (SCA) concerns in PR's. Therefore, an important component of the staff's review has been to evaluate DOE's progress on SCA concerns, in addition to evaluating whether or not the PR was responsive to the staff's concerns on previous PRs.

In a letter of February 17, 1993 (Barrett to Bernero), DOE responded to NRC staff concerns related to PR 5. The staff believes that DOE has made an effort to respond to many of its concerns. For example, the new format and information provided in PR 7 is greatly improved over previous PRs. However, many of the staff's concerns related to the amount and quality of information provided in the PRs are still pertinent, and in many areas the PRs still do not provide a clear picture of the status and results of certain site characterization activities, particularly with respect to design activities related to the Exploratory Studies Facility (ESF) and waste package. In addition, the staff continues to believe that the PRs would be more useful if they were published closer to the end of the reporting period. The staff acknowledges that the timeliness of PR 7 was significantly improved over previous PRs, and encourages DOE to continue to improve in this area.

The staff's review has resulted in three comments and four questions (Enclosure 1). Comment 1 is related to DOE's lack of a clearly defined,

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reference conceptual waste package design at this time. For example, DOE has suggested that it may change waste packages, emplacement methods, and repository thermal loading. Although both PR 6 and 7 mention design activities for the ESF, the NRC staff has not received descriptions of many of the changes in the ESF, which is significantly different from the reference ESF design described in the SCP (Comment 2). Such changes are significant, and may impact other activities related to the characterization of the site. It is recognized that as DOE gains information, it may be beneficial to change designs; however, it is recommended that DOE communicate such changes to the NRC as soon as is practicable.

The DOE did not propose to close any open items in either PR. However, in PR Number 6 (Page 2-7) it is stated that SCA Question 1 is considered to be resolved. The staff believes Question 1 to be an open item and has included an evaluation of information related to that question (Enclosure 2). The staff's review also resulted in several observations. Those observations are related to the content and structure of the PRs and are as follows:

1. Although the progress reports include summaries of results of ongoing work, there are instances where the results summarized appeared minimal compared to the number of publications that were referred to in the PRs as either finalized or in review. It is recommended that summaries thoroughly cover results to-date.
2. References should be as complete as possible, including those for works in press or review. The PRs provide complete references for documents that are already published, but do not provide adequate information for documents mentioned in the text that are in press or under review. Specifically, for documents not yet published, the PRs often provide only the name of the senior author in the text, but no other information, including the title. The lack of a title and other pertinent information (e.g., meeting where presentation took place or publication) makes it difficult to track the progress of activities in subsequent reports.

One example of incomplete reference information is in PR 7, Section 2.2.11.3, Activity 8.3.1.15.1.3.1, pages 2-111 to 2-112, where a report is described and results are summarized, but the author or title are not provided. Another example is in PR 7, Section 2.2.11.6, Study 8.3.1.15.1.6, page 2-117, where a report is mentioned, but no author or title are provided.

3. Many sections of the PRs provide only cursory summaries of activities. For example, in PR 7, Section 2.2.11.4, Activity 8.3.1.15.1.4.1, page 2-114, a "simple mathematical model" is mentioned with no further description. "A study addressing what variables are important ..." is mentioned, with no description of the variables. In Section 2.2.13.11, Activity 8.3.1.17.4.3.2, page 2-125, "a search for evidence of possible surface-fault rupture ..." is mentioned, with no description of the results of the search. Future PRs should either include additional information or provide a reference as to where the reader can locate further explanation.

An example of a PR section that contains a level-of-detail that the staff believes to sufficiently describe the progress of an activity is in PR 7, Section 2.6.1.3, Activity 1.10.4.2.2, pages 2-147 - 2-156. In the discussion the status of the Activity and its progress is presented in sufficient detail, there are interpretations of the results, and conclusions are drawn from the results. In contrast, many of the other activities, in which there is ongoing work, lack any detailed discussion.

This letter is intended to transmit information for DOE's use in the preparation of future PRs. If you have any concerns with these observations or information contained in the Enclosures, we are available to meet with you and your staff as needed. Please contact me or Mr. Joseph Holonich of my staff if there are any questions regarding this letter. I can be reached at (301) 504-3352, or Mr. Holonich can be reached at (301) 504-3387.

Sincerely,

Original signed by
Guy A. Ariotto

Robert M. Bernero, Director
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

- cc: R. Loux, State of Nevada
- T. J. Hickey, Nevada Legislative Committee
- C. Gertz, DOE/NV
- M. Murphy, Nye County, NV
- M. Baughman, Lincoln County, NV
- D. Bechtel, Clark County, NV
- D. Weigel, GAO
- P. Niedzielski-Eichner, Nye County, NV
- B. Mettam, Inyo County, CA
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Robert M. Bernero, Director
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NAME	JLinehan		JYoungblood		GArlotto		RBernero	
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**SECTION 2.6.5.3 ACTIVITY 1.4.2.1 - SELECTION OF THE CONTAINER MATERIALS FOR
THE LICENSE APPLICATION DESIGN**

COMMENT 1

Since the issuance of the Site Characterization Plan there has been no updated information provided on the Yucca Mountain Project's official reference advanced conceptual waste package design.

BASIS

Section 2.6.5.3 of PR 6 states that the three materials for advanced conceptual design (ACD) are recommended for use as single container materials in the SCP-CD thin-wall container design and that other materials and design configurations will also be studied during ACD. No further discussions or references are provided on these other materials and design configurations.

Section 2.6.5.3 of PR 7 states that a paper on the selection of candidate materials for waste package conceptual design is in internal review and will be published, but forecasts that no other activity is planned for FY 1993. In addition, for FY 1993 nothing is planned for the activities which directly affect the development of waste package designs (Sections 2.6.5.4 through 2.6.5.12).

DOE is considering substantial waste package changes. For example, DOE (Stahl, 1992) has proposed horizontal drift emplacement of waste packages instead of vertical or horizontal borehole emplacement. In addition, DOE is considering a waste package that has multiple layers. These proposed changes are not discussed or referenced in PRs 6 and 7.

In a NRC/DOE meeting (NRC, 1992) to discuss DOE's preliminary multipurpose canister (MPC) study, DOE representatives stated that the robust twenty-one element self-shielded MPC concepts are being considered for advanced conceptual designs.

Geological considerations, particularly those involving the analysis of the impacts on performance by fault displacement hazards and seismic hazards may be significantly affected by the design of waste emplacement.

RECOMMENDATIONS

Identify in future PR updates, the reference waste package/engineered barrier system design concepts and changes being considered for ACD and license application design.

As a result of the addition of material candidates, DOE should re-examine its materials test program baseline documents to include desired information for all materials under consideration for waste package ACD.

For example, an eight volume document "Survey of Degradation Modes of Candidate Materials for High-Level Radioactive-Waste Disposal Containers" was published by Lawrence Livermore Laboratory in August 1988. Six candidate materials; stainless steel 304L, 316L, Alloy 825; CDA 102 copper, CDA 613 (aluminum bronze) and CDA 715 (70-30 Cu-Ni) were studied in the survey. With the new list of candidate materials, DOE should supplement the survey for Alloy C-4, Titanium Grade 12, and any other materials of interest for waste package ACD.

REFERENCE

- NRC, 1993, Memorandum to C. Haughney from S. Ruffin, subject: Meeting with DOE on multi-purpose canister study, dated January 5, 1993.
- Stahl, D., 1992, Source term concept and definition: Presentation to the Nuclear Waste Technical Review Board Meeting, Las Vegas, Nevada, October 14-16, 1992.

**SECTION 2.1.2 EXPLORATORY STUDIES FACILITY (ESF) DESIGN AND CONSTRUCTION
SECTION 2.4 REPOSITORY DESIGN**

COMMENT 2

Although the ESF design has undergone major changes since the issuance of the Site Characterization Plan (SCP), those changes and how they affect the potential repository have not been reflected in Progress Reports.

BASIS

Since the issuance of the Site Characterization Plan (SCP) a Title I design has been issued for an ESF [RSN, 1991], and 50% design review meetings have been held for portions of an ESF that is different from the ESF described in the SCP.

In the ESF Alternatives Study (ESFAS) (Dennis, 1991), a brief description is provided for the preferred ESF/repository alternative, which differs from the ESF/repository design presented in the SCP.

In the reviewed progress reports, changes in the heat load are mentioned in Sections 2.4.3.1 and 2.6.1.3. Those changes could alter the repository concept significantly from that presented in the ESFAS and the SCP.

Although the ESF has undergone major changes since the SCP, DOE has not shown how the revised ESF will interface with the repository conceptual design of the SCP, or with a revised repository conceptual design.

DOE has not shown that the phased approach being used for the ESF Title II design will result in a satisfactory design for the complete ESF.

Access to a complete ESF Title II design is critical to understanding how the separate ESF design phases mesh together to form a complete design that is compatible with the conceptual design of the Geologic Repository Operations Area (GROA).

RECOMMENDATIONS

All future progress reports should contain up-to-date information related to ESF and repository design and design changes.

REFERENCES

- Dennis, A. W., ed., 1991, Exploratory studies facility alternatives study final report, volumes 1 and 2: Sandia National Laboratories, SAND 91-0025.
- RSN, 1991, Title I design summary report for the exploratory studies facility: Raytheon Services Nevada, September 1991.

SECTION 2.1.1 QUALITY ASSURANCE PROGRAM**COMMENT 3**

The current listing of items and activities (Q-List) covered by the 10 CFR Part 60, Subpart G (which references 10 CFR Part 50 Appendix B) quality assurance program does not appear to have been updated to reflect the Q-List items applicable to the revised ESF design activities.

BASIS

This comment restates the concern expressed in SCP Comment 126.

A number of design packages are presently being developed and finalized without including the related design activities on an updated Q-List.

RECOMMENDATION

Future PRs should include an up-to-date listing or a reference to a listing of those items and activities covered by the 10 CFR Part 60 quality assurance program that are important to safety and waste isolation.

SECTION 2.2.1.11 STUDY 8.3.1.2.2.7 - HYDROCHEMICAL CHARACTERIZATION OF THE UNSATURATED ZONE

QUESTION 1

What evaluation has DOE made of the potential for air movement from the ESF to adversely impact the collection of geochemical data necessary for site characterization?

BASIS

This question is a more specific example related to SCA Comment 123. Comment 123 related the concern that "The effects of ventilation of the exploratory shafts and the underground testing rooms may have been underestimated in the evaluation of the potential interference with testing and the potential for irreversible changes to baseline site condition; also, there is not an adequate analysis of the effects of ventilation in the ESF on the ability of the site to isolate waste." Furthermore, the comment suggests that "at an early date, but before construction of the exploratory shafts is begun, DOE should provide an analysis that considers the effects on ventilation of the ESF, including both liquid and gas flows, on the rock adjacent to the ESF."

The NRC staff is concerned that surface-based tests planned to obtain chemical data necessary for site characterization could be adversely impacted by the ESF. Excavation of the ESF could compromise specific geochemical surface-based tests by allowing air to circulate from the ESF through the rocks of Yucca Mountain. Study Plan 8.3.1.2.2.7 identifies chemical species that will be sampled in the Yucca Mountain unsaturated zone. Some of these chemical species such as Deuterium, Tritium, Freon-11, Freon-12, Argon 39, Carbon 14, and Oxygen-18 can move through the unsaturated zone in both liquid and gas phases. If air from ESF drifts moves significant distances along paths of high air permeability, such as open fractures, gases from the drifts could mix with liquids and gases in the rock. At locations where this occurs, future geochemical sampling of predisturbance baseline conditions could be compromised.

Current estimates of air flow through the ESF suggest that a significant volume of rock could come in contact with air containing different concentrations and types of chemical species. For example, a presentation by Peters (1992, Table 2), estimated that 264,533 cubic ft./min. (cfm) of air may eventually circulate through the ESF with 178,000 cfm used by internal combustion engines. Alternatively, in Dennis (1991, p. B-67), it is estimated that air fluxes in the main tunnel could range from 300,000 cfm to 500,000 cfm.

The NRC staff is aware that two studies have been completed estimating the extent of ESF dewatering (Hopkins, 1987, and Sobolik, 1991), but those investigations do not address the impact the ESF on the gathering of chemical data. In addition, we have been unable to find where this concern is addressed by the Site Characterization Plan, or Study Plans 8.3.1.2.2.1, 8.3.1.2.2.3, 8.3.1.2.2.4, and 8.3.1.2.2.7.

Study Plan 8.3.1.2.2.7 references geochemical tests to characterize the Yucca Mountain site. Of the tests described in this study plan, we are particularly concerned with surface-based tests using boreholes, such as geochemical sampling associated with the deep unsaturated zone boreholes described in Study Plan 8.3.1.2.2.3.

RECOMMENDATION

Consideration should be given to the anticipated effect of air movement from the ESF on surface-based geochemical tests. If air movement from the ESF is anticipated to significantly affect the gathering of geochemical data necessary for licensing from surface-based tests, it is recommended that this data be collected before it can be compromised. This recommendation should be considered in a timely manner.

REFERENCES

- Dennis, A.W., 1991, Exploratory studies facility alternatives study final report: Sandia National Laboratories, SAND91-0025, v. 2, p. B-67.
- Hopkins, P., 1987, Effect of drift ventilation on repository hydrology and resulting solute transport implications: Sandia National Laboratories, SAND86-1571.
- Peters, J.W., 1992, Ramp sizing by ventilation requirements: Presentation to Nuclear Waste Technical Review Board Structural Geology & Geoenvironment Panel Meeting, Las Vegas, Nevada, Nov. 4-5, 1992.
- Sobolik, S.R., Fewell, M.E., and Eaton, R.R., 1991, Movement of shaft and drift construction water in Yucca Mountain, Nevada - an extended study: Sandia National Laboratories, SAND91-0791.

SECTION 2.2.6 POSTCLOSURE TECTONICS (SCP SECTION 8.3.1.8)

SECTION 2.6.1 POST EMPLACEMENT NEAR-FIELD ENVIRONMENT
(SCP SECTION 8.3.4.2)

QUESTION 2

How and to what extent is DOE factoring site characterization analyses into its Total System Performance Assessment (TSPA) calculations and how are the results and preliminary conclusions of performance assessment activities being considered in on-going and future site characterization activities?

BASIS

At a December 1992 NRC/DOE Technical Exchange, DOE discussed initial TSPAs which were published by Sandia National Laboratories (SNL) (Barnard and others, 1992) and Pacific Northwest Laboratory (Eslinger and others, 1993). The staff considers that this work demonstrates important progress toward resolution of SCA Comment 1, which addresses the need for DOE to provide early and iterative evaluations of the adequacy of data being gathered and the ability of the site to meet the 10 CFR Part 60 performance objectives.

In PRs 6 and 7, analyses, results, and preliminary conclusions from the TSPA are discussed. It is not clear from these discussions, the extent to which site characterization analyses have been factored into these assessments.

In PR 7, under Study 8.3.1.8.1.2 - Physical Processes of Magmatism and Effects on the Repository (p. 2-98), presentation of a paper describing studies of possible eruptive and subsurface effects of Yucca Mountain site disruption by basaltic volcanism is mentioned. However, what is not discussed, either under this study or in the performance assessment section of the report (Section 2.7), is whether this work was factored into the TSPA analyses on volcanism and, if so, how it was.

A second example concerns the evaluations of the effects of various repository thermal loadings on hydrologic flow, conducted at Lawrence Livermore National Laboratory and SNL and extensively discussed in PR 7 (Study 1.10.4.2 - Hydrologic Properties of Waste Package Environment, pp. 2-151-155). Again, it is not clear from this discussion or from the discussion of performance assessment-related activities in Section 2.7 of the report, the extent to which this work was used or referenced in the TSPA calculations.

RECOMMENDATION

Future Progress Reports should describe more explicitly the implementation of the link between site characterization and performance assessment activities, both in cases (1) when data gathered or analyses conducted under site characterization are used or factored into performance assessment calculations and (2) when results and preliminary conclusions from performance assessment analyses have, are being, or will be factored into on-going and future site characterization activities.

REFERENCES

- Barnard, R.W., Wilson, M.L., Dockery, H.A., Gauthier, J.H., Kaplan, P.G., Eaton, R.R., Bingham, F.W., and Raley, T.H., 1992, TSPA 1991: An initial total-system performance assessment for Yucca Mountain: Sandia National Laboratories, SAND91-2795.
- Eslinger, P.W., Doremus, L.A., Engel, D.W., Miley, T.B., Murphy, M.T., Nichols, W.E., White, M.D., Langford, D.W., and Ouderkirk, S.J., 1993, Preliminary total-system analysis of a potential high-level nuclear waste repository at Yucca Mountain: Pacific Northwest Laboratory, PNL-8444.

SECTION 2.4.3.1 DESIGN ACTIVITY 8.3.1.4.1.1 - DESIGN ACTIVITY TO VERIFY ACCESS AND DRIFT USABILITY

QUESTION 3

How does DOE plan to demonstrate confidence in the drift design methodology?

BASIS

The drift design methodology for the repository (Hardy and Bauer, 1991) is based on an areal power density (APD) of 57 kW/acre (124KW/ha). Sections 4.3.1 and 2.6.1.3 of PR 7 describe calculations that are based on an APD of 114 kW/acre (247 kW/ha).

In Hardy and Bauer (1991), the in situ, thermal, and seismic stresses that act on the support (rock bolts and/or shotcrete) of example drifts are calculated and presented. In Section 12.11 of Hardy and Bauer (1991), it is stated, "rockbolt and shotcrete stresses shown in the preceding sections exceed the allowable stress levels in most cases." Therefore, it has not been demonstrated that the drift design can produce acceptable support stresses for an APD of 57 kW/acre, nor is it demonstrated if, or how, the methodology is affected by an increase in thermal stress produced by an increase in the APD to 114 kW/acre (247kW/ha).

RECOMMENDATION

Demonstrate that the design methodology will result in a successful design or modify the design methodology to produce a support system in which the allowable stresses are not exceeded for the selected APD.

REFERENCE

Hardy, M. P. and Bauer, S.J., 1991, Drift design methodology and preliminary application for the Yucca Mountain Site Characterization Project: Sandia National Laboratories, SAND89-0837.

TABLE 2.1 STATUS OF SCA OPEN ITEMS**QUESTION 4**

What specific plans and studies are proposed to address NRC's Site Characterization Analysis (SCA) open items?

BASIS

In DOE progress reports 6 and 7 Table 2.1 provides the status of SCA open items and identifies proposed methods to resolve those open items. The proposed methods for resolution are listed in general terms in many cases (e.g., Resolution code #5, "Concern addressed by implementation of the YMP plan, Study Plan/activity or other design studies in current technical baseline") and it is unclear what specific activities of the site characterization program will address a particular open item. For example, resolution code #5 does not identify the specific plan or study that would address an individual open item. Identification of a plan or study, would inform the NRC staff about which studies are intended to address various open items.

RECOMMENDATION

Where available, specific references should be provided to identify draft and final reports intended to resolve open items. Activities responding to SCA and study plan concerns should include a reference to the concern in the summary and a brief statement about any progress toward its resolution.

Enclosure 2

SECTION 8.3.1.17.4.9.3 ACTIVITY: EVALUATE VARIATIONS IN THE NATURE AND INTENSITY OF QUATERNARY FAULTING WITHIN 100 KM OF YUCCA MOUNTAIN THROUGH MORPHOMETRIC AND MORPHOLOGIC ANALYSIS

SECTION 8.3.1.17.4.12.1 ACTIVITY: EVALUATE TECTONIC PROCESSES AND TECTONIC STABILITY AT THE SITE

SCA Question 1

The SCP lists many surficial mapping projects, some of which are currently on-going or are near completion. How does the DOE plan to integrate these various mapping tasks and the resultant information?

Evaluation of DOE Response

- o On page 2-7 of DOE Progress Report 6, it is indicated that DOE believes that SCA Question 1 is resolved based on information provided in a letter dated December 16, 1991.
- o In the Roberts to Linehan letter dated December 16, 1991, DOE indicates that mapping was being performed at a scale of 1:12,000 or larger, that the data would be compiled on 1:24,000 base maps, and that a Geographic Information System (GIS) is being developed to depict various data at different scales.
- o Informal discussions have indicated that any GIS may be years away from the point where the staff will have easy access to DOE compiled data.
- o In order to make early judgments on the adequacy of DOE's investigations and the ability to meet 10 CFR Part 60 requirements regarding siting and design, the staff will need accurate geologic maps depicting the location of Quaternary faults compiled at scales of 1:24,000 and larger.
- o Study Plan 8.3.1.17.4.2 indicates that fault locations on a 1:24,000 scale map will be located within 24 meters on the ground. This accuracy is not adequate to provide the staff with sufficient information to make judgments regarding the adequacy of siting and design measures.
- o Although DOE has indicated that a GIS is being developed, when this system will be emplaced and how the staff will access it is still an open question.
- o The staff considers Question 1 to remain open.

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