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Resources, Community, and
Economic Development Division

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February 27, 1989

The Honorable J. Bennett Johnston
Chairman, Committee on Energy
and Natural Resources
United States Senate

The Honorable James A. McClure
Ranking Minority Member
Committee on Energy and Natural Resources
United States Senate

On March 26, 1984, you requested that we provide quarterly status reports on the implementation of the Nuclear Waste Policy Act of 1982. The act required the Department of Energy (DOE) to implement a federal program for the safe and permanent disposal of high-level nuclear waste in one or more geologic repositories. It also assigned responsibility to the Nuclear Regulatory Commission (NRC) to license and regulate these repositories. In December 1987, the Congress amended the act.¹ Among other things, the amendments directed DOE to characterize (investigate) a site at Yucca Mountain, Nevada, to determine if the site is suitable for a repository and to terminate all site-specific activities at two other candidate sites.

Site Characterization

On December 28, 1988, DOE issued its final plan for characterizing Yucca Mountain. The first major characterization step is to construct an exploratory shaft facility. The facility, which will consist of two shafts mined to repository depth and underground testing rooms, will be used to conduct site characterization activities.

Before DOE can begin constructing the exploratory shaft facility, it must

- develop, implement, and demonstrate to NRC that its quality assurance program for exploratory-shaft-related activities, including the design and construction of the facility, meets regulatory standards;
- obtain and consider NRC's comments on its site characterization plan; and
- hold public hearings in the vicinity of the site to inform area residents of the plan and receive their comments.

¹The Nuclear Waste Policy Amendments Act of 1987, contained in the Budget Reconciliation Act for Fiscal Year 1988 (P.L. 100-203).

forced DOE to delay exploratory shaft facility construction until November 1989.

Observations on the Potential for Additional Delay

Although DOE was prompted to delay facility construction by 5 months, further delay is possible for either of two reasons. First, DOE's current schedule for developing, implementing, and demonstrating the adequacy of its quality assurance program to NRC is slipping. In July 1988, DOE and NRC agreed on an approach and a May 1989 time frame for qualifying portions of DOE's quality assurance program needed for near-term site characterization work. In November 1988, however, NRC staff informed NRC's Commissioners that DOE would not meet this schedule. In January 1989, DOE acknowledged this slippage and extended its schedule for qualifying the program until September 1989.

Second, NRC's schedule for reviewing DOE's final site characterization plan is dependent on whether DOE meets its schedule. For example, although DOE issued the plan in December 1988, it is still reanalyzing the design for the exploratory shaft facility presented in the final plan to determine if the design satisfactorily addresses all applicable NRC regulatory requirements. Early results of this analysis indicated that DOE's design documents do not explicitly address 31 regulatory requirements. Among other things, DOE will have to assess whether the facility's design is deficient because of omissions of applicable requirements and address any impacts on the design of the facility. DOE plans to issue the results of its analysis in February 1989, and NRC plans to comment on the site characterization plan in July 1989. If, however, significant deficiencies in the design of the facility are identified from DOE's analysis or from NRC's review of the analysis, additional time will be needed to resolve the deficiencies. In a more general sense, NRC's review of the final plan depends on the extent to which DOE has adequately addressed, either in the plan or related documents, issues that NRC raised on the draft plan.

Appendix I describes, in more detail, the events that caused the 5-month delay in starting construction of the exploratory shaft facility and why further delays could occur.

Methodology

To obtain information about DOE's progress in resolving NRC's concerns on the draft site characterization plan, we attended numerous meetings held between DOE and NRC during the quarter. The meetings focused on NRC's concerns about the exploratory shaft facility, including the facility's design, and DOE's approach and schedule for resolving the concerns.

Appendix I
Delays in Start of Exploratory Shaft Facility
Construction

DOE has completed its preliminary design of the exploratory shaft facility. The first version of the design was contained in DOE's "consultation draft" site characterization plan issued to NRC and others for comment on January 8, 1988. A second, more advanced version of the design was presented in the final site characterization plan issued on December 28, 1988. NRC will review and comment on the facility's design as part of its review of the final plan. If NRC has major concerns with the final plan, it could object to DOE's proceeding with site characterization until the concerns are satisfactorily resolved.

After site characterization, if DOE determines that Yucca Mountain is suitable for nuclear waste disposal, it will recommend selection of the site to the President, who, in turn, may formally recommend selection of the site to the Congress. Under NWPA, as amended, the state of Nevada could submit to the Congress a notice of disapproval of the President's selection of the site. The site then shall be disapproved, unless the Congress enacts a joint resolution approving the site's selection. If the site is eventually selected, DOE will use the information acquired during site characterization to prepare an application to NRC for authorization (a license) to construct the repository. DOE expects to apply for a construction authorization in 1995.

To obtain a license to construct a repository, DOE must acquire sufficient information during site characterization to demonstrate that the requirements contained in NRC's regulations have been met.¹ For example, DOE must demonstrate that waste deposited in the repository can be safely isolated from the environment for thousands of years. In addition, DOE must apply stringent quality assurance measures to repository-related work that would be used to support a license application. Such work would include, for example, activities related to demonstrating the safety of the repository and its capability to isolate waste. Among other things, NRC's quality assurance requirements require DOE to (1) inspect and audit activities that affect quality, (2) establish controls over testing programs and testing equipment, (3) establish and maintain quality assurance records, and (4) initiate corrective action to resolve identified problems. When properly implemented, quality assurance measures provide evidence that repository work is adequate for demonstrating compliance with NRC's licensing regulations.

¹These requirements are contained in 10 CFR 60—"Disposal of High-Level Radioactive Wastes in Geologic Repositories; Licensing Procedures."

NRC requires that activities relating to satisfying regulatory requirements—such as requirements for ensuring waste isolation—be conducted under stringent quality controls so that the results of these activities can be used later to demonstrate compliance with licensing requirements. According to NRC, the exploratory shafts are important to waste isolation because they provide a potential pathway for water to get into the repository. Consequently, the siting, design, and construction of the exploratory shaft facility must be conducted under the same stringent quality assurance controls that apply to a repository.

In a July 1988 meeting between the agencies, NRC told DOE that DOE's existing quality assurance program did not ensure that repository activities were being conducted under sufficient quality controls. One example of this is that DOE could not demonstrate how the facility's design specifications—such as the location of the two shafts—were established or the relationship between the specifications and regulatory requirements.

NRC staff believe their exploratory shaft facility comments on the draft plan illustrate that DOE did not adequately implement the required process for controlling design work. According to NRC, if DOE's design control process had been adequate, DOE would also have found that the design did not adequately consider applicable regulatory requirements. For example, NRC requires that site characterization work be conducted in a manner that limits adverse effects on long-term repository performance to the extent practical. In reviewing the draft site characterization plan, however, NRC found that DOE had not sufficiently considered the potential adverse effects of locating the two shafts in areas subject to flooding and erosion. According to NRC, the proposed locations create the possibility of (1) significant long-term adverse impacts on the site's waste isolation capability that cannot be corrected and (2) adverse effects on DOE's ability to adequately characterize the site.

In July 1988, DOE responded to NRC's concerns about the application of quality assurance to the exploratory shaft facility by stating that it would apply the required quality assurance measures to the facility's design after construction on it had begun. NRC advised DOE, however, that this approach would not identify design problems early enough to correct them in some cases. For example, if DOE disturbed the site by sinking the two exploratory shafts and later found out that the locations were wrong, it could not correct the error. In this regard, this was not the first time that NRC had cautioned DOE about weaknesses in its

facility. In a December 1988 meeting with NRC, DOE officials stated that it was too early to determine whether the preliminary results would require changes to the facility's design. As a result, DOE proceeded to issue its final site characterization plan on December 28 even though the outcome of the design acceptability analysis—expected to be issued early in February 1989—might affect the design contained in the plan.

Further Delays in Start of Construction Are Possible

A further delay in constructing the exploratory shaft facility is possible for either of two reasons. First, DOE may not be able to demonstrate the adequacy of its quality assurance program for near-term work within its revised schedule. DOE has stated that it will not begin exploratory shaft construction until NRC accepts DOE's quality assurance program. Second, NRC's schedule for completing its review of the final site characterization plan depends on the adequacy, timeliness, and outcome of DOE's design acceptability analysis and the quality of documentation submitted to NRC by DOE to close out open NRC staff comments.

Resolution of Quality Assurance Issues

To obtain NRC's agreement that DOE is ready to sink exploratory shafts at Yucca Mountain, Nevada, DOE must satisfactorily resolve NRC's major concerns on DOE's draft site characterization plan and any additional objections that NRC may identify in its review of the final plan. Although DOE is not obligated to follow NRC's recommendations, it has committed to having a fully qualified quality assurance program in place covering exploratory-shaft-related activities before constructing shafts at the site. This program includes the use of adequate design controls for the exploratory shaft facility.¹

In July 1988, DOE and NRC agreed on a plan and schedule for qualifying those portions of DOE's quality assurance program needed to begin near-term site work. The schedule envisioned NRC's acceptance of this portion of DOE's quality assurance program by May 1989.² Although NRC agreed to this schedule, it had previously told DOE that the schedule would be

¹In an earlier report, we reported on numerous program weaknesses identified in NRC's oversight of DOE's quality assurance program development since 1984. As a result of its oversight experience and its review of DOE's draft site characterization plan, NRC formally commented, in March 1988, that it did not have confidence in the adequacy of DOE's quality assurance program. DOE concurred that its program was not sufficiently mature and that improvements would be needed to begin site characterization. DOE further stated that the essential program would be in place and verified by NRC before DOE starts site characterization. (See *Nuclear Waste: Repository Work Should Not Proceed Until Quality Assurance Is Adequate* (GAO/RCED-88-159, Sept. 29, 1988).)

²At that time, DOE intended to begin constructing the exploratory shaft facility in June 1989.

Appendix I
Delays in Start of Exploratory Shaft Facility
Construction

a result, NRC may need to revise its review schedule to provide sufficient time for a thorough review of the plan. According to NRC staff, the additional information consists of the design acceptability analysis and documentation submitted to close out open items between the agencies.

The matter is further complicated if DOE identifies a significant deficiency in the design of its exploratory shaft facility as a result of its design acceptability analysis, or if NRC staff identify problems with DOE's analysis. Correcting the deficiency or resolving the problems will take additional time. In such an event, according to an NRC official, the form of corrective action could be to revise the site characterization plan and, in our view, this could delay subsequent site characterization milestones.

Major Contributors to This Report

Resources,
Community, and
Economic
Development Division,
Washington, D.C.

Keith O. Fultz, Director, Energy Issues (202) 275-1441
John W. Sprague, Associate Director, Energy Issues
Dwayne E. Weigel, Assistant Director
Emi Nakamura, Assignment Manager
Kathleen J. Turner, Evaluator-in-Charge

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Principal GAO Products on the Nuclear Waste Program

Congressional Reports

Nuclear Waste: Termination of Activities at Two Sites Proceeding in an Orderly Manner (GAO/RCED-89-66, Feb. 6, 1989).

Nuclear Waste: DOE's Method for Assigning Defense Waste Disposal Costs Complies With NWPA (GAO/RCED-89-2, Feb. 2, 1989).

Nuclear Waste: Repository Work Should Not Proceed Until Quality Assurance Is Adequate (GAO/RCED-88-159, Sept. 29, 1988).

Nuclear Waste: Fourth Annual Report on DOE's Nuclear Waste Program (GAO/RCED-88-131, Sept. 28, 1988).

Nuclear Waste: Information on Cost Growth in Site Characterization Cost Estimates (GAO/RCED-87-200FS, Sept. 10, 1987).

Nuclear Waste: A Look at Current Use of Funds and Cost Estimates for the Future (GAO/RCED-87-121, Aug. 31, 1987).

Nuclear Waste: DOE Should Provide More Information on Monitored Retrieval Storage (GAO/RCED-87-92, June 1, 1987).

Nuclear Waste: Status of DOE's Implementation of the Nuclear Waste Policy Act (GAO/RCED-87-17, Apr. 15, 1987).

Nuclear Waste: Status of DOE's Nuclear Waste Site Characterization Activities (GAO/RCED-87-103FS, Mar. 20, 1987).

Nuclear Waste: Institutional Relations Under the Nuclear Waste Policy Act of 1982 (GAO/RCED-87-14, Feb. 9, 1987).

Reports to Agency Officials

Nuclear Waste: DOE Should Base Disposal Fee Assessment on Realistic Inflation Rate (GAO/RCED-88-129, July 22, 1988).

achievable only under "best case conditions." By November 1988, when NRC staff briefed the NRC Commissioners on the waste program, NRC staff members stated that DOE's schedule was slipping and that DOE was a long way from resolving NRC's concerns about DOE's quality assurance program. DOE has recognized this problem and at a January 25, 1989, meeting with NRC, DOE presented a revised schedule for qualifying its program. If the new schedule is achieved, DOE believes it would be ready to start near-term site characterization work in September 1989. However, both DOE and NRC officials acknowledged that the schedule is very optimistic and subject to slippage if DOE's planned audits, or NRC's observations of the audits, reveal any major problems.

NRC Review and Comment on Site Characterization Plan

NRC intends to provide its analysis of DOE's plan, including the design of the exploratory shaft facility, in July 1989—about 4 months before DOE plans to begin constructing the facility. However, its ability to provide comments within this time frame depends, in part, on the adequacy, timeliness, and outcome of DOE's design acceptability analysis. Until recently, NRC had intended to provide DOE with shaft-related comments on the site characterization plan 3 months after receipt of the plan, if DOE provided details on the facility's design 2 or 3 months prior to releasing the plan. DOE did not release this information within that time frame and, as a result, NRC cannot conduct an expedited review of the facility's design. According to NRC, it will need 7 months to provide DOE with comments on the exploratory shaft facility design concurrent with its comments on the plan.

According to NRC staff, DOE must demonstrate that its design control process complies with NRC's quality assurance requirements before NRC's concerns about the exploratory shaft facility can be resolved. Consequently, NRC's ability to provide definitive comments on the final site characterization plan will remain in question until its underlying concern about adequate design controls for the exploratory shaft facility is resolved. In addition, NRC's 7-month review schedule for the final plan presumed that DOE would issue its design acceptability analysis with the final plan in December 1988, but DOE now plans to issue the analysis early in February 1989. According to NRC staff, the longer the delay between DOE's issuance of the final site characterization plan and the design acceptability analysis, the longer it will take for NRC to complete its review of the final plan.

NRC staff are expecting a substantial increase in the amount of information they must review to assess DOE's final site characterization plan. As

approach to applying quality assurance to repository work. In a November 1987 letter to DOE, for example, NRC had advised DOE that the latter agency's intended approach to applying quality assurance measures to repository work could result later on in a need to retrofit more stringent quality assurance standards to completed activities if sufficient quality controls had not been initially applied. According to NRC, a number of nuclear power plants have faced this situation and have either cancelled their plants or incurred long delays and cost increases because of the difficulties they encountered in retrofitting quality assurance measures on their plants.

Schedule Delay Needed to Upgrade DOE's Quality Assurance Program

In an October 1988 meeting with NRC staff, DOE officials confirmed that the preliminary design of the exploratory shaft facility had not been developed under a quality control process that complied with NRC's quality assurance requirements. Although DOE believed that its current design would not have differed significantly if the process had complied with NRC's requirements, it announced a 5-month delay—from June 1989 until the end of November 1989—in starting facility construction. According to DOE, the postponement is necessary for it to develop and implement the quality assurance program before beginning construction.

To address NRC's design concerns, DOE stated that it needs to both ensure that future design activities meet quality assurance standards and analyze the acceptability of earlier design work. Therefore, DOE officials announced that DOE would perform all activities related to the exploratory shaft facility—including the forthcoming detailed construction design—under stringent quality controls unless lesser controls can be properly justified. Further, DOE is performing a "design acceptability analysis" to validate design work related to the exploratory shaft facility that is contained in the final site characterization plan. The analysis is intended to demonstrate how DOE's exploratory shaft facility design meets regulatory requirements and will include a determination of what regulatory requirements apply to design work and an assessment of whether the design meets these requirements. For example, the analysis will address whether DOE's choice of locations for the two exploratory shafts adequately considered all applicable regulatory requirements.

The preliminary results of DOE's design acceptability analysis indicated that DOE did not explicitly address 31 regulatory requirements in its design documents. As a result, DOE must also (1) assess whether deficiencies in the facility's design exist because of the omission of applicable requirements and (2) address any impacts on the design of the

NRC's quality assurance regulation also requires DOE to establish a process for controlling repository design work to, among other things, ensure that regulatory requirements are correctly translated into specifications, drawings, and instructions for constructing a repository. Because the exploratory shaft facility would become part of a repository, DOE must apply the same stringent quality controls to the facility's design. The process for controlling design work provides the means for documenting and eventually verifying that DOE's repository design meets NRC's licensing requirements.

DOE's Design Work Does Not Meet Quality Assurance Requirements

In May 1988, NRC staff provided DOE with about 160 specific concerns resulting from their technical review of DOE's draft site characterization plan for Yucca Mountain. NRC stated that five of these concerns—called objections—were important enough that site characterization work should not begin until they are satisfactorily resolved. One major concern was that DOE's draft plan did not recognize the range of alternative models that can be supported by existing limited data and that need to be considered in the development of testing programs.² Another major concern was related to the adequacy of DOE's quality assurance program for site characterization activities. The remaining three concerns pertained to the preliminary design of the exploratory shaft facility. Specifically, NRC expressed concern about DOE's decisions to penetrate Calico Hills—a rock formation between the planned repository and the underlying water table—and to locate the two shafts in areas subject to flooding and erosion. It was also concerned about potential interference between testing programs and construction, and other testing activities. (Two of our previous quarterly reports discussed NRC's comments on the draft site characterization plan.³)

Since commenting on the draft plan, NRC's staff have concluded that their major concerns about the exploratory shaft facility are symptomatic of a larger, more fundamental, concern about the adequacy of DOE's quality assurance program. The problem is the absence of the design control process, required by NRC's quality assurance regulations, in DOE's development of the preliminary designs of the facility.

²Models are simplified representations of actual conditions and are used to simulate and evaluate the behavior of a geologic system at a potential repository site over a long period of time.

³Nuclear Waste: Quarterly Report on DOE's Nuclear Waste Program as of March 31, 1988 (GAO/RCED-88-163BR, May 19, 1988), and Nuclear Waste: Quarterly Report on DOE's Nuclear Waste Program as of June 30, 1988 (GAO/RCED-88-204BR, Aug. 29, 1988).

Delays in Start of Exploratory Shaft Facility Construction

The Department of Energy's (DOE) recent decision to delay construction of the exploratory shaft facility by 5 months was necessary because of its difficulties in (1) developing and implementing its quality assurance program and (2) then certifying to the Nuclear Regulatory Commission (NRC) that the exploratory shaft facility meets NRC's standards for quality assurance. Among other things, for example, DOE must reevaluate previous exploratory shaft facility design work and apply more rigorous quality assurance standards to future facility design activities. Further delay in starting construction of the facility is possible unless outstanding quality assurance issues are resolved soon and NRC can complete its review of DOE's site characterization plan and related documents on the current tight schedule.

Background

The Nuclear Waste Policy Act (NWPA) of 1982, as amended, charges DOE with disposing of highly radioactive wastes in a repository. DOE must investigate the site at Yucca Mountain, Nevada, to determine if the site is suitable for a repository. The first major step in characterizing the site is to construct an exploratory shaft facility for underground tests and experiments at Yucca Mountain. The facility will consist of two vertical shafts, underground testing rooms and tunnels, and support facilities on the surface. If DOE eventually develops a repository at the site, the facility will be part of the repository.

Before DOE can sink exploratory shafts for underground testing at the site, DOE must develop, implement, and demonstrate to NRC that its quality assurance program for exploratory-shaft-related activities, including the design and construction of the facility, meets regulatory standards. Also, NWPA and NRC regulations require DOE to submit a site characterization plan for NRC's review and comment and then for DOE to consider NRC's comments. The site characterization plan describes the site and DOE's preliminary designs for the repository. The site characterization plan also presents DOE's plans to obtain the geologic and environmental data necessary to determine if the site complies with NRC's repository-licensing regulations for permanent disposal of highly radioactive waste.

NWPA assigned responsibility for licensing and regulating the repository to NRC. Until DOE applies for a license, NRC's formal role in the repository program is limited to observing repository program activities and providing regulatory guidance to DOE. NRC's licensing regulations, however, require consultation between DOE and NRC prior to DOE's application for a license. One method of pre-licensing consultation mentioned in the act is NRC's review and comment on DOE's site characterization plan.

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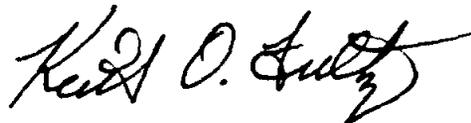
DOE	Department of Energy
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act

We also attended an NRC staff briefing for NRC's Commissioners on the status of DOE's efforts to resolve NRC's concerns. In addition to attending these meetings, we reviewed meeting minutes and other documentation provided at the meetings.

We discussed key facts presented in this report with cognizant NRC and DOE officials and incorporated their comments where appropriate. Our work was performed from October through December 1988.

We are sending copies of this report to the Chairmen of the Senate Committee on Governmental Affairs, the House Committee on Government Operations, and the House Committee on Energy and Commerce; the Secretary of Energy; the Chairman, Nuclear Regulatory Commission; and other committees of the Congress and interested parties.

Appendix II lists principal GAO products on the nuclear waste program that have been issued in the last 2 years. Major contributors to this report are listed in appendix III.



Keith O. Fultz
Director, Energy Issues

With regard to the latter requirement, DOE has begun a public comment period, including a series of public meetings and hearings, running from January 15 through April 15, 1989. It will then prepare a document responding to public comments; however, the act does not require this document.

Until October 1988, DOE intended to complete preconstruction requirements and begin constructing the exploratory shaft facility in June 1989; however, at that time, it postponed construction to November 1989. The remainder of this report addresses DOE's decision to delay construction of the facility by 5 months and presents our observations on the potential for additional delay.

Schedule Delay Needed to Improve Quality Assurance Program

In January 1988, DOE issued a draft site characterization plan describing the Yucca Mountain site and the preliminary design of the exploratory shaft facility. It also described DOE's plans to obtain data to determine if the site complies with NRC's regulations for the permanent disposal of highly radioactive waste. NRC staff reviewed the draft plan and raised several concerns to DOE in May 1988.

Among NRC's major concerns were one specifically addressing the adequacy of DOE's quality assurance program and three pertaining to the preliminary design of the exploratory shaft facility.² Subsequently, NRC concluded that the latter three concerns are also symptomatic of a larger quality assurance problem. Specifically, NRC determined that DOE's design work for the exploratory shaft facility was not conducted under sufficient quality controls to ensure that the design adequately addressed all applicable NRC regulatory requirements. For example, in NRC's view, DOE had not adequately considered the potential adverse effects of locating the two exploratory shafts in areas subject to flooding and erosion.

In October 1988, DOE agreed with NRC's position. Therefore, to demonstrate that its design was adequate, DOE said it would reevaluate whether the design described in its final site characterization plan meets regulatory requirements. The need to reevaluate its completed design work, coupled with the need to develop and implement an adequate quality assurance program for exploratory-shaft-related activities,

²Nuclear Waste: Quarterly Report on DOE's Nuclear Waste Program as of June 30, 1988 (GAO/RCED-88-204BR), and Nuclear Waste: Quarterly Report on DOE's Nuclear Waste Program as of Sept. 30, 1988 (GAO/RCED-89-22FS).

