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NUCLEAR WASTE

Uncertainties About the Yucca Mountain Repository Project

Statement of (Ms.) Gary Jones, Director, Natural Resources and Environment

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Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss the Department of Energy's (DOE) project to develop a nuclear waste repository. As required by law, DOE has been investigating a site at Yucca Mountain, Nevada, to determine its suitability for disposing of highly radioactive wastes in a mined geologic repository. On February 14, 2002, the secretary of energy recommended to the president approval of this site for the development of a nuclear waste repository. The next day, the president recommended approval of the site to the Congress. The president's recommendation began a statutory review process for the approval or disapproval of the site, including action by the state of Nevada, the Congress, DOE, and the Nuclear Regulatory Commission (NRC) within specified time frames. If the site is approved, DOE must apply to NRC for authorization (a license) to construct a repository. If the site is not approved for a license application, or if NRC denies a license to construct a repository, the administration and the Congress will have to consider other options for the long-term management of existing and future nuclear wastes.

Our testimony, which is based on our recent report on the Yucca Mountain Repository Project,[1] addresses (1) DOE's readiness to submit a license application within the statutory time frame, (2) the extent to which DOE can meet its goal of opening a repository at Yucca Mountain in 2010, and (3) the extent to which DOE is managing the project consistent with applicable departmental procedures.

Summary

DOE is not prepared to submit an acceptable license application to NRC within the statutory limits that would take effect if the site is approved. The president's recommendation of the Yucca Mountain site to the Congress triggered specific statutory time frames for the next steps in the repository project. Nevada, which had 60 days from February 15 to disapprove the site, did so on April 8. The Congress now has 90 days (of continuous session) from that date in which to enact legislation overriding the state's disapproval. On May 8, the House of Representatives passed a joint resolution approving the site for a repository. If the Senate also passes this resolution—resulting in final approval of the site—the Nuclear

[1] U.S. General Accounting Office, *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project*, *GAO*-02-191 (*Washington*, D.C.: Dec. 21, 2001).

Waste Policy Act requires DOE to then submit a license application to NRC within 90 days of the effective date of the legislation. Thus, the process gives DOE about 5 to 8 months from the date of the president's recommendation to submit the license application. However, a September 2001 detailed assessment of the repository program by DOE's managing contractor concluded that DOE would not be ready to submit a license application that would be acceptable to NRC until January 2006. DOE did not accept the contractor's proposed new schedule and directed the contractor to develop a proposal to shorten the time to a license application to December 2004, or about 29 months from now. The contractor has now developed such a proposal, which is under review within DOE. Moreover, while a site recommendation and a license application are separate processes, essentially the same data are needed for both. Waiting until DOE was closer to having the additional information needed to support an acceptable license application would have put DOE in a better position to submit the application within the time frames set out in the law, and to respond to questions and challenges that may emanate from the statutory review process subsequent to the president's recommendation.

DOE is unlikely to achieve its goal of opening a repository at Yucca Mountain by 2010. On the basis of DOE's managing contractor's September 2001 reassessment, sufficient time would not be available for DOE to obtain a license from NRC and construct enough of the repository to open it in 2010. Even under the more recent proposal to submit a license application as early as December 2004, it is questionable whether DOE could open the repository in 2010. A key factor in the future licensing and construction of a repository is whether DOE will be able to obtain the increases in annual funding that would be required to open the repository by 2010. Because of the uncertainty of meeting the 2010 goal, DOE is exploring alternative approaches, such as developing surface facilities for storing waste at the site until sufficient underground disposal facilities can be constructed. Had DOE elected to defer a site recommendation until it was closer to having an acceptable license application, it could have ensured that the site recommendation was based on the approach to developing a repository that it intends to follow. This would have enabled DOE to develop an estimated schedule to design and build the preferred approach and to estimate its cost, including the annual funding requirements, as part of the information on which to make a site recommendation.

DOE currently does not have a reliable estimate of when, and at what cost, a license application can be submitted or a repository can be opened

because DOE stopped using its cost and schedule baselines to manage the site investigation in 1997. DOE needs to reestablish a baseline for the repository program that accounts for the outstanding technical work needed to prepare an acceptable license application and the estimated schedule and cost to achieve this milestone. In conjunction, DOE needs to use the baseline as a tool for managing the program, in accordance with the department's policies and procedures for managing major projects. Therefore, our December 2001 report recommended that the secretary of energy reestablish the baseline through the submission of a license application and follow the department's management requirements, including a formal procedure for changing program milestones. According to DOE, it is currently in the process of establishing a new baseline for the nuclear waste program.

Background

Recognizing the critical need to address the issue of nuclear waste disposal, the Congress enacted the Nuclear Waste Policy Act of 1982 to establish a comprehensive policy and program for the safe, permanent disposal of commercial spent fuel and other highly radioactive wastes in one or more mined geologic repositories. The act created the Office of Civilian Radioactive Waste Management within DOE to manage its nuclear waste program. Amendments to the act in 1987 directed DOE to investigate only the Yucca Mountain site.

The Nuclear Waste Policy Act also set out important and complementary roles for other federal agencies:

- The Environmental Protection Agency (EPA) was required to establish health and safety standards for the disposal of wastes in repositories. EPA issued standards for the Yucca Mountain site in June 2001 that require a high probability of safety for at least 10,000 years.[2]
- NRC is responsible for licensing and regulating repositories to ensure their compliance with EPA's standards. One prerequisite to the secretary's recommendation was obtaining NRC's preliminary comments on the sufficiency of DOE's site investigation for the purpose of a license application. NRC provided these comments on November 13, 2001. If the site is approved, then NRC, upon accepting a license application from

[2] The Energy Policy Act of 1992 required EPA to establish specific health and safety standards for a repository at Yucca Mountain.

DOE, has 3 to 4 years to review the application and decide whether to issue a license to construct, and then to operate, a repository at the site.[3]

- The Nuclear Waste Technical Review Board (the board) reviews the technical and scientific validity of DOE's activities associated with investigating the site and packaging and transporting wastes. The board must report its findings and recommendations to the Congress and the secretary of energy at least twice each year, but DOE is not required to implement these recommendations.

DOE has designated the nuclear waste program, including the site investigation, as a "major" program that is subject to senior management's attention and to its agencywide guidelines for managing such programs and projects. The guidelines require the development of a cost and schedule baseline, a system for managing changes to the baseline, and independent cost and schedule reviews. DOE is using a management contractor to carry out the work on the program. The contractor develops and maintains the baseline, but senior DOE managers must approve significant changes to cost or schedule estimates. In February 2001, DOE hired Bechtel SAIC Company, LLC (Bechtel), to manage the program and required the contractor to reassess the remaining technical work and the estimated schedule and cost to complete this work.

DOE Will Not Be Ready to Submit a License Application within the Statutory Time Frame

DOE is not prepared to submit an acceptable license application to NRC within the statutory limits that would take effect if the site were approved. Specifically, DOE has entered into 293 agreements with NRC to gather and/or analyze additional technical information in preparation for a license application that NRC would accept. DOE is also continuing to address technical issues raised by the board. In September 2001, Bechtel concluded, after reassessing the remaining technical work, that DOE would not be ready to submit an acceptable license application to NRC until January 2006. DOE did not accept the 2006 date. Instead, it directed the contractor to prepare a new plan for submitting a license application to NRC by December 2004. DOE's current plan is that, by the end of September 2002, Bechtel will develop, and DOE will review and approve, a new technical, cost, and schedule baseline for submitting a license application to NRC in December 2004.

[3] The acceptance of a license application is not the same as approving an application. A decision to approve or disapprove any application would be made by NRC following extensive review and testing.

Moreover, while a site recommendation and a license application are separate processes, DOE will need to use essentially the same data for both.[4] Also, the act states that the president's recommendation to the Congress is that he considers the site qualified for an application to NRC for a license. The president's recommendation also triggers an express statutory time frame that requires DOE to submit a license application to NRC within about 5 to 8 months.

DOE Lacks Information for a License Application

The 293 agreements that DOE and NRC have negotiated address areas of study within the program where NRC's staff has determined that DOE needs to collect more scientific data and/or improve its technical assessment of the data. According to NRC, as of March 2002, DOE had satisfactorily completed work on 38 of these agreements and could resolve another 22 agreements by September 30 of this year. These 293 agreements generally relate to uncertainties about three aspects of the long-term performance of the proposed repository: (1) the expected lifetime of engineered barriers, particularly the waste containers; (2) the physical properties of the Yucca Mountain site; and (3) the supporting information for the mathematical models used to evaluate the performance of the planned repository at the site.

The uncertainties related to engineered barriers revolve around the longevity of the waste containers that would be used to isolate the wastes. DOE currently expects that these containers would isolate the wastes from the environment for more than 10,000 years. Minimizing uncertainties about the container materials and the predicted performance of the waste containers over this long time period is especially critical because DOE's estimates of the repository system's performance depend heavily on the waste containers, in addition to the natural features of the site, to meet NRC's licensing regulations and EPA's health and safety standards.

The uncertainties related to the physical characteristics of the site center on how the combination of heat, water, and chemical processes caused by the presence of nuclear waste in the repository would affect the flow of water through the repository.

[4] See *General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories; Yucca Mountain Site Suitability Guidelines* (preamble), 66 *Fed. Reg.* 57298, 57322 (Nov. 14, 2001).

The NRC staff's concerns about DOE's mathematical models for assessing the performance of the repository primarily relate to validating the models; that is, presenting information to provide confidence that the models are valid for their intended use and verifying the information used in the models. Performance assessment is an analytical method that relies on computers to operate mathematical models to assess the performance of the repository against EPA's health and safety standards, NRC's licensing regulations, and DOE's guidelines for determining if the Yucca Mountain site is suitable for a repository. DOE uses the data collected during site characterization activities to model how a repository's natural and engineered features would perform at the site.

According to DOE, the additional technical work surrounding the 293 agreements with NRC's staff is an insignificant addition to the extensive amount of technical work already completed—including some 600 papers cited in one of its recently published reports and a substantial body of published analytic literature. DOE does not expect the results of the additional work to change its current performance assessment of a repository at Yucca Mountain.

From NRC's perspective, however, the agreements provided the basis for it to give DOE its preliminary comments on the sufficiency of DOE's investigation of the Yucca Mountain site for inclusion in a future license application. In a November 13, 2001, letter to the under secretary of energy, the Chairman of the NRC commented that

> "[a]lthough significant additional work is needed prior to the submission of a possible license application, we believe that agreements reached between DOE and NRC staff regarding the collection of additional information provide the basis for concluding that development of an acceptable license application is achievable."

The board has also consistently raised issues and concerns over DOE's understanding of the expected lifetime of the waste containers, the significance of the uncertainties involved in the modeling of the scientific data, and the need for an evaluation and comparison of a repository design having a higher temperature with a design having a lower temperature. The board continues to reiterate these concerns in its reports. For example, in its most recent report to the Congress and the secretary of energy, issued on January 24, 2002, the board concluded that, when DOE's technical and scientific work is taken as a whole, the technical basis for DOE's repository performance estimates is "weak to moderate" at this time. The board added that gaps in data and basic understanding cause important uncertainties in the concepts and assumptions on which DOE's

performance estimates are now based; providing the board with limited confidence in current performance estimates generated by DOE performance assessment model.

As recently as May 2001, DOE projected that it could submit a license application to NRC in 2003. It now appears, however, that DOE may not complete all of the additional technical work that it has agreed to do to prepare an acceptable license application until January 2006. In September 2001, Bechtel completed, at DOE's direction, a detailed reassessment in an effort to reestablish a cost and schedule baseline. Bechtel estimated that DOE could complete the outstanding technical work agreed to with NRC and submit a license application in January 2006. This date, according to the contractor, was due to the cumulative effect of funding reductions in recent years that had produced a "…growing bow wave of incomplete work that is being pushed into the future." Moreover, the contractor's report said, the proposed schedule did not include any cost and schedule contingencies. The contractor's estimate was based on guidance from DOE that, in part, directed the contractor to assume annual funding for the nuclear waste program of $410 million in fiscal year 2002, $455 million in fiscal year 2003, and $465 million in fiscal year 2004 and thereafter.[5] DOE did not accept this estimate because, according to program officials, the estimate would extend the date for submitting a license application too far into the future. Instead, DOE accepted only the fiscal year 2002 portion of Bechtel's detailed work plan and directed the contractor to prepare a new plan for submitting a license application to NRC by December 2004. Bechtel has prepared such a plan and the plan is under review by DOE. Although we have not reviewed the entire plan, we note that the plan (1) assumes that the program receives the $525 million in funds requested by the Administration for fiscal year 2003, which would be more than $100 million above the funds provided for fiscal year 2002, and (2) work on 10 of the department's 293 agreements with NRC would not be complete by the target license application date of December 2004.

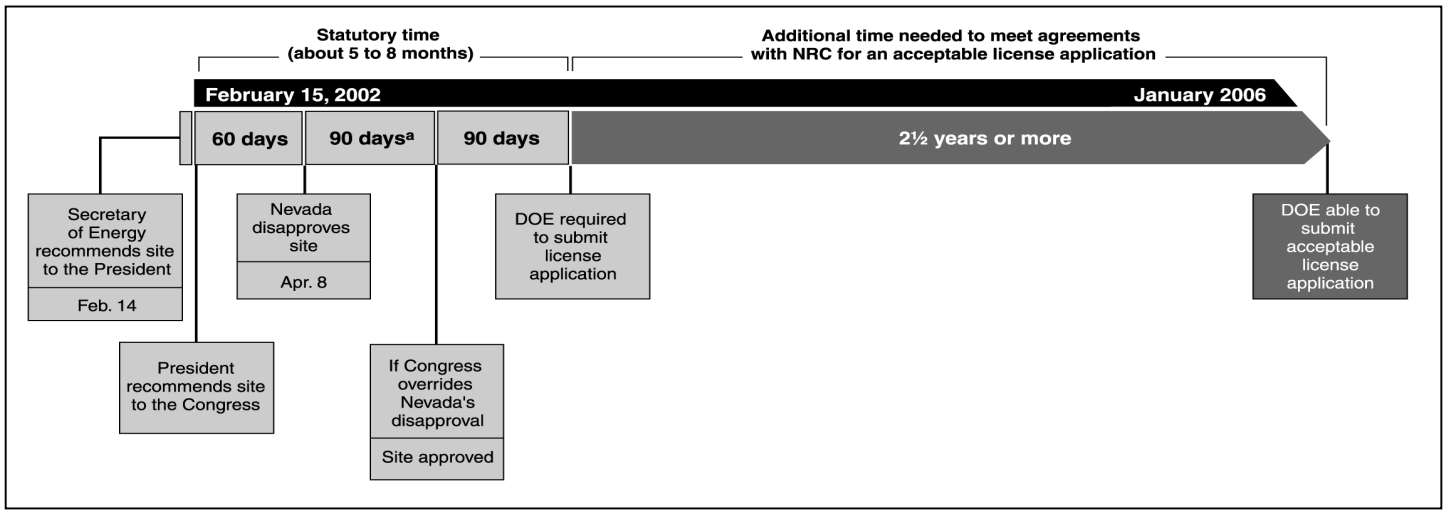
[5] DOE's budget request for fiscal year 2003 is about $527 million, or $72 million more than assumed in Bechtel's reassessment. The preliminary amounts for fiscal years 2004 and 2005 are $538 million and $550 million, respectively.

Essentially the Same Information Is Needed for a Site Recommendation and a License Application

Under the Nuclear Waste Policy Act, DOE's site characterization activities are to provide information necessary to evaluate the Yucca Mountain site's suitability for submitting a license application to NRC for placing a repository at the site. In implementing the act, DOE's guidelines provide that the site will be suitable as a waste repository if the site is likely to meet the radiation protection standards that NRC would use to reach a licensing decision on the proposed repository. Thus, as stated in the preamble (introduction) to DOE's guidelines, DOE expects to use essentially the same data for the site recommendation and the license application.

In addition, the act specifies that, having received a site recommendation from the secretary, the president shall submit a recommendation of the site to the Congress if the president considers the site qualified for a license application. Under the process laid out in the Nuclear Waste Policy Act, once the secretary makes a site recommendation, there is no time limit under which the president must act on the secretary's recommendation. However, when the president recommended, on February 15, that the Congress approve the site, specific statutory time frames were triggered for the next steps in the process. Figure 1 shows the approximate statutory time needed between a site recommendation and submission of a license application and the additional time needed for DOE to meet the conditions for an acceptable license application. The figure assumes that the Congress overrides the state's disapproval of April 8, 2002. As shown in the figure, Nevada had 60 days—until April 16—to disapprove the site. The Congress now has 90 days (of continuous session) from that date in which to enact legislation overriding the state's disapproval. If the Congress overrides the state's disapproval and the site designation takes effect, the next step is for the secretary to submit a license application to NRC within 90 days after the site designation is effective. In total, these statutory time frames provide about 150 to 240 days, or about 5 to 8 months, from the time the president makes a recommendation to DOE's submittal of a license application. On the basis of Bechtel's September 2001 and current program reassessments, however, DOE would not be ready to submit a license application to NRC until January 2006 or December 2004, respectively.

Figure 1: Comparison of Statutory Site Approval Process with DOE's Projected Schedule



[a]Ninety calendar days of continuous session of the Congress.

DOE Is Unlikely to Open a Repository in 2010 As Planned

DOE states that it may be able to open a repository at Yucca Mountain in 2010. The department has based this expectation on submitting an acceptable license application to NRC in 2003, receiving NRC's authorization to construct a repository in 2006, and constructing essential surface and underground facilities by 2010. However, Bechtel, in its September 2001 proposal for reestablishing technical, schedule, and cost baselines for the program, concluded that January 2006 is a more realistic date for submitting a license application. Because DOE objected to this proposed schedule, the contractor has now proposed a plan for submitting the application in December 2004. Because of uncertainty over when DOE may be able to open the repository, the department is exploring alternatives that might still permit it to begin accepting commercial spent fuel in 2010.

Extension of License Application Date Will Likely Postpone 2010 Repository Goal

An extension of the license application date to December 2004 or January 2006 would likely preclude DOE from achieving its long-standing goal of opening a repository in 2010. According to DOE's May 2001 report on the program's estimated cost, after submitting a license application in 2003, DOE estimates that it could receive an authorization to construct the repository in 2006 and complete the construction of enough surface and underground facilities to open the repository in 2010, or 7 years after submitting the license application. This 7-year estimate from submittal of the license application to the initial construction and operation of the

repository assumes that NRC would grant an authorization to construct the facility in 3 years, followed by 4 years of construction. Assuming these same estimates of time, submitting a license application in the December 2004 to January 2006 time frame would extend the opening date for the repository until 2012 or 2013.

Furthermore, opening the repository in 2012 or 2013 may be questionable for several reasons. First, a repository at Yucca Mountain would be a first-of-a-kind facility, meaning that any schedule projections may be optimistic. DOE has deferred its original target date for opening a repository from 1998 to 2003 to 2010. Second, although the Nuclear Waste Policy Act states that NRC has 3 years to decide on a construction license, a fourth year may be added if NRC certifies that it is necessary. Third, the 4-year construction time period that DOE's current schedule allows may be too short. For example, a contractor hired by DOE to independently review the estimated costs and schedule for the nuclear waste program reported that the 4-year construction period was too optimistic and recommended that the construction phase be extended by a year-and-a-half.[6] Bechtel anticipates a 5-year period of construction between the receipt of a construction authorization from NRC and the opening of the repository. A 4-year licensing period followed by 5 years of initial construction could extend the repository opening until about 2014 or 2015.

Finally, these simple projections do not account for any other factors that could adversely affect this 7- to 9-year schedule for licensing, constructing, and opening the repository. Annual appropriations for the program in recent years have been less than $400 million. In contrast, according to DOE, it needs between $750 million and $1.5 billion in annual appropriations during most of the 7- to 9-year licensing and construction period in order to open the repository on that schedule. In its August 2001 report on alternative means for financing and managing the program, DOE stated that unless the program's funding is increased, the budget might become the "determining factor" whether DOE will be able to accept wastes in 2010.[7]

[6] U.S. Department of Energy, *Independent Cost Estimate Review of the Civilian Radioactive Waste Management Program, 2001 Total System Life Cycle Cost (Washington, D.C.:* Jan. 2001).

[7] U.S. Department of Energy, *Alternative Means of Financing and Managing the Civilian Radioactive Waste Management Program*, DOE/RW-0546 (Washington, D.C.: Aug. 2001).

In part, DOE's desire to meet the 2010 goal is linked to the court decisions that DOE—under the Nuclear Waste Policy Act and as implemented by DOE's contracts with owners of commercial spent fuel—is obligated to begin accepting spent fuel from contract holders not later than January 31, 1998, or be held liable for damages. Courts are currently assessing the amount of damages that DOE must pay to holders of spent fuel disposal contracts. Estimates of potential damages for the estimated 12-year delay from 1998 to 2010 range widely from the department's estimate of about $2 billion to $3 billion to the nuclear industry's estimate of at least $50 billion. The damage estimates are based, in part, on the expectation that DOE would begin accepting spent fuel from contract holders in 2010. The actual damages could be higher or lower, depending on when DOE begins accepting spent fuel.

DOE Is Reviewing Alternative Ways to Accept Wastes in 2010

Because of the uncertainty of achieving the 2010 goal for opening the Yucca Mountain repository, DOE is examining alternative approaches that would permit it to meet the goal. For example, in a May 2001 report, DOE examined approaches that might permit it to begin accepting wastes at the repository site in 2010 while spreading out the construction of repository facilities over a longer time period. The report recommended storing wastes on the surface until the capacity to move wastes into the repository has been increased. Relatively modest-sized initial surface facilities to handle wastes could be expanded later to handle larger volumes of waste. Such an approach, according to the report, would permit partial construction and limited waste emplacement in the repository, at lower than earlier estimated annual costs, in advance of the more costly construction of the facility as originally planned. Also, by implementing a modular approach, DOE would be capable of accepting wastes at the repository earlier than if it constructed the repository described in the documents that the secretary used to support a site recommendation.

DOE has also contracted with the National Research Council to provide recommendations on design and operating strategies for developing a geologic repository in stages, which is to include reviewing DOE's modular approach. The council is addressing such issues as the (1) technical, policy, and societal objectives and risks for developing a staged repository; (2) effects of developing a staged repository on the safety and security of the facility and the effects on the cost and public acceptance of such a facility; and (3) strategies for developing a staged system, including the design, construction, operation, and closing of such a facility. In March 2002, the council published an interim report on the study in which it addresses a conceptual framework for a generic repository program. The

Council plans to issue a final report this fall, in which it intends to provide specific suggestions for incorporating additional elements of staged repository development into DOE's repository program.

DOE's Current License Application Milestone Date Is Not Supported by the Program's Baseline

As of December 2001, DOE expected to submit the application to NRC in 2003.[8] This date reflects a delay in the license application milestone date last approved by DOE in March 1997 that targeted March 2002 for submitting a license application. The 2003 date was not formally approved by DOE's senior managers or incorporated into the program's cost and schedule baseline, as required by the management procedures that were in effect for the program. At least three extensions for the license application date have been proposed and used by DOE in program documents, but none of these proposals have been approved as required. As a result, DOE does not have a baseline estimate of the program's schedule and cost—including the late 2004 date in its fiscal year 2003 budget request—that is based on all the work that it expects to complete through the submission of a license application.

DOE's guidance for managing major programs and projects requires, among other things, that senior managers establish a baseline for managing the program or project. The baseline describes the program's mission—in this case, the safe disposal of highly radioactive waste in a geologic repository—and the expected technical requirements, schedule, and cost to complete the program. Procedures for controlling changes to an approved baseline are designed to ensure that program managers consider the expected effects of adding, deleting, or modifying technical work, as well as the effects of unanticipated events, such as funding shortfalls, on the project's mission and baseline. In this way, alternative courses of action can be assessed on the basis of each action's potential effect on the baseline. DOE's procedures for managing the nuclear waste program require that program managers revise the baseline, as appropriate, to reflect any significant changes to the program.

After March 1997, according to DOE officials, they did not always follow these control procedures to account for proposed changes to the program's baseline, including the changes proposed to extend the date for license application. According to these same officials, they stopped

[8] DOE's 2003 budget request states that DOE now expects to submit the license application between October and December 2004.

following the control procedures because the secretary of energy did not approve proposed extensions to the license application milestone. As a result, the official baseline did not accurately reflect the program's cost and schedule to complete the remaining work necessary to submit a license application.

In November 1999, the Yucca Mountain site investigation office proposed extending the license application milestone date by 10 months, from March to December 2002, to compensate for a $57.8 million drop in funding for fiscal year 2000. A proposed extension in the license application milestone required the approval of both the director of the nuclear waste program and the secretary of energy. Neither of these officials approved this proposed change nor was the baseline revised to reflect this change even though the director subsequently began reporting the December 2002 date in quarterly performance reports to the deputy secretary of energy. The site investigation office subsequently proposed two other extensions of the license application milestone, neither of which was approved by the program's director or the secretary of energy or incorporated into the baseline for the program. Nevertheless, DOE began to use the proposed, but unapproved, milestone dates in both internal and external reports and communications, such as in congressional testimony delivered in May 2001.

Because senior managers did not approve these proposed changes for incorporation into the baseline for the program, program managers did not adjust the program's cost and schedule baseline. By not accounting for these and other changes to the program's technical work, milestone dates, and estimated costs in the program's baseline since March 1997, DOE has not had baseline estimates of all of the technical work that it expected to complete through submission of a license application and the estimated schedule and cost to complete this work. This condition includes the cost and schedule information contained in DOE's budget request for fiscal year 2003.

When DOE hired Bechtel to manage the nuclear waste program, one of the contractor's first assignments was to document the remaining technical work that had to be completed to support the submission of a license application to NRC and to estimate the time and cost to complete this work. The contractor's revised, unofficial baseline for the program shows that it will take until January 2006 to complete essential technical work and submit an acceptable license application. Also, DOE had estimated that completing the remaining technical work would add about $1.4 billion to the cumulative cost of the program, bringing the total cost of the Yucca

Mountain project's portion of the nuclear waste program to $5.5 billion.[9] As noted earlier, DOE accepted only the fiscal year 2002 portion of the proposed baseline and then directed the contractor to prepare a plan for submitting a license application to NRC by December 2004. The resulting plan is now under review within DOE.

Because of these management weaknesses, we recommended in our December 2001 report that the secretary of energy reestablish the baseline through the submission of a license application and follow the department's management requirements, including a formal procedure for changing program milestones. According to DOE, it is currently in the process of establishing a new baseline for the nuclear waste program.

Mr. Chairman, this concludes our prepared statement. We would be happy to respond to any questions that you or members of the subcommittee may have.

Contacts and Acknowledgments

For further information about this testimony, please contact me at (202) 512-3841. Dwayne Weigel, Daniel Feehan, Doreen Feldman, Susan Irwin, and Robert Sanchez also made key contributions to this statement.

[9] DOE estimated that the program cost $4.1 billion, on the basis of year-of-expenditure dollars from the program's inception in 1983 through March 2002. The $5.5 billion estimate for the license application is based on year-of-expenditure dollars from 1983 through January 2006.