



Department of Energy

Washington, DC 20585

SEP 25 1990

Dr. Don U. Deere
Chairman, Nuclear Waste Technical
Review Board
1100 Wilson Boulevard
Arlington, Virginia 22209

Dear Dr. Deere:

On behalf of the Department of Energy (DOE) and the Office of Civilian Radioactive Waste Management, I would like to thank the Board for its thoughtful and effective reviews of our site evaluation, waste packaging, and transportation activities over the past year.

Enclosed are DOE's initial responses to the Board's recommendations in its First Report to Congress and the Secretary of Energy. You will note a number of the responses refer to ongoing analyses that we are conducting, most notably with regard to the design and construction of the exploratory shaft facility. The final decisions that DOE will make in these areas obviously depend on the results of the analyses. As we wanted to keep the Board informed of our progress in conducting the analyses, several meetings to discuss the ongoing analyses have already been held and others are scheduled. The initial responses that are enclosed will, therefore, be updated as appropriate to reflect the results of DOE's analyses and subsequent discussions with the Board.

As the new Director of a complex scientific program with national impact, I look forward to our future interactions and want to assure you of the Department's desire to cooperate fully with the Board.

Sincerely,

John W. Bartlett, Director

Office of Civilian Radioactive
Waste Management

Enclosure

OCRWM Responses to the NWTRB Recommendations in its
First Report to the U.S. Congress and the U.S. Secretary of Energy,
March 22, 1990

INTRODUCTION

The Nuclear Waste Policy Act of 1982 (NWPAA) established the Office of Civilian Radioactive Waste Management (OCRWM) and assigned to its Director the responsibility for carrying out the functions of the U.S. Secretary of Energy (the Secretary) under the NWPAA. The Nuclear Waste Policy Amendments Act of 1987 (NWPAA A) established the Nuclear Waste Technical Review Board (the Board or the NWTRB) to evaluate the technical and scientific validity of activities undertaken by the Secretary after the date of the enactment of the NWPAA, including site characterization activities and activities relating to the packaging or transportation of high-level radioactive waste or spent nuclear fuel.

The Department of Energy (DOE) and the Board interactions occur in a variety of formats. These interactions have included Technical Presentations and Technical Information Exchange meetings to convey technical and scientific information to the full Board or NWTRB Panels and to provide a forum for interaction between the Board and DOE and its contractors. To the extent possible, representatives of State and local governments, Indian Tribes, and utilities, as well as members of the public have been provided opportunities, by the Board, to observe and/or participate in technical meetings between the Board and DOE.

The Board is mandated to report, not less than two times per year, to the Congress and the Secretary its findings, conclusions, and recommendations. The Board's report, issued on March 22, 1990, represents the *First Report to the U.S. Congress and the U.S. Secretary of Energy*. In the first NWTRB report, "the Board's objective has been to identify the most important technical and scientific issues that the DOE should analyze further and to specify a possible course of action." This document, "OCRWM Responses to the NWTRB Recommendations...", contains the OCRWM responses to the Board's 17 technical and scientific recommendations along with responses to other recommendations of the Board.

DOE is committed to developing a geologic repository for spent fuel and high-level waste through a scientifically based, technically sound, and cost-effective program, and the development of the repository remains the focus of the OCRWM program. The difficulties facing the repository program, therefore, received particular attention during the Secretary's comprehensive program review, *Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program*, November 1989. The Secretary's review focused on management readiness to proceed with scientific investigations at the Yucca Mountain candidate site, including the implementation of a quality-assurance program that has been reviewed and accepted by the Nuclear Regulatory Commission (NRC); OCRWM's understanding of the magnitude of the effort to be undertaken; and the views of the State of Nevada (the State). This review led to the development of a revised schedule, including near-term decision milestones, and significant changes in the focus of the near-term program. The new focus on surface-based testing is not meant to suggest that underground testing at the proposed repository horizon is now deemed less important. On the contrary, the Secretary's evaluation has led to an extension of the schedule for in situ testing, in accordance with the commitment to conduct a scientifically based and technically sound Program. The

Secretary believes that conducting both surface-based and underground tests, combined with continuing evaluation of the data as they are obtained, will allow a cost-effective and timely assessment of the proposed site.

Currently, none of the required State of Nevada permits which allow technical and scientific investigations to proceed—the permit for underground injection, the air registration certificate, and the ground-water appropriation permit—has been obtained. The State has refused to issue these permits on the grounds that State law prohibits the disposal of spent fuel and high-level waste in Nevada. Although this matter is being litigated, DOE will continue its efforts to obtain the permits and is willing to work with the State to resolve specific permit issues.

To the extent that it can, DOE is collecting relevant data in strict accordance with the requirements of applicable Nevada statutes. DOE is continuing ongoing activities at, and near, Yucca Mountain to monitor transient events (e.g., seismicity, meteorology, stream drainage and runoff). These activities do not require air quality or other permits. Continuation of these monitoring activities is necessary to avoid loss of irretrievable information that is essential for assessing the magnitude and recurrence interval of potentially disruptive events and processes that could affect waste isolation.

As soon as the permits necessary for surface-based testing are issued, DOE will begin onsite testing to collect scientific information on the unsaturated zone. DOE will also collect information on zones of recent faulting to better understand the potential for surface offsets in the vicinity of the waste-handling building and the potential of major earthquakes. Also planned are investigations aimed at better understanding the origin of the calcite-silica deposits that have been identified by some program critics as indicators of saturated conditions in the proposed repository horizon. All these scientific investigations will provide early information about the suitability of the proposed site. This approach is in concert with a number of suggestions, particularly from the State, the Edison Electric Institute (EEI), and NRC, that scientific investigation activities focus on potentially adverse conditions and that efforts be made to evaluate key suitability issues early in the process.

TECHNICAL AND SCIENTIFIC RECOMMENDATIONS

The Board has recommended that the DOE take action on 17 issues. These issues are discussed below in the following format. Each issue is quoted from the Board's March 22, 1990, report and is followed by an appropriate response by OCRWM to the NWTRB recommendations.

A. Mechanical Excavation

"Maximize the use of the most modern mechanical excavation techniques in the recently initiated studies of alternative shaft and tunnel construction methods."

Response:

The Department of Energy (DOE) is committed to determining which method of mining will be most efficient for the exploratory shaft facility (ESF), with respect to collection of needed data, potential impacts on the waste isolation capabilities of the site, time, and cost. The choice between mechanical excavation and drill-and-blast techniques involves consideration of numerous factors,

including (from a scientific perspective) the types and amounts of data needed on the characteristics of fractures within the geologic units above and at the repository horizon, and the best method for gathering that data.

A major effort is under way to reexamine the current design of the ESF, and to evaluate alternatives to that design. Thirty-four major options are being considered, including twenty-eight with some component of mechanical mining techniques. In July, DOE met with the NWTRB to discuss the progress of work addressing this topic. Studies of these alternatives will be completed in early 1991. The Department will continue to update the Board on the status of the ESF alternatives evaluation.

B. Ghost Dance Fault

"Intersect the Ghost Dance Fault with an exploratory drift at more than one location."

Response:

DOE has provided the Board with a report that describes an evaluation conducted by DOE. On the basis of this evaluation, DOE plans to intersect the Ghost Dance Fault, in at least one more location in the Topopah Spring Member, in addition to the intersection previously planned. DOE expects the second intersection to be located where the fault offset may be greater. Preliminary recommendations for investigation of the Calico Hills unit would also provide at least two more intersections with the Ghost Dance Fault at a lower horizon. The layout of the ESF is being evaluated by the ESF Alternatives Task Group, which will recommend the actual number and subsequent location of penetrations of the Ghost Dance fault. Progress on this topic was discussed in the July 25, 1990, NWTRB technical exchange panel meeting.

In addition, studies of the hydrologic properties of the Ghost Dance Fault and other faults fall under Site Characterization Plan (SCP) Activity 8.3.1.2.2.4.10: "Hydrologic properties of major faults encountered in the main test level of the exploratory shaft." SCP Activity 8.3.1.2.2.3.2: "Site vertical borehole studies," provides for a pair of boreholes (USW UZ-7 and USW UZ-8) to straddle and test the hydraulic and geologic properties of the Ghost Dance Fault, and also considers geophysical studies in the boreholes to investigate the repository block.

C. Early Exploratory Drifting

"Plan an exploratory drift in an east-west direction across the Yucca Mountain geologic block."

Response:

DOE is evaluating additional exploratory drifting through the ESF Alternatives Task Group and the Calico Hills Risk Benefit Analysis (CHRBA) which are planned for completion in early 1991. The ESF Alternatives Task Group and CHRBA are also examining alternative configurations for exploratory drifting in the Topopah Spring Member and the Calico Hills unit. Sufficiently flexible ESF layouts are currently being considered, such that additional exploratory east-west drifting maybe incorporated in the future when the results of surface-based testing become available. The additional exploratory drifting proposed would add to the understanding of the host rock, although current data and the proposed program of exploratory drilling and drifting are expected to reduce the likelihood of encountering unrecognized pre-tiva Canyon Member faults

cutting the Topopah Spring Member. DOE intends to construct additional exploratory drifts, where prudent. The technical justification and location of additional exploratory drifts will be determined when the ESF Alternatives Study is completed and will be reassessed as the results of scientific information, obtained from the proposed Yucca Mountain site, become available.

D. Exploratory Ramp

"Continue studies for incorporating an exploratory ramp entering the Yucca Mountain geologic block from the east."

Response:

DOE recognizes that there may be some advantages associated with the substitution of an exploratory ramp for one of the shafts. A ramp was considered previously, but the evaluations of possible configurations conducted at that time resulted in adoption of the current conceptual design. Among the benefits that might accrue through incorporation of an exploratory ramp is an improved ability to evaluate the degree to which surface-based testing of fault and fracture densities may indicate rock characteristics in the subsurface. The ESF Alternatives Task Group is presently evaluating the use of an exploratory ramp for access to the ESF. Twenty-eight different options include one or more ramps. Progress on this topic was discussed in the July 25, 1990, NWTRB technical exchange panel meeting. The studies evaluating these alternatives will be completed in early 1991, and DOE intends to continue its interactions with the Board on this subject.

E. Non-Welded Tuff

"Include in the exploratory program ample penetration of softer, less permeable tuff units by borings, shafts, ramps, or tunnels."

Response:

DOE is reexamining its current plans to expand the characterization of the non-welded tuff units both above and below the repository horizon through in situ exploration. Specifically, the risk-benefit analysis of the Calico Hills unit reexamines the methods of characterization of the Calico Hills unit. DOE believes the testing program is flexible and can be modified if additional information needs are identified, or if the current ESF design or construction method is revised. Progress on this topic was discussed in the July 25, 1990, NWTRB technical exchange panel meeting.

Several studies, which are described in the SCP, outline DOE's current plans for non-welded tuff characterization. Study 8.3.1.4.2.1: "Surface and subsurface stratigraphic studies of the host rock and surrounding units," is intended to gather data to describe units surrounding the host rock. Study 8.3.1.2.2.3: "Characterization of percolation in the unsaturated zone - surface based study," will provide extensive data on the matrix hydraulic properties of these tuffs. Data pertaining to water occurrence and flow at the upper and lower boundaries will be obtained from radial borehole studies described in Study 8.3.12.2.4: "Characterization of Yucca Mountain percolation in the unsaturated zone - exploratory shaft study."

F. Excavation-Testing Sequence

"Develop innovative ways of coordinating and sequencing excavation and scientific testing."

Response:

Results of a comprehensive reevaluation of the testing program, both with respect to inclusion and ordering of tests will depend upon the final outcome of the ESF Alternatives, CHRBA, and the Surface-Based Testing Priorities tasks. Coordination and sequencing of scientific and excavation testing activities will also be addressed in prerequisites planning for new field activities. In the past, the coordination of excavation and testing sequences was considered in the Design Acceptability Analysis, in Chapter 8 of the SCP, and in the report "Evaluation of Alternative ESF Shaft Construction Methods and Test Sequences for Yucca Mountain Project Office". DOE has recently committed to place high priority on tests that could provide early indications of site unsuitability. This test strategy is being incorporated into the ESF Alternatives Study.

G. Unsaturated Zone Recharge

"Expand and accelerate the studies of snowmelt and rainfall infiltration into alluvium and near-surface fractures."

Response:

DOE is not in a position to expand or accelerate studies until the current impasse with the State of Nevada is resolved. DOE is currently monitoring infiltration in existing boreholes as part of ongoing studies, and as soon as new drilling can begin, additional holes will be added to the current network Study 8.3.12.1.1: "Characterization of the meteorology for regional hydrology," and Study 8.3.1.12.2.1: "Meteorological data collection at the Yucca Mountain site," directly relate to surface infiltration and recharge of the unsaturated-zone and include the following activities whose priority is being evaluated by the Surface-Based Testing Priorities Task Group:

8.3.1.2.2.1.1: "Characterization of hydrologic properties of surficial materials"

8.3.1.2.2.1.2: "Evaluation of natural infiltration"

8.3.1.2.2.1.3: "Evaluation of artificial infiltration"

8.3.1.12.2.1.1: " Site meteorological monitoring program"

Study plans for the infiltration studies are in the final phases of DOE review, and initiation of the comprehensive drilling program associated with these studies is among the highest priorities for DOE when permits are granted for work at the site.

H. Fracture Flow

"Continue the sampling analysis of ^3H and ^{36}Cl isotopes to gain a better understanding of the surface features that control the deep penetration of recharge."

Response:

DOE is aware of the importance of isotope geochemistry to the understanding of groundwater recharge at Yucca Mountain. Priorities for the following studies addressing this issue are being evaluated by the Surface-Based Testing Priorities Task Group:

- 8.3.1.2.2: "Unsaturated-zone hydrologic system at the site"
- 8.3.1.2.3: "Saturated zone hydrologic system at the site"
- 8.3.1.5.2: "Potential effects of future climatic conditions on hydrologic characteristics"

Section 8.3.5.20 of the SCP discusses analytical techniques requiring significant development

J. Calico Hills Hydrogeologic Properties

"Explore the Calico Hills tuff unit with surface borings and with the exploratory shaft facility."

Response:

NRC raised an objection to the consultation draft of the SCP and required that DOE demonstrate that the penetration of the Calico Hills unit by a shaft and/or exploratory drifts would not compromise the waste isolation capabilities of the site. DOE is currently conducting a risk/benefit analysis of options for exploration of the Calico Hills unit in concert with the ESF Alternatives Study. A preliminary recommendation for providing early access to and capability for extensive exploratory drifting in the Calico Hills unit was presented to the NWTRB in the technical exchange panel meeting on July 24-25, 1990. This recommendation has been incorporated into the ESF Alternatives Study and resulted in the addition of 17 options to provide early access to the Calico Hills unit. Documentation of the results of the CHRBA is expected to be available early in 1991.

K. Adsorption in Unsaturated Tuffs

"Study radionuclide adsorption in unsaturated tuffs over the range of temperatures and variable conditions of pH, ionic strength and competing and complexing aqueous ionic species concentrations expected at the site."

Response:

The geochemistry program, as described in the SCP, is designed to study radionuclide adsorption in unsaturated tuffs over a conservative range of conditions expected at the site. Activities which address unsaturated-zone experiments include:

- 8.3.1.3.6.1.3: "Unsaturated tuff columns"
- 8.3.1.3.6.2.3: "Diffusion in unsaturated tuff columns"

The relevance of data from these activities to potential transport from the repository will be addressed by Study 8.3.1.3.7.2: "Demonstration of applicability of laboratory data to repository transport calculations."

L. Radionuclide Adsorption Workshop

"Organize a radionuclide adsorption workshop to determine the applicability of available radionuclide adsorption data on tuff and to establish additional research and model development needs."

Response:

A workshop was held on September 11 and 12, 1990, for DOE and its contractors, as well as for outside researchers in the forefront of this field. The purpose of the workshop was two-fold: 1) the applicability of available radionuclide adsorption data on tuff and models for predicting adsorption under existing conditions at Yucca Mountain, and 2) additional radionuclide adsorption research and model development needed to demonstrate that quantitative, scientifically defensible predictions of radionuclide adsorption are possible and how such measured and predicted adsorption relates to compliance with the radionuclide release rate criteria set forth in 40 CFR191. A report is being prepared that analyzes the results of the workshop and explains any modifications that will be made to the geochemistry program as a result of the discussions.

Study 8.3.1.3.72: Demonstration of applicability of laboratory data to repository conditions, is intended to address these concerns, and the Yucca Mountain Project Office is coordinating its efforts with those of the DOE Office of Defense Programs on radionuclide migration.

M. Performance Assessment Methodology

"Develop methodology to demonstrate performance assessments."

Response:

Continuing development of the principles, practices and procedures for performance assessment is a primary goal of the performance assessment program. DOE has described its general approach in the Performance Assessment Strategy Plan and in the SCP. The specific activities for implementing the performance assessment strategy are described in the Performance Assessment Implementation Plan. DOE has also initiated Preliminary Performance Assessment Computational Exercises (PACE). These assessments have helped to demonstrate what DOE needs to accomplish in order to further develop its approach to performance assessment.

N. Preliminary Performance Assessment

"Carry out preliminary performance assessment calculations to demonstrate that such computations are possible and to determine if any site characteristic has been detected that would disqualify the site."

Response:

DOE has been involved in performance assessment calculational exercises (PACE) since 1989. The goal of the PACE exercises was precisely to evaluate the current state of models, computational capabilities, and the availability of site data. These exercises are expected to be a continuing activity. Performance assessment teams have also provided significant input to the activities evaluating ESF alternatives, performing risk-benefit analysis of Calico Hills shaft penetrations, and establishing priorities for the surface-based testing program.

The Surface-Based Testing Priorities Task Group is developing performance-based approaches for evaluating the potential repository site to determine if site characteristics point to a need to disqualify the site. SCP section 8.3.5.20: "Analytical techniques requiring development," likewise addresses the issue of ensuring that performance assessment is capable of providing timely input to evaluation and design of the repository system.

O. RADTRAN/TRANSNET

"Validate the RADTRAN model and some components in the TRANSNET package."

Response:

DOE is documenting the RADTRAN model in accordance with OCRWM Quality Assurance Program requirements and is planning to have an independent group conduct a peer review of RADTRAN. DOE will base its plans for verification and validation of RADTRAN and some components in the TRANSNET package on the recommendations developed by this independent peer review group. These verification and validation plans will be discussed with the Board when they are developed.

P. Risk Models User-Needs Assessment

"Assess the needs of potential RADTRAN/TRANSNET users with respect to what the various civilian radioactive waste program users want to accomplish and the levels of detail they require for different applications."

Response:

Documentation for RADTRAN, including a user manual, is currently being written in accordance with OCRWM requirements. Data modules specific to DOE/OCRWM expected spent fuel and high-level waste shipments are being developed for RADTRAN/TRANSNET application. As new data modules are incorporated into the models, further evaluations will be made of RADTRAN/TRANSNET user needs for DOE/OCRWM shipments.

Q. ¹⁴C Release Mechanism

"Expand studies of ¹⁴C release mechanisms and initiate a consultive program with the EPA and the NRC to examine the appropriateness of the ¹⁴C limit."

Response:

Both the Environmental Protection Agency (EPA) and the NRC have been informally made aware of DOE's concerns with their regulatory requirements for control of ¹⁴C releases. DOE is now reviewing the technical and regulatory approaches for resolving this issue and will keep the Board informed of the progress being made.

SCP activities that address the issue of ¹⁴C release from the repository system include:

8.3.1.3.8.1.1: "Physical transport mechanisms and rates - retardation mechanisms and transport with retardation"

83.1.3.8.1.2 "Gas transport measurements"

8.3.5.10.2.1.5: "Evaluation of the inventory and release of carbon-14 from zircaloy cladding"

8.3.5.13.3.1.2: "Development of a model for gas-phase releases"

STRATEGIC TECHNICAL AND NON-TECHNICAL RECOMMENDATIONS

"Strategic technical recommendations involve value judgments about technical and non-technical factors. On such matters, the Board will attempt to explain the issues more clearly, suggest possible mechanisms or processes for addressing and/or resolving the issues, or make judgments on them. The Board makes the following four recommendations to the DOE in this category."

A. System Safety

"Initiate a transportation system safety program."

Response:

DOE recognizes its responsibility for transportation safety within the OCRWM program. The transportation system and transportation casks will have to be designed, licensed and operated to comply with stringent NRC and Department of Transportation regulatory requirements. DOE's current strategy expects that compliance with these requirements will provide the conservative degree of safety that is necessary for transportation of spent fuel and high level waste. DOE is presently evaluating steps to more clearly introduce system safety elements in the transportation program, and plans to discuss the subject further with the Board.

B. Human Factors

"Initiate a human factors program for transportation safety."

Response:

DOE has recognized the importance of human factor studies and, in fact, commissioned the report by Abkowitz et al., 1988, cited by the Board. DOE has also considered human factors in the design and review of transportation casks. DOE is evaluating the introduction of dedicated human factors components into the transportation program, and plans to discuss the subject further with the Board.

C. Operational Planning

"Evaluate the use of risk-based planning tools in developing a broad based and complete transportation operational plan."

Response:

DOE is, at the present time, studying the applicability of the Management Oversight Risk Tree (MORT) to the transportation program. DOE plans to discuss the results of these studies with the Board.

D. Environmental and Public Health Program

"Develop a systems approach to the Yucca Mountain ecosystem studies program so that each individual study is integrated into an overall environmental program."

Response:

DOE uses a systems approach to its ecosystem studies program, which monitors the effects of site characterization activities on biological resources. Within the scope of site characterization impacts, the program integrates studies focusing on four categories: 1) site characterization effects, 2) desert tortoise, 3) reclamation support and, 4) radiological support.

These studies are coordinated and integrated into other parts of the environmental program. For example, the findings of the ecosystems studies are provided to the reclamation program and radiological monitoring program. The ecosystem studies also provide input to mitigation strategies and are used to keep current the Environmental Monitoring and Mitigation Plan and other environmental program elements.

A more detailed description of the ecosystems study program was provided to the Environment and Public Health Panel of the Board on April 24-26, 1990. Further discussion of the integrated systems approach that is underway can be scheduled with the Board as needed.

SCIENCE POLICY RECOMMENDATIONS

"Science policy recommendations involve decisions typically dealt with in the upper echelons of the Executive Branch or Congress. Such issues involve storage, disposal, and transportation of spent nuclear fuel; the development of EPA standards and NRC regulations; and the repository licensing process. Three recommendations are presented in this category."

A. DOE and State of Nevada Interactions

"Continue efforts to resolve the present impasse on permitting of site characterization studies."

Response:

As the Board is aware, the matter is being litigated. Currently, none of the required State of Nevada permits—the permit for underground injection, the air registration certificate, and the ground-water appropriation permit—has been obtained. The State has refused to issue these permits on the grounds that State law prohibits the disposal of spent fuel and high-level waste in Nevada. Although this matter is being litigated, DOE will continue its efforts to obtain the per-

mits and is willing to work with the State to resolve specific permit issues. DOE is making every effort to resolve the impasse. To the extent that it can, DOE is collecting relevant data in strict accordance with the requirements of applicable Nevada statutes.

B. The EPA Standard: 40 CFR191

"Consider six modifications when EPA Standard: 40 CFR 191 is revised."

Response:

DOE has advised EPA of its concerns in the past. DOE will continue to advise EPA of its concerns and the basis for these concerns in its comments on Working Draft 2 of 40 CFR 191 and on the proposed rule when it is published for comment.

C. Consideration of Uncertainties in Setting Standards

"Regulatory agencies should consider inherent uncertainties and limitations in geologic information and data projected for periods of tens of thousands of years in regard to the rigor of formulating acceptable and realistic environmental radiation protection standards."

Response:

DOE has been working with EPA to ensure that the repromulgation of 40 CFR 191 results in a reasonable standard. DOE continues to discuss with NRC the meaning of certain regulatory criteria and both agencies meet regularly on topics of importance to the program.