# Department of Energy

Washington, DC 20585

June 30, 1994



Dr. John E. Cantlon
Chairman
Nuclear Waste Technical Review Board
1100 Wilson Boulevard
Arlington, Virginia 22209

Dear Dr. Cantlon:

Enclosed is the Department of Energy's response to the questions contained in the Nuclear Waste Technical Review Board's letter dated May 17, 1994. To comply with your request for a timely response, we have attempted to capture the current state of the development of the Proposed Program Approach (previously referred to as Scenario A), which is still undergoing review and revision based upon further analysis and external comment.

One of the foremost strategic goals of the Department is to resolve the disconnect between the program's expectations and its ability to achieve them. As these expectations have evolved over the years, the program has lost its ability to meet the original intent of the Nuclear Waste Policy Act of 1982, as amended. Therefore, the Proposed Program Approach is an attempt to realign the program closer to the original intent of the legislative and regulatory framework, and to develop a set of goals and a schedule that has a reasonable probability of success and is consistent with the resources that can be allocated to it.

The Proposed Program Approach incorporates many of the Board's past recommendations and is also consistent with the recommendations made by the National Academy of Sciences in its 1990 report, *"Rethinking High-Level Waste."* That report stressed that it is not practical to assume that all information would be available prior to constructing a repository. The Proposed Program Approach lays out a stepwise approach to repository development through a series of decisions based on an increasing knowledge base that is fully consistent with the existing regulatory framework. The approach also addresses the realities of near-term storage of spent fuel.

As we continue to develop the Proposed Program Approach, we welcome the Board's specific comments and recommendations regarding our technical program.

We also intend to continue to inform the Board as we further refine the proposal in response to external comments and more detailed analysis. Please contact me at (202) 586-6842, if you wish to discuss the current status of the proposal further.

Sincerely,

Daniel A. Dreyfus, Director
Office of Civilian Radioactive
Waste Management

Enclosure

# Department of Energy
# Responses to Questions Contained In
# Nuclear Waste Technical Review Board's Letter
# Dated May 17,1994

In a letter to Daniel A. Dreyfus, the Director of the Office of Civilian Radioactive Waste Management (OCRWM) dated May 17, 1994, the Nuclear Waste Technical Review Board posed ten questions regarding Scenario A, currently referred to as the Proposed Program Approach. The Department of Energy's (DOE) response to these questions is provided below.

## Question 1:

(a) What are the specific technical bases for the decisions that led to the development of Scenario A? (b) Will the *Site Characterization Plan* be modified to reflect the new program design? (c) If so, what process will be used to modify it? (d) If not, what will be the status of the existing Site *Characterization Plan* in structuring the technical investigations at Yucca Mountain?

## Response:

The basis for the decisions that led to development of the Proposed Program Approach (the successor to "Scenario A") was the recognition by DOE that the expectations for the program could not be achieved given the historical funding levels. Specifically, the realities of the near-term, at reactor, storage of spent commercial fuel must be addressed, and a technical approach to the determination of the suitability of the candidate Yucca Mountain site for a geologic repository must be articulated. This approach must include the production of the requisite environmental and regulatory documents required to support decision making within both budget and schedule constraints. Additionally, DOE recognized that science could not meet unrealistic expectations regarding the level of knowledge and the uncertainty associated with the predictions of long-term repository performance required for licensing.

DOE believes that the Nuclear Waste Policy Act of 1982, as amended (NWPA), intended that site characterization would provide sufficient information for decision making with an implicit understanding that significant uncertainties associated with the prediction of long-term performance of a repository system would remain. The NWPA authorizes the development of geologic repositories through a process that includes a series of decisions which reflect an increasing base of knowledge. The Proposed Program Approach is a strategy to realign the program's direction with the original intent of the legislative/regulatory framework.

The Site Characterization Plan (SCP), issued in 1988, contained an extensive testing, design, and performance assessment program to acquire the data for decision making. The SCP was neither intended nor required to be revised, but, there was explicit recognition of the need to make specific revisions to the program as data is obtained.

Implementation of the Proposed Program Approach will not alter this premise. Changes to the site characterization program are reported semi-annually in the Site Characterization Progress Reports. Changes to the program are controlled through revisions to the Site Characterization Program Baseline and the Site Design and Test Requirements Document, as well as the supporting study plans. When the details of the Proposed Program Approach are further developed, resulting changes to the program will be documented in these and other documents using the program's baseline change control procedures. These changes will be identified over the next several months.

## Question 2:

At the January 1994 Board meeting, you said that "institutionalizing stakeholder interaction" was one of the OCRWM program's important short-term goals, (a) How does the DOE decide which decisions are "key decisions," requiring stakeholder input? (b) How and to what extent did the DOE obtain stakeholder and public input prior to formulating Scenario A? (c) Which stakeholders were involved? (d) What specific mechanisms is the DOE using to obtain stakeholder and public input?

## Response:

DOE's draft public participation policy recognizes public involvement as a fundamental component of program operations and directs program managers to identify "key decisions" (those where predecisional public input should be solicited) in consultation with their stakeholders. OCRWM is reviewing its plans to ensure they are consistent with the Department's proposed public involvement policy. DOE would welcome any suggestions the Board may have with respect to criteria that could be applied in determining the need for expanded stakeholder involvement.

To meet the time constraints of the Congressional budget cycle, DOE made a number of initial assumptions with regard to the framework of the Proposed Program Approach, which was supported by the Administration's Fiscal Year 1995 Budget Request. In making these assumptions, DOE considered the positions that its many stakeholders had communicated on a continuing basis to program officials. As the proposed strategy was being refined, DOE managers, both in Washington and in Las Vegas, interacted frequently with program stakeholders and Congressional staff. These interactions provided valuable input to the formulation of the Proposed Program Approach.

Specifically, DOE managers met with representatives from State, Tribal and local governments, industry groups and trade-associations, regulatory agencies, professional societies, environmental organizations, and labor organizations. These meetings included discussions about development of the scenarios used in the planning process. In addition, the program hosted several stakeholder meetings to discuss aspects of the Proposed Program Approach. In February, meetings were held in Washington and in Las Vegas to discuss the Administration's Fiscal Year 1995 Budget Request, which included a broad description of the program's proposed direction. In May, the program sponsored a major stakeholder meeting in Las Vegas to discuss with the Director the overall program direction, the Proposed Program Approach, and the site suitability evaluation process. Representatives of the OCRWM program also routinely participated in a variety of industry, governmental, and professional society meetings that provided opportunities to receive input and feedback regarding the program's plans and activities.

Once the program completed analysis of the strategic scenarios, a preferred approach was selected to propose to program stakeholders, the Congress, the Board, the Nuclear Regulatory Commission (NRC), and the public in the appropriate forums.

The identification of a preferred alternative does not predispose a decision to proceed. As the Board is aware, implementation of the Proposed Program Approach is predicated upon adequate funding. Securing this funding requires significant lead time and timely actions on the part of DOE. This will involve both Administration-wide and Congressional approval. The Congressional appropriation process is an open, public, and representative process, and the program's proposed approach in broad terms, was aired completely in that process in support of the funding request. Despite the preceding ac-

tions, DOE will continue to evaluate and refine elements of the Proposed Program Approach, based, in part, upon the input from its stakeholders and, of course, dependent upon the results of Congressional direction.

## Question 3:

Scenario A calls for increased budgets, a decreased scope of near-term site characterization activities (e.g., potentially less tunneling), and a demanding schedule, (a) What specific studies previously planned under the SCP and in the study plans (i) will be completed before application for a license to begin repository construction, (ii) will be deferred until after repository construction, (iii) will be deferred until after repository operation begins, and (iv) will be deleted? (b) What criteria were used to assign particular studies to one of the four categories?

## Response:

The detailed plans that identify which site characterization studies will be conducted, deferred, or eliminated are being developed and will be provided to the Board along with a description of the criteria used to make those determinations when they are available later this year. In general, however, such decisions will be consistent with the strategy articulated in the Proposed Program Approach, which recognizes the existing incremental process for repository licensing beginning with the submittal of the initial license application for construction authorization (10 CFR 60.24(a) and 60.31), followed by an updated application for authorization to receive and possess spent fuel and high-level waste (10 CFR 60.24(b) and 60.41), and a final application for an amendment to close the repository (10 CFR 60.51).

This strategy focuses near-term activities on the information required for determining the suitability of the candidate Yucca Mountain site, and if suitable, the requirements for obtaining a repository construction authorization, including ensuring the safety of repository operations and providing an adequate basis for confidence in waste package containment. A lower priority will be given initially to those tests that support demonstration of compliance with requirements related to longer term radionuclide transport and release. Sufficient testing and modelling will be conducted in this latter category to develop bounding analyses for the license application. Further testing would be deferred and conducted as part of the performance confirmation program required by 10 CFR Part 60.

## Question 4:

The OCRWM has asked for increased program funding because it believes that the scientific work has been under funded, (a) If Congress provides the requested funding for Scenario A, specifically how much will allocations to underground excavation, waste package and materials research, and other site-suitability activities be increased? (b) How much will be allocated to overhead and infrastructure? (c) Will these allocation priorities change if funding to the program is not increased to the level requested?

## Response:

The details of the testing program that would support the Proposed Program Approach are being developed. Consequently, the allocation of budgets among the various elements of the repository program are not available at this time. The re-baselined budget information should be available in early

Fiscal Year 1995 and will be provided to the Board at that time. The program has, however, stated that the proposed increase will predominately be allocated to work at Yucca Mountain. Compliance and management costs will be constrained.

The funding allocation will also reflect the program management improvements achieved in the reorganization of the Yucca Mountain Site Characterization Office, and the re-alignment of headquarters elements along with any recommendations or other actions resulting from the ongoing independent financial and management review of the Yucca Mountain Site Characterization Office. In any case, the funding allocation will be based on the program's priorities and will support only the minimum infrastructure and overhead required for achieving interim milestones and completing the program's mission.

As DOE reported to Congress, if the funding level in the Administration's Fiscal Year 1995 Budget Request is not obtained, and the prognosis for future budgets were to indicate that DOE will receive a level of funding consistent with past years, the entire OCRWM program will be re-evaluated. The resultant funding priorities for such a program would clearly be dependent on the nature of that program. Under such funding constraints, it is probable that a full program, carrying all licensing activities forward, would not be continued.

## Question 5:

Scenario A calls for the completion of a five-mile main loop with additional drifting *only if necessary.* (a) What is the technical basis that supports this change from the current program design? (b) What technical criteria will the DOE use to decide whether the five-mile loop is sufficient for a decision on site suitability? (c) If a five-mile loop is insufficient, how will the DOE decide how much additional underground excavation will be needed?

## Response:

The technical basis for reducing the amount of underground excavation to be conducted is an extension of underlying bases of the Proposed Program Approach, which was discussed in the response to Question 1. Our current thinking is that the site characterization program will be refocused to obtain the information that is critical to support DOE and NRC decisions pertaining to site suitability and licensing. In the Proposed Program Approach, the goal of the underground excavation program is not the completion of the five-mile (7.8 km) loop. Rather, emphasis is being placed on completing sufficient excavation to support two critical activities: (1) constructing at least two exploratory drifts off the main drift in the Topopah Spring Level to obtain information on the water content and age in the Ghost Dance Fault and (2) starting the Exploratory Studies Facility (ESF) heater tests in the North Ramp Extension as soon as possible. Depending on what is found in the Ghost Dance Fault, a decision will be made about the appropriate exploration of the Calico Hills unit. Such a decision would obviously impact the timing for the completion of the 7.8 km loop.

Further details on the proposed drifting sequence follow, keeping in mind that this is our current thinking subject to discussion with the Board and other stakeholders:

According to the strategy in the Proposed Program Approach, ESF excavation will begin in August 1994 in the North Ramp using the 7.6 meter tunnel-boring machine (TBM #1). Acquisition will be made of a second, smaller diameter TBM (TBM #2) during Fiscal Year 1995, concurrent with North

Ramp excavation. Once TBM #1 has completed the North Ramp and "turned the comer" into the Topopah Spring Level main drift, TBM #2 will be erected, and the North Ramp Extension will be excavated. This will be concurrent with Topopah Spring Level main drift excavation by TBM #1.

TBM #1 will proceed south along the Topopah Spring Level main drift until it passes the northernmost of the two Ghost Dance Fault exploratory drifts. This drift will then be driven, approximately 120 to 150 meters, through the Ghost Dance Fault. TBM #1 will proceed south in the Topopah Spring Level main drift past the southernmost Ghost Dance Fault drift. Once again, TBM operations will be halted long enough to start the second Ghost Dance Fault exploratory drift. After completion of the second Ghost Dance Fault exploratory drift, TBM #1 will proceed with completion of the 7.8 km loop. The rate of advance will be dependent on resources needed for other ESF excavation activities. TBM #2 will finish the North Ramp Extension shortly after the time period that the Ghost Dance Fault drifts are excavated. After completion of the North Ramp Extension, several parallel drifts will be driven to the north off the North Ramp Extension to house heater tests.

A decision on excavation into the Calico Hills unit will be made once information is available from the Ghost Dance Fault drifting described above. If Calico Hills drifting is needed, it will likely be driven using TBM #2. The point of access and ultimate configuration of Calico Hills drifting is the subject of a study to be performed in early Fiscal Year 1995.

The adequacy of the information obtained through an integrated exploration and testing program will be determined through suitability evaluations, design development, and in the preparation of the initial license application. If the geologic data is deemed insufficient to support decision making, additional excavation and testing will ensue. The criteria used to determine the adequacy of data are under development and will be provided to the Board when they are available.

## Question 6:

Thermal loading is a key parameter associated with various waste isolation strategies and repository/waste package designs, (a) Under Scenario A, when will a preliminary decision about thermal loading be made? (b) When will a final decision be made? (c) What specific information does the DOE believe will be required to make sound technical decisions on (i) repository design and (ii) a waste package design that is compatible with the MFC? (d) How will the timing of the DOE's application to the NRC for a construction license affect the DOE's thermal-loading decision?

## Response:

Under the Proposed Program Approach, the range or ranges of thermal-loadings will initially be bounded in 1998. As further information becomes available, the bounding evaluations will be reviewed and updated, and will be included in the license application to construct the repository, scheduled to be submitted in 2001.

The Proposed Program Approach calls for making the thermal-loading decision prior to the completion of the updated license application for receiving and possessing waste. This updated license application is scheduled to be submitted in 2008. Thermal-loading will be confirmed as a result of data collected during the performance confirmation program.

An understanding of the mechanisms which influence the coupled Thermal-Mechanical-Hydrologic-Chemical performance of the natural barriers is required to make sound technical decisions relative to thermal-loading for repository and waste package design. The development of a variety of sub-models and a testing of their validity is included in the program's scientific and engineering programs. These models will provide the basis for thermal loading decisions.

(i) For repository design, the following are examples, and not necessarily a complete list, of the information being developed:

A description of thermal mechanisms for heat transfer, including the fraction of heat transferred by each mechanism (conduction, convection, and radiation).

A hydrologic model that will bound the hydrologic performance of the natural barriers. This model will incorporate information gathered on bulk permeabilities, saturation, fluid and vapor flow, and fracture/matrix coupling.

A model of the thermal-mechanical response of the host rock. This model will include data collected on rock compressive and tensile strength, thermal expansion coefficients, moduli (elastic, deformation, etc.), Poisson's ratio, and joint frequency and orientation.

A geochemical model of the response of the natural barriers will include information on reaction rates, water chemistry (Eh, pH) and the change with temperature, sorption coefficients, retardation rates, colloid formation, and dispersivity.

(ii) For waste package design, these and other models will be used to address:

Hydrologic and geochemical responses of the potential site as they impact the waste package environment.

Geomechanical response of the near-field environment and the potential for rock falls within the emplacement openings.

Metallurgical, mechanical, and corrosion behavior of containment barriers in response to temperature.

Thermal stability of each waste package/engineered barrier system component during its proposed lifetime.

DOE's license application to construct the repository is scheduled for submittal to NRC in 2001. Prior to this submittal, the impacts of a range of thermal-loadings will be analyzed and the results of those analyses reported with the initial license application. The analyses will support the use of particular bounds for thermal-loading to justify reasonable assurance of meeting the performance objectives of 10 CFR Part60.

## Question 7:

Under Scenario A, the waste will "remain retrievable" for 100 years, (a) What contingency plans for retrieving the waste will be developed before deciding whether to adopt Scenario A? (b) When will retrieval plans be developed? (c) How will these plans affect the total system life cycle cost (TSLCC) and the adequacy of the 1-mil-per-kilowatt-hour fee?

## Response:

The criteria for retrievability of emplaced waste are under development. As part of the development process, different retrieval time periods and normal and abnormal retrieval conditions will be evaluated. To date, the program has developed a draft Concept of Retrieval Operations and revised the DOE Position on Retrievability and Retrieval for a Geologic Repository. That position was originally an appendix of the "Generic Requirements for a Mined Geologic Disposal System" (DOE OGR-B2) document produced in the mid- to late 1980s. The Concept of Operations addresses both normal and abnormal retrieval conditions.

To further examine this subject of extended retrievability, DOE has directed a study of the advantages and disadvantages of extended retrievability periods. The "Retrievability Period System Study" is scheduled to be completed by September 30,1994, and will evaluate 50-, 100-, and 200-year retrieval periods, to focus the advanced conceptual design effort.

To maintain the option to retrieve for 100 years would mean extending the caretaker period by approximately 50 years. As used in the last published TSLCC analysis (DOE/RW-0236, May 1989), the caretaker period is the interval of time from the last waste package emplacement until the end of the retrieval period. Using the same cost model and assumptions as used in the May 1989 TSLCC analysis, the increased cost due to a 50-year extension of the caretaker period would be $1,224 million (in 1993 dollars). As with the May 1989 TSLCC analysis, this does not include retrieval costs, but does include costs for removing a small number of waste packages for performance confirmation testing. The Proposed Program Approach affects multiple aspects of the program scope (and costs) and hence the May 1989 TSLCC analysis and the December 1990 Addendum (DOE/RW-0295P) are out of date with respect to the Proposed Program Approach. An adequate revision to the TSLCC cannot be done until sufficient engineering design is completed in early Fiscal Year 1995. It is estimated that the next revision to the TSLCC will be completed by the end of Fiscal Year 1995. Upon completion of that effort, the fee adequacy issue can be addressed.

## Question 8:

Descriptions of Scenario A refer to a "site suitability evaluation," "technical site suitability," and a "site recommendation report." (a) When and how will the DOE identify the specific tests and data necessary to support these site-suitability determinations? (b) Does the DOE believe the siting guidelines of 10 CFR Part 960 are adequate for determining site suitability under Scenario A? (c) If not, what amendments are envisioned and what process will be used to adopt them?

## Response:

DOE is preparing Fiscal Year 1995 and out year planning guidance for project participants that will incorporate the concepts from the Proposed Program Approach, including proposed milestones for the suitability decision schedule. This guidance will start the process of identifying the specific tests and data necessary to support the site suitability determinations that were proposed in the Proposed Program Approach. The results of this planning will be documented in a Technical Implementation Plan for site investigations for Fiscal Year 1995 and in the long-range plan for the out years. The Fiscal Year 1995 Technical Implementation Plans will be finalized in September 1994. The Long-Range Plan should be finalized in mid-1995.

DOE believes that the siting guidelines are adequate for determining site suitability under the Proposed Program Approach. The Proposed Program Approach simply provides a phased schedule for a site suitability decision. This schedule allows DOE to evaluate specific guidelines or groups of guidelines when sufficient data and analyses are available for the evaluation. Using this phased approach, DOE has an opportunity to make earlier decisions on specific guidelines as the data become available, rather than waiting until 1998 or later to produce an overall evaluation of all guidelines.

Although DOE is not adapting the siting guidelines for the Proposed Program Approach, DOE has elected to re-examine the siting guidelines in light of past statutory and regulatory changes. The purpose of this initiative is to determine if sections of the guidelines might require formal clarification, or even revision, before suitability evaluations begin. DOE has requested input to this decision from program stakeholders in an April 25, 1994, *Federal Register* Notice of Inquiry, and at the May 21, 1994, stakeholders meeting. Once the public comment period has closed, DOE will review these comments and decide what process, if any, will be used to clarify or revise the siting guidelines.

## Question 9:

The NRC's regulation (10 CFR Part 60) requires the DOE to demonstrate, prior to repository construction, that there is "reasonable assurance" that the facility will perform safely. The SCP outlines a testing plan that implies an agreement between the NRC and the DOE about how "reasonable assurance" will be demonstrated. Under Scenario A, some of the tests will be postponed until after repository operation begins, (a) How will the DOE demonstrate the level of assurance in the performance of the repository that would have been obtained under the SCP? (b) Will it be necessary to reinterpret or change the level of assurance? (c) If so, how will it change?

## Response:

The extensive site characterization program originally outlined in the SCP, including subsequent changes, reflects the expectations of data and analyses required to predict long-term repository performance and go beyond what is actually needed to comply with the regulatory requirements. Our current thinking is that the amount of information needed to support the decisions embodied in the Proposed Program Approach will provide a sufficient basis for a "reasonable assurance" finding. In developing the underlying rationale for the Proposed Program Approach, we evaluated both the letter and intent of 10 CFR Part 60 to ensure that the Proposed Program Approach was consistent with the flexibility already inherent in the existing regulation. For example, at the time of submittal of the license application, 10 CFR 60.24(a) requires that: *"The application shall be as complete as possible in the light of information that is reasonably available at the time of docketing"* Furthermore, DOE believes that NRC expects that the "reasonable assurance" finding will be based on limited information. 10 CFR 60.102 states:

> *While these performance objectives and criteria are generally stated in unqualified terms, it is not expected that complete assurance that they will be met can be presented.... Proof of the future performance... over time periods of many hundreds of many thousands of years is not to be had in the ordinary sense of the word. For such long-term objectives and criteria, what is required is reasonable assurance, making allowance for the time period, hazards, and uncertainties involved, that the outcome will be in conformance with those objectives and criteria.*

## Question 10:

According to presentations made at the panel meeting on March 22, 1994, by representatives of the Council on Environmental Quality and the DOE's General Counsel Office, the Yucca Mountain Environmental Impact Statement should include a discussion of various repository and waste package design alternatives, (a) Under Scenario A, what alternatives will be sufficiently well understood to be evaluated? (b) Will separate impact statements be prepared for MPC procurement, repository development, and transportation? (c) How will the interdependencies among those activities be analyzed?

## Response:

In response to the Secretary of Energy's June 1994 Policy on the National Environmental Policy Act (NEPA), and the suggestions made by interested parties in the past year, OCRWM is reviewing its NEPA strategy. This review will include an evaluation of alternative approaches for implementing the NEPA requirements for the various program activities and the proposed methodology to address the interdependencies among those activities. The issues raised by the Board will also be addressed in scoping activities that will be associated with implementation of NEPA requirements.