**UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

STATE OF WASHINGTON, Petitioner, v. UNITED STATES DEPARTMENT OF ENERGY, DR. STEVEN CHU, Secretary of the U.S. Department of Energy, NUCLEAR REGULATORY COMMISSION, Respondents.	NO. 10-1082 STATE OF WASHINGTON'S PETITION FOR REVIEW AND FOR DECLARATORY AND INJUNCTIVE RELIEF

I. INTRODUCTION

1. This is a civil action arising from the decision of the Respondents, United States Department of Energy (DOE) and its Secretary, Dr. Steven Chu (hereafter collectively referred to as DOE), to irrevocably terminate development of a permanent repository for high-level radioactive waste and spent nuclear fuel at Yucca Mountain, Nevada (the Yucca Mountain project) in favor of an unknown and yet-to-be-identified alternative. As part of this decision, DOE on March 3, 2010, moved to withdraw with prejudice its application to the Respondent Nuclear Regulatory Commission (NRC) for a license to begin construction of the Yucca Mountain repository.

2. The State of Washington requests a judgment declaring that DOE's decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative, including its motion to withdraw with prejudice the license application, violates the Nuclear Waste Policy Act (NWPA), 42 U.S.C. §§ 10101-10270. Specifically, DOE lacks authority under the NWPA to unilaterally terminate the Yucca Mountain project where, as here, it has concluded its investigation into the suitability of the site and recommended it as suitable for a permanent repository, Congress has designated Yucca Mountain as such under the NWPA, and DOE has submitted to the NRC an application for a license to begin construction of the Yucca Mountain repository.

3. The State of Washington requests a judgment declaring that DOE's decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative violates the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321-4370(f), its implementing regulations applicable to all agencies including DOE, 40 C.F.R. Parts 1500-1508, and the DOE's implementing procedures, 10 C.F.R. Part 1021. Specifically, DOE's actions to forever foreclose consideration of the Yucca Mountain site in favor of an unknown and yet-to-be identified alternative has occurred without DOE completing a final environmental impact statement required by NEPA in order to assess the environmental consequences of such an action, including but not limited

to impacts on the human population and environment of the State of Washington. This failure to comply with NEPA's requirements is arbitrary and capricious and not in accordance with the law in violation of the Administrative Procedure Act (APA), 5 U.S.C. §§ 701-706.

4. The State of Washington requests a judgment declaring that DOE's decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative violates the APA, 5 U.S.C. §§ 701-706. Specifically, DOE's actions, which are intended to permanently end any consideration of the Yucca Mountain site in favor of an unknown and yet-to-be identified alternative, have been made without reference to any rationale or administrative record and is therefore arbitrary and capricious and not in accordance with the law.

5. The State of Washington requests a judgment declaring that the NRC is without authority to consider DOE's motion to withdraw its Yucca Mountain license application or to grant that motion.

6. Based upon the aforementioned statutory violations, both individually and collectively, the State of Washington requests an order permanently enjoining DOE from implementing its decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative, including withdrawing in any fashion its license application

for the purpose of precluding any future consideration of Yucca Mountain as a deep geologic repository for high-level radioactive waste and spent nuclear fuel.

7. Based upon the aforementioned statutory violations, both individually and collectively, the State of Washington requests an order requiring DOE to continue to undertake its obligations with respect to the Yucca Mountain project, as defined by the NWPA and funded by Congress.

8. Based upon the aforementioned statutory violations, both individually and collectively, the State of Washington requests all other relief deemed necessary and proper by the Court.

II. JURISDICTION

9. This Court has original and exclusive jurisdiction of the State of Washington's petition for review and the claims herein pursuant to the NWPA, 42 U.S.C. § 10139(a)(1)(A), (B), (D).

10. This Court also has jurisdiction of the State of Washington's claims for a declaratory judgment pursuant to the Declaratory Judgment Act, 28 U.S.C. § 2201(a).

11. This Court also has jurisdiction of the State of Washington's NEPA-related and APA claims pursuant to the judicial review provision of the APA, 5 U.S.C. §§ 701-706.

III. VENUE

12. Venue is proper in this Court pursuant to 42 U.S.C. § 10139(a)(2) and 5 U.S.C. § 703.

IV. PARTIES AND STANDING

13. Respondent United States Department of Energy (DOE) is an executive department of the United States, created pursuant to 42 U.S.C. § 7131. DOE is responsible under the NWPA for: (a) conducting research and testing at the Yucca Mountain site to determine its suitability to serve as a permanent repository for high-level radioactive waste and spent nuclear fuel; (b) recommending to the President whether the Yucca Mountain site is suitable to serve as a repository; and (c) submitting to the NRC an application for a license to construct the aforementioned repository, if the President forwards to Congress the that recommendation that Yucca Mountain be approved as the site of a permanent repository, and that approval takes effect. 42 U.S.C. §§ 10133, 10134(a)-(b).

14. Respondent Dr. Steven Chu is the Secretary of DOE and is the chief administrative officer of DOE. Secretary Chu is the official ultimately responsible for DOE's compliance with the terms of the NWPA, NEPA, and the APA.

15. Respondent Nuclear Regulatory Commission (NRC) is the independent agency assigned the task of considering DOE's license application to

construct a high-level radioactive waste and spent nuclear fuel repository at Yucca Mountain. 42 U.S.C. § 10134(b), (d).

16. Petitioner is the State of Washington, which has standing to bring this action. DOE's decision to irrevocably terminate the Yucca Mountain project in favor of a yet-to-be identified alternative will cause the State of Washington and its citizens injury-in-fact. It is likely this harm can be averted if this Court grants the relief requested by the Petitioner.

17. Specifically, and as described in greater detail in paragraphs 27-46, below, massive amounts of high-level radioactive waste and spent nuclear fuel are currently stored at the Hanford Nuclear Reservation (Hanford), a federal property managed by DOE and located near Richland, Washington. Approximately one million gallons of high-level waste has already leaked into Washington's air, soil and water, and this leakage is expected to continue.

18. DOE is responsible for cleaning up the Hanford waste. Pursuant to a binding legal agreement, DOE has committed to meeting its obligations by designing and building a $12.3 billion waste treatment plant at Hanford to recover and process the waste for permanent disposal. The plant has been designed and is being built to meet the specific requirements of the Yucca Mountain site.

19. Respondents' decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative threatens to

harm the State of Washington's compelling and tangible interest in protecting the health, safety and welfare of its citizens. The summary termination of the Yucca Mountain project will send a ripple effect through Hanford's tank waste retrieval and treatment mission. The mission of retrieving high-level radioactive waste from Hanford's aging and leak-prone underground storage tanks is directly tied to the above-referenced waste treatment plant, which itself is directly tied to the Yucca Mountain project. Any delay or interruption of the waste treatment plant (now or in the future) in proximate relation to termination of the Yucca Mountain project, such as a redesign and rebuild to produce a waste form acceptable at a different repository, may delay even further the projected thirty-year project of retrieving untreated waste from Hanford's aging, unfit-for-use single shell tanks. More than one-third of these tanks are already known or suspected to have leaked high-level waste to Hanford's soils and groundwater.

20. Further, any delay in siting a new repository as a result of the termination of the Yucca Mountain project until such time as any new repository site is identified, investigated, approved and constructed—if ever—will require extending the storage of tank waste and other materials at Hanford, with its attendant risks to human health and the environment.

21. All of the aforementioned interests of the State of Washington are within the zone of interests Congress intended to be protected by the NWPA,

NEPA, and the Atomic Energy Act. *See, e.g.,* 42 U.S.C. § 10131(a)(2), (a)(6); 42 U.S.C. § 4331; 42 U.S.C. § 2239.

22. The negative impact on the State's interests will be redressed if this Court issues a favorable decision on the claims made in the State's petition and grants the State the relief it has requested. This relief will ensure that the Yucca Mountain siting process, which has been ongoing for over 20 years, will not be irrevocably terminated in favor of an unknown and yet-to-be identified alternative absent a change to the NWPA by Congress or an unfavorable decision by the NRC on the merits of DOE's license application for the Yucca Mountain site.

V. FACTS

<u>The Hanford Site</u>:

23. DOE's Hanford Site covers 586 square miles in south-central Washington.

24. The Columbia River flows through or is contiguous to the Hanford Site before flowing through the "Tri-Cities" of Richland, Kennewick, and Pasco, Washington. The Tri-Cities are home to approximately 170,000 persons (2007 official estimate).

25. The Columbia River is a water source for municipal, agricultural, and industrial uses in south-central Washington, as well as downstream in Washington

and Oregon. The Columbia River supports aquatic life and related biota, including salmon that migrate and breed within and near the Hanford Site.

26. The Hanford Site itself is significant to the State and its citizens. Large portions of the Hanford Site were designated as the Hanford Reach National Monument in 2000. The National Monument and other portions of the Hanford Site contain some of the only intact tracts of shrub-steppe habitat in Washington, which support a unique variety of plants and wildlife. The Hanford Site, including plants and wildlife within the Hanford Site, is significant to Native American tribes including the Confederated Tribes and Bands of the Yakama Nation, the Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce Tribe.

Hanford's Tank Waste:

27. From the mid-1940s to the late 1980s, the United States produced plutonium at the Hanford Site for use in nuclear weapons. Affidavit of Suzanne Dahl-Crumpler, attached hereto as Exhibit 1, ¶ 10. Plutonium production and other activities at Hanford created enormous amounts of radioactive, hazardous, and mixed wastes, much of which remains at the site, still awaiting cleanup and/or proper disposal.

28. There are over 1,500 identified contaminated sites and structures at Hanford, which individually and collectively pose substantial risks to human health and the environment. These include 177 underground storage tanks holding

approximately 53 million gallons of mixed high-level radioactive and hazardous waste. *Id.* ¶¶ 11, 17. This volume constitutes nearly two-thirds of the nation's defense related high-level waste. *Id.* ¶¶ 16, 41

29. The Hanford tank waste was generated beginning in the 1940s from the reprocessing of spent fuel rods to extract weapons-grade plutonium. *Id.* ¶ 10, 11. All of this waste is "mixed," containing a mixture of hazardous waste and radioactive material. *Id.* ¶¶ 13, 14. The hazardous waste component of tank waste is regulated under the federal Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901-6992(k), and Washington's Hazardous Waste Management Act (HWMA), chapter 70.105 Revised Code of Washington.

30. Hanford's tank waste includes at least 26 hazardous waste constituents, including heavy metals and volatile organic compounds. *Id.* ¶ 14. All of these constituents are potentially harmful to human health and the environment. *Id.* In addition, the tank waste contains at least 46 identified radionuclides. *Id.* ¶ 13. These radionuclides are also potentially harmful to human health and the environment. *Id.* Once released, some of these radionuclides will persist in the environment for hundreds of thousands of years. *Id.*

31. Over 80 percent of Hanford's 177 underground storage tanks are single-shell tanks (SSTs) that do not comply with RCRA and HWMA standards

for hazardous waste tanks. *Id.* ¶¶ 19, 20. These 149 SSTs currently hold approximately 30 million gallons of toxic waste. *Id.* ¶ 19.

32. All 149 SSTs have been identified by DOE as "unfit for use" pursuant to 40 C.F.R. § 265.191 (incorporated by reference in WAC 173-303-400(3)). *Id.* ¶ 20.

33. At least 67 of the SSTs have leaked an estimated one million or more gallons of waste to the environment. *Id.* ¶ 22. This leaked waste is mobile and has contaminated the soils surrounding the tanks. *Id.* ¶ 23. Some of the leaked tank waste has reached Hanford's groundwater. *Id.* This groundwater is hydraulically connected to the Columbia River. *Id.*

34. Unless affirmative steps are taken to timely remove the waste from the SSTs, further leakage of tank waste to the environment will occur. *Id.* ¶¶ 22, 24; *see also*, ¶¶ 28, 30, 44. Once leaked, tank waste will continue to migrate into Hanford's groundwater and toward the Columbia River.

35. Hanford lacks sufficient regulatory compliant (double-shelled) tank capacity to allow for the retrieval and transfer of all but a limited volume of the waste currently stored in the SSTs. *Id.* ¶ 29. To date, DOE's strategy for addressing this situation has by and large been to rely on the prospective treatment capacity of a future Waste Treatment Plant (WTP) to process tank waste and

create the "throughput" necessary to retrieve and transfer SST tank waste into compliant storage. *Id.* ¶¶ 29, 30.

Hanford Tank Waste Treatment:

36. There is currently no treatment capacity for tank waste at Hanford. *Id.* ¶ 15. The tank waste is instead being stored in violation of the prohibition on storing land disposal restricted waste under the HWMA and RCRA. WAC 173-303-140(2)(a) (incorporating by reference 40 C.F.R. § 268.50).

37. To address Hanford's multiple environmental compliance issues, in 1989 the Washington State Department of Ecology (Ecology), the federal Environmental Protection Agency (EPA), and Respondent DOE entered into the Hanford Federal Facility Agreement and Consent Order (hereafter, the Tri-Party Agreement). *Id.* ¶ 25. The Tri-Party Agreement establishes numerous milestones (schedules and associated regulatory requirements) for cleanup of the Hanford Site and for bringing Hanford facilities into compliance with applicable requirements. *Id.*

38. The milestones included in the Tri-Party Agreement include: (a) The retrieval of all high-level waste from the SSTs by a defined end date (currently 2018); (b) The design and construction of a Waste Treatment Plant; and (c) Complete treatment of all retrieved waste by a defined end date (currently 2028). *Id.* ¶ 26.

39. The Waste Treatment Plant is central to the federal government's efforts to comply with its obligation to clean up the Hanford site. *Id.* ¶ 30. The design process is 78 percent completed and construction of the Plant is almost 50 percent complete. *Id.* ¶ 44. The Plant is projected to begin treating waste in 2019 and to become fully operational by 2022. *See Id.* ¶ 27. The scope of this effort and the enormous amounts of waste at Hanford that need to be retrieved and treated are reflected in the $12.3 billion cost to design and construct the Waste Treatment Plant. *Id.* ¶ 31.

40. The waste treatment process is designed to split tank waste into two streams: a concentrated "high level waste" (HLW) fraction and a remaining "low activity waste" (LAW) fraction. *Id.* ¶ 33. Both waste streams will then be "vitrified" (immobilized in a solid glass matrix) and placed into steel canisters to provide additional containment and shielding. *Id.* ¶¶ 34, 35.

41. The vitrified HLW fraction will constitute only approximately 10 percent of the total waste volume, but will contain approximately 90 percent of the total waste radioactivity. *Id.* ¶ 38. Despite constituting only 10 percent of the total waste volume, it is still estimated that the treated HLW volume from Hanford's tanks will exceed 7,200 metric tons.

42. Following vitrification, HLW canisters will be held in a specialized storage building at Hanford while awaiting offsite disposal. *Id.* ¶ 45. Pursuant to

a 1996 Record of Decision, DOE has determined that Hanford's vitrified HLW will be disposed of offsite in a national geologic repository to permanently isolate the wastes from humans and the environment to the greatest extent practicable and provide for protection of public health and the environment. *Id.* ¶ 40. DOE's subsequent planning documents include Hanford's vitrified HLW among the volume of waste to be disposed of at the Yucca Mountain repository. *Id.* ¶ 41.

43. Based on this, the Waste Treatment Plant at Hanford is being designed and constructed in order to ensure the treated waste complies with the waste acceptance standards specific to Yucca Mountain, as promulgated by the NRC under 10 C.F.R. Part 63. *Id.* ¶¶ 42, 43. These standards include such matters as canister size and weight, radionuclide content and thermal output limits. *Id.* ¶ 43.

44. If the Yucca Mountain siting process is terminated or significantly delayed, major regulatory, administrative and technical issues will have to be revisited at Hanford, especially as regards the design and parameters of the Waste Treatment Plant. *Id.* ¶ 44. This could require changes necessary to meet another repository's acceptance criteria or to accommodate the fact that the treated waste will necessarily need to be stored at Hanford until such time as another repository site is investigated, approved by DOE, the President and Congress, and licensed by NRC. *Id.* ¶¶ 44, 45. These changes could be as extreme as a construction tear-

down and rebuild of the Waste Treatment Plant. *Id.* ¶ 44. Such changes would add significantly to the over $12 billion price tag of the Waste Treatment Plant.

45. Because of the interdependence between the Waste Treatment Plant and tank retrievals, any delay or adjustment in construction of the Waste Treatment Plant to accommodate a new repository site will have a ripple effect, delaying the retrieval of untreated waste from the SSTs. *Id.* at 28, 29, 30; *see also*, ¶¶ 22, 24, 44. Further delay in retrieving these unfit-for-use tanks will exacerbate the already dire risks associated with Hanford's tank waste. *Id.* ¶¶ 13, 14, 22, 24, 28.

46. Finally, termination or delay of the Yucca Mountain siting process will also have a deleterious impact on not just the tank waste at Hanford, but also on the other nuclear materials stored by the federal government at Hanford. *Id.* at 46, 47. This includes over 2500 metric tons of spent nuclear fuel, over 1300 capsules of cesium and over 600 capsules of strontium. *Id.* Termination or delay of the Yucca Mountain siting process will force Washington and the federal government to continue to store these extremely hazardous materials at Hanford, with concomitant danger to Washington's citizens and the environment. *Id.*

<u>The NWPA and the Decision to Pursue Siting of a Nuclear Waste Repository at Yucca Mountain</u>:

47. The federal government first began its attempts to site a repository for the nation's high-level radioactive waste and spent nuclear fuel in the 1970s. H.R. Rep. No. 97-491(I), at 26-27 (1982), *as reprinted in* 1982 U.S.C.C.A.N. 3792, 3793. These early attempts were quickly derailed by the extremely hazardous nature of the waste and the threat it poses to humans and the environment, the incredible duration of the waste's toxicity, and the consequent uproar in the communities the federal government first looked to as potential repository sites. *Id.*

48. In recognition of these difficulties in siting a repository, Congress enacted the NWPA in 1982. As described in more detail below, the NWPA mandates a systematic approach to the siting of a repository that emphasizes a systematic approach to the siting of a repository. *See generally*, 42 U.S.C. §§ 10132-10138, 10141, 10174a, 10191-10198, 10262-10270.

49. DOE began searching for appropriate repository sites in 1983. 42 U.S.C. § 10132(a). In the next several years, DOE conducted environmental assessments of the suitability of numerous sites across the country, including Yucca Mountain. U.S. Dept. of Energy, Recommendation by the Secretary of Energy Regarding the Suitability of the Yucca Mountain Site for a Repository

Under the Nuclear Waste Policy Act of 1982, 4 (2002) (hereafter, Secretary's Suitability Determination), attached hereto as Exhibit 2. Indeed, DOE's research into Yucca Mountain's suitability as a site for storing nuclear waste predates the enactment of the NWPA by six years. *Id.*

50. In 1986, DOE, using an "accepted, formal scientific method," ranked the appropriateness of the various sites it had investigated. *Id.* Yucca Mountain was the highest-ranked site. *Id.*

51. The following year, Congress amended the NWPA to focus DOE's research efforts on the Yucca Mountain site. 42 U.S.C. § 10172.

52. The NWPA prescribes the thorough inquiry DOE thereafter conducted at Yucca Mountain between 1987 and 2002 to determine whether it is an appropriate site for a repository. 42 U.S.C. §§ 10132-10133. During this time period, DOE spent "billions of dollars and millions of hours of research" in determining whether a repository site could be safely located at Yucca Mountain. Exhibit 2 at 1. DOE's scientific analysis of the site and its inclusion of interested parties (including state, local and tribal governments) throughout the process are described in detail in the Secretary's Suitability Determination at 12-33. According to DOE, "Yucca Mountain is far and away the most thoroughly researched site of its kind in the world" and its suitability has been "studied for

more than twice the amount of time it took to plan and complete the moon landing." *Id.* at 1, 2.

53. In January 2002, the Secretary of DOE formally recommended to the President that a nuclear waste repository could be safely sited at Yucca Mountain. *Id.*; H.R. Rep. No. 107-425, at 533 (2002), *as reprinted in* 2002 U.S.C.C.A.N. 532. In doing so, the Secretary concluded that "the amount and quality of research the [DOE] has invested into [determining Yucca Mountain's suitability as a repository] – done by top flight people . . . – is nothing short of staggering. After careful evaluation, I am convinced that the product of over 20 years, millions of hours, and four billion dollars of this research provides a sound scientific basis for concluding that the site can perform safely during both the pre- and post-closure periods, and that it is indeed scientifically and technically suitable for development as a repository." Ex. 2 at 45. The Secretary also stated that "compelling national interests" supported moving forward at Yucca Mountain: "I am convinced . . . that a repository for nuclear waste at Yucca Mountain will advance, in important ways, our energy security, our national security, our environmental goals, and our security against terrorist attacks." *Id.* at 45-46.

54. Based upon DOE's recommendation to move forward with siting a repository at Yucca Mountain, and consistent with the NWPA, the President in February 2002 recommended Yucca Mountain to Congress. 42 U.S.C.

§ 10134(a)(2)(A); H.R. Rep. No. 107-425, at 534 (2002), *as reprinted in* 2002 U.S.C.C.A.N. 532.

55. The NWPA provides interested parties, including the Governor and legislature of the State of Nevada, not only the right to participate in the process of evaluating Yucca Mountain, but also the right to formally disapprove the President's recommendation of Yucca Mountain. 42 U.S.C. §10136(b)(1)-(2). The Governor of Nevada did this in April 2002.

56. However, again consistent with the NWPA, Congress overrode Nevada's veto in July 2002. P.L. 107-200. Congress in July 2002 formally designated Yucca Mountain as the site of a permanent repository for high-level radioactive waste and spent nuclear fuel. *Id.*

DOE's Non-Discretionary Duty to Submit Application to Construct a Permanent Repository at Yucca Mountain and NRC's Non-Discretionary Duty to Issue a Ruling on the Merits of the Application:

57. Subsequently, in June 2008, DOE submitted its formal application to the NRC for a license to begin construction of a high-level radioactive waste and spent nuclear fuel repository at Yucca Mountain. DOE's application is required by the NWPA. 42 U.S.C. §10134(b) (after Congressional designation of a repository, "the Secretary shall submit to the Commission an application for a construction authorization for a repository at such site. . . .").

58. Once DOE submits a license application, the NRC is required to consider the application and issue a final decision on the merits of the application. 42 U.S.C. § 10134(d) (NRC "shall consider an application for a construction authorization" of a repository and "shall issue a final decision approving or disapproving the issuance of a construction authorization . . . .").

59. On October 22, 2008, the NRC noted for hearing DOE's Yucca Mountain license application. 73 Fed. Reg. 63,029.

<u>DOE's Decision to Forever Abandon Yucca Mountain Licensing Application</u>:

60. As recently as May 2009, Secretary Chu stated that DOE intended to continue with the NRC licensing process. *FY 2010 Appropriations Hearing: Before the S. Subcomm. on Energy and Water Development, and Related Agencies*, 111th Cong. 10-11 (May 19, 2000) (statement of Secretary Chu).[1]

61. However, in a series of statements and actions beginning on January 29, 2010, DOE abruptly reversed course. DOE now seeks to irrevocably terminate the Yucca Mountain project in favor of an unknown, yet-to-be identified alternative and it has – and is continuing – to take steps to do so.

62. On Friday, January 29, 2010, Secretary Chu announced the formation of a commission to examine how and where to store the nation's high-level

---

[1] Available at http://appropriations.senate.gov/ht-energy.cfm?method=hearings.view&id=95551689-1902-4074-af76-2cfb7f705475.

radioactive waste and spent nuclear fuel. U.S. Dept. of Energy, *Secretary Chu Announces Blue Ribbon Commission on America's Nuclear Future* (Jan. 29, 2010).[2] In this announcement, Secretary Chu stated that DOE would not proceed with the Yucca Mountain repository site. *Id.*

63. The following Monday, February 1, 2010, in conjunction with announcing DOE's proposed Fiscal Year (FY) 2011 budget, Secretary Chu announced that DOE would move to withdraw its Yucca Mountain licensing application and permanently terminate the Yucca Mountain project. U.S. Dept. of Energy, *FY 2011 Budget Request: Budget Highlights* 8 (Feb. 2010).[3]

64. On March 3, 2010, DOE filed with the NRC its formal motion to withdraw with prejudice its Yucca Mountain licensing application. U.S. Dept. of Energy's Motion to Withdraw Application for License, Atomic Safety and Licensing Board (ASLB) Docket No. 63-001.

65. The State of Washington filed a motion to intervene in the licensing proceeding. State of Washington's Petition for Leave to Intervene and Request For Hearing, ASLB Docket No. 63-001 (March 3, 2010). In doing so, the State of Washington sought an opportunity to challenge DOE's attempt to forever remove Yucca Mountain from consideration as the site of a permanent repository.

---

[2] Available at http://www.energy.gov/news/8584.htm.

[3] Available at http://www.mbe.doe.gov/budget/11budget/Content/FY2011Highlights.pdf.

66. However, on April 6, 2010, the ASLB issued an order effectively staying its consideration of both DOE's motion to withdraw the license application and the State of Washington's motion to intervene until such time as this Court has had an opportunity to consider the various challenges to DOE's action raised by several parties, including private citizens living near Hanford, Washington, Aiken County, South Carolina, and the State of South Carolina. Memorandum and Order (Suspending Briefing and Consideration of Withdrawal Motion), ASLB Docket No. 63-001-HLW.

DOE's Vague Explanation of the Rationale Underlying Its Decision to Forever Abandon the Yucca Mountain Site.

67. From its first announcement of its intent to permanently terminate the Yucca Mountain project, DOE has repeatedly offered one ambiguous explanation for its decision: that Yucca Mountain is "not a workable option." *See, e.g.,* U.S. Dept. of Energy, *FY 2011 Budget Request: Budget Highlights* (Feb. 2010) 5, 8; *FY 2011 Budget Hearing: Before the S. Comm. on Energy and Natural Resources*, 111th Cong. 10 (Feb. 4, 2010) (statement of Sec. Dr. Steven Chu)[4]; Letter from Steve Isakowitz, Chief Financial Officer, DOE, to the Hon. Byron Dorgan, Chair, S. Subcomm. On Energy and Water Development 1 (Feb. 17, 2010), attached hereto as Exhibit 3; Letter from Steve Isakowitz, Chief Financial

[4] Available at http://www.congressional.energy.gov/documents/2-4-10_Final_Testimony_(Chu).pdf.

Officer, DOE, to the Hon. Peter J. Visclosky, Chair, H. Subcomm. On Energy and Water Development 1 (Feb. 17, 2010), attached hereto as Exhibit 4; *FY 2011 Budget Hearing: Before the H. Comm. on Science and Technology*, 111th Cong. 10 (March 3, 2010) (statement of Sec. Dr. Steven Chu)[5];

68. Beyond the "not a workable option" language, DOE has published no other formal explanation of its decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative (e.g., in the Federal Register).

DOE Is Continuing to Take Actions To Terminate Yucca Mountain as Soon as Possible.

69. Immediately after announcing its intent to permanently remove Yucca Mountain from consideration as a permanent repository, DOE began to take steps to shut down its Yucca Mountain activities.

70. On February 8, 2010, DOE moved to withdraw its application for groundwater permits for the Yucca Mountain project. Letter from Ned B. Larson, Federal Project Director, Nevada Rail Line Project, Dept. of Energy, to Tracy Taylor, State Engineer, Division of Water Resources, State of Nevada, attached hereto as Exhibit 5.

---

[5] Available at http://www.congressional.energy.gov/documents/Final_Testimony_3-3_HST__CHU_.pdf.

71. On February 17, 2010, DOE sent letters to the chairmen of the House and Senate appropriations subcommittees responsible for DOE's budget. Exhibits 3 and 4. These letters contain DOE's notice of its intent to "reprogram" or reallocate FY 2010 funding that had been requested by DOE and approved by Congress to continue the licensing application process, to instead fund Yucca Mountain termination activities. *Id.*; U.S. Dept. of Energy, *FY 2010 Congressional Budget Request, Vol. 5*, 504 (FY 2010 budget request for DOE sub-agency responsible for Yucca Mountain "is dedicated solely to supporting to (sic) the NRC [Yucca Mountain] LA [licensing application] process."), 505, 520, 540[6]; P.L. 111-85, 123 Stat. 2864, 2868.[7]

72. DOE's actions in reprogramming these funds may violate the Purpose Law, 31 U.S.C. § 1301(a) ("appropriations shall be applied only to the objects for which the appropriations were made except as otherwise provided by law."). Specifically, when Congress approved DOE's proposed FY 2010 budget, it made clear that DOE could not deviate from its intended use of the appropriated funds without prior Congressional authorization. P.L. 111-85 (Oct. 2009) at 102.

---

[6] Available at http://www.cfo.doe.gov/budget/10budget/Content/Volumes/Volume5.pdf.

[7] Specifically, DOE requested a total of $197 million from two sources for its sub-agency, Office of Civilian Radioactive Waste Management (OCRWM), that is responsible for Yucca Mountain. U.S. Dept. of Energy, *FY 2010 Congressional Budget Request, Vol. 5*, 504. This is the total amount that was, in fact, appropriated. 123 Stat. 2864, 2868.

Congress defined agency reprogramming of funds to include "the reallocation of funds from one activity to another within an appropriation, or any significant departure from a program, activity or organization described in the agency's budget justification as presented to an approved by Congress." *Id.* It then ordered that "any reallocation of new or prior year budget authority . . . must be submitted to the House and Senate Committees on Appropriations in writing *and may not be implemented prior to approval by the Committees.*" *Id.* (emphasis added). Congress has not provided any such approval.

73. On February 26, 2010, DOE issued a letter announcing that on March 1, 2010, it would terminate all "data collection and performance confirmation activities" at Yucca Mountain and shut down "the power and communications systems for all surface and subsurface work and data collection processes" there.[8] Letter from William J. Boyle, Director, Regulatory Affairs Division, Office of Technical Management, Dept. of Energy, to Michael F.

---

[8] The "performance confirmation" activities mentioned in DOE's February 26th letter refer to "the program of tests, experiments, and analyses that is conducted to evaluate the adequacy of the information used to demonstrate compliance with the performance objectives" required of the Yucca Mountain facility by the NRC. 10 C.F.R. § 63.2; *see also,* 10 C.F.R. § 63.131. Any interruption in the required performance confirmation activities, and the data collected thereby, could threaten the viability of any future licensing proceeding, should this Court grant the State of Washington's requested relief.

Weber, Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission 1, attached hereto as Exhibit 6.

74. It appears that the Yucca Mountain site was, in fact, closed down in early March 2010, and access to the site by scientific personnel terminated. Exhibit 7.

75. On March 10, 2010, DOE issued a notice of expected separation to all employees working for the Office of Civilian Radioactive Waste Management, the DOE subagency responsible for investigating the siting of a repository at Yucca Mountain. Letter from David Zahransky, Chief Operating Office, Office of Civilian Radioactive Waste Management (OCRWM), Dept. of Energy, to all OCRWM employees, attached hereto as Exhibit 8.

76. On or about March 17, 2010, DOE announced it will no longer update the Yucca Mountain license application and that any future activities need no longer be screened for their potential impact on the license application. Exhibit 9 at 3.

77. Finally, DOE and its primary Yucca Mountain subcontractor, USA-Repository Services (USA-RS)[9], have put together a written plan that calls for a quick end to USA-RS's work on the Yucca Mountain project. Exhibit 10.

---

[9] *See*, http://www.lanl.gov/news/index.php/fuseaction/nb.story/story_id/14978/nb_date/2008-11-07.

Specifically, DOE will issue a letter to USA-RS on April 16, 2010, formally terminating the contract, and USA-RS will stop work that same day. *Id.* at 2. USA RS plans to vacate its offices and remove all equipment from them in May 2010. *Id.* at 3. Finally, USA-RS will "initiate employee separations" in May and June 2010. *Id.* at 4.

78. Although DOE has continued to take various steps to terminate the Yucca Mountain project, DOE has not prepared an environmental impact statement, or provided indication of any analysis under the NEPA, regarding its decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative.

VI. CLAIMS FOR RELIEF

COUNT 1: Violation of the NWPA

79. Plaintiff repeats and incorporates by reference the allegations contained in paragraphs 1 through 78 above.

80. Under the NWPA, 42 U.S.C. § 10134(b), DOE "*shall submit* to the [NRC] an application for a construction authorization for a repository at such site. . ." upon the approval of the Yucca Mountain site as a repository pursuant to the NWPA. (Emphasis added.) Upon such approval, DOE is thus without discretion or authority to summarily terminate the Yucca Mountain licensing process, and its contrary actions are in violation of the NWPA.

81. Under the NWPA, further provisions require DOE's development and maintenance of the Yucca Mountain repository project upon the approval of the Yucca Mountain site as a repository. *See e.g.,* 42 U.S.C. § 10134(e)(1) (requiring the Secretary to prepare a project decision schedule "that portrays *the optimum way to attain the operation of the repository*"); 42 U.S.C. § 10134(e)(2) (any federal agency that cannot comply with the project decision schedule must report to Congress, with a corresponding report from the Secretary). Upon such approval, DOE is thus without discretion or authority to summarily terminate the Yucca Mountain project, and its contrary actions are in violation of the NWPA.

82. Under the NWPA, 42 U.S.C. § 10134(d), the NRC "*shall consider* an application for a construction authorization for all or part of a repository" and "*shall issue a final decision* approving or disapproving the issuance of a construction authorization. . ." (Emphasis added.) *See also,* 42 U.S.C. § 10134(d) (based upon project decision schedule, the NRC may extend the three-year timeline imposed on it under the NWPA to reach its decision on DOE's construction authorization application). The NRC is without discretion or authority to, either by its own accord or by granting DOE's motion to withdraw, terminate its own consideration of DOE's Yucca Mountain license application short of a decision on the merits, and any contrary actions would be in violation of the NWPA.

COUNT 2: Violation of NEPA

83. Plaintiff repeats and incorporates by reference the allegations contained in paragraphs 1 through 82 above.

84. NEPA requires federal agencies to prepare an environmental impact statement (EIS) with alternatives for all "major Federal actions significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C).

85. NEPA further requires the preparation of an EIS at the proposal stage, before an agency makes its decision. 42 U.S.C. § 4332(C); 10 C.F.R. § 1021.210(b). Until an EIS is completed, NEPA's implementing regulations prohibit taking actions that would "[h]ave an adverse environmental impact" or "*[l]imit the choice of reasonable alternatives*." 40 C.F.R. § 1506.1(a) (emphasis added). DOE's own NEPA regulations require it to "complete its NEPA review for each DOE proposal *before making a decision on the proposal*", 10 C.F.R § 1021.210(b) (emphasis added), and before DOE has "reached the level of investment or commitment likely to determine subsequent development *or restrict later alternatives*. . . ." 10 C.F.R. § 1021.212(b) (emphasis added).

86. DOE's decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative is a major federal project significantly affecting the quality of the human environment. DOE's failure to prepare an EIS analyzing the impacts of its decision is arbitrary and

capricious, an abuse of discretion, not in accordance with law, and without observance of procedure required by law within the meaning of the APA, 5 U.S.C. § 706(2).

COUNT 3: Violation of the Administrative Procedure Act (APA)

87. Plaintiff repeats and incorporates by reference the allegations contained in paragraphs 1 through 86 above.

88. An agency action is arbitrary and capricious in violation of the APA, 5 U.S.C. § 706(2)(A), if the agency "has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise." *Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983).

89. DOE's decision and actions in terminating the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative, including its vague and cryptic assertion that it Yucca Mountain is "not a workable option" and that the nation needs a "different solution," is arbitrary and capricious under the aforementioned standard.

VII. PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that this Court:

90. Declare that DOE's decision to irrevocably terminate consideration of Yucca Mountain, Nevada, as the potential site for a permanent high-level radioactive waste and spent nuclear fuel repository in favor of an unknown and yet-to-be identified alternative violates the NWPA and, consequently, is null and of no legal effect;

91. Declare that DOE's decision to irrevocably terminate consideration of Yucca Mountain, Nevada, as the potential site for a permanent high-level radioactive waste and spent nuclear fuel repository in favor of an unknown and yet-to-be identified alternative violates NEPA and, consequently, is null and of no legal effect;

92. Declare that DOE's decision to irrevocably terminate consideration of Yucca Mountain, Nevada, as the potential site for a permanent high-level radioactive waste and spent nuclear fuel repository in favor of an unknown and yet-to-be identified alternative violates the APA and, consequently, is null and of no legal effect;

93. Issue a permanent injunction prohibiting DOE from implementing its decision to irrevocably terminate the Yucca Mountain project in favor of an unknown and yet-to-be identified alternative;

94. Issue a permanent injunction requiring DOE to continue to undertake its obligations with respect to the Yucca Mountain project, as defined by the NWPA and as funded by Congress;

95. Issue a permanent injunction prohibiting the NRC from considering or granting DOE's motion to withdraw its license application for Yucca Mountain; and

96. Grant such other relief as the Court deems appropriate.

RESPECTFULLY SUBMITTED this 2th day of April, 2010.

ROBERT M. MCKENNA
Attorney General

ANDREW A. FITZ, WSBA #22169
TODD R. BOWERS, WSBA #25274
Senior Counsel
P.O. Box 40117
Olympia, WA 98504-0117
(360) 586-6770
Application for Admittance Pending

OF COUNSEL:

MICHAEL L. DUNNING
H. LEE OVERTON
JONATHAN C. THOMPSON
Assistant Attorneys General
State of Washington
Office of the Attorney General
PO Box 40117
Olympia, WA 98504-0117

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

STATE OF WASHINGTON, Petitioner, v. UNITED STATES DEPARTMENT OF ENERGY, DR. STEVEN CHU, Secretary of the U.S. Department of Energy, NUCLEAR REGULATORY COMMISSION, Respondents.	NO. AFFIDAVIT OF SUZANNE L. DAHL-CRUMPLER

I, SUZANNE L. DAHL-CRUMPLER, swear and affirm under penalty of perjury that the following is true and correct.

1. I am now, and at all times mentioned have been a citizen of the United States, and am a resident of the State of Washington, over the age of eighteen years, competent to make this affidavit, and make this affidavit from my own personal knowledge, judgment, and professional experience.

2. I am and have been employed by the State of Washington, Department of Ecology (Ecology), Nuclear Waste Program, for nearly 15 years, beginning in July 1995. I have a Bachelor of Science in Geology and a Masters of Science in Hydrogeology from Baylor University in Waco, Texas. I have over 20 years of experience in issues related to environmental cleanup, Resource

Conservation and Recovery Act (RCRA) implementation, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) implementation, ground water and fate and transport, risk assessments, and National Environmental Policy Act (NEPA) analysis.

3. As an employee of Ecology, I have worked on environmental compliance and cleanup issues related to the Department of Energy's (DOE) Hanford Nuclear Reservation since 1995.

4. I am currently the Nuclear Waste Program's Tank Waste Treatment Section Manager. I have worked in this position for over 2 years. Prior to that, I was the Nuclear Waste Program's Tank Waste Disposal Project Manager and Tank Waste Project Manager for approximately 12 years. In the past, Ecology had all Hanford tank waste issues in one project, which I managed. This included managing issues related to Hanford tank safety resolution, interim stabilization, tank farm operations, tank waste characterization, tank farm upgrades, tank waste retrieval, tank farm closure, characterization of the vadose zone and groundwater beneath the tanks, tank waste treatment, and tank waste disposal and storage after treatment. In my present position, I manage issues related to half of the entire Hanford tank program, which includes tank waste characterization, tank waste treatment, and treated tank waste disposal and storage. I supervise 14 people who work on tank waste treatment and disposal issues.

5. I currently serve as the Nuclear Waste Program's management lead for issues related to DOE's development of the Draft Hanford Tank Closure Waste Management EIS, on which Ecology is a cooperating agency. During the 1995-97 time frame, I was involved as a key person in developing the Hanford Tank Waste Remediation System EIS (referenced further below), which Ecology co-authored with DOE.

6. For approximately the last decade, I have served as Ecology's expert on high level waste issues. I have interacted with the Nuclear Regulatory Commission (NRC) and National Academy of Sciences on a number of occasions with respect to the classification of the low-activity waste derived from treating high-level waste, and in the possible disposal of "tank heels" that cannot be retrieved from tanks containing high-level waste.

7. In this affidavit, I will describe the Hanford site; Hanford's high-level radioactive tank waste; Hanford's current system for storing that tank waste; the regulatory status of that tank waste; the current plan for treating and disposing of tank waste (including that plan's interrelationship with the Yucca Mountain project); and other spent nuclear fuel and high-level waste at Hanford and within Washington.

A. Hanford Description

8. Hanford is part of the nationwide complex that was used in the production of plutonium for nuclear weapons. The federal government selected the site in the early 1940s as part of the Manhattan Project. It was used extensively throughout the Cold War for the production of weapons-grade plutonium. Weapons production at Hanford ended in 1989, when the mission of the site was changed to cleanup.

9. Hanford structures include nine inactive reactors along the Columbia River, five inactive chemical reprocessing facilities in the central plateau, several spent nuclear fuel storage basins along the Columbia River, the Plutonium Finishing Plant, fuel fabrication facilities, large underground storage tanks located on the central plateau, and many miscellaneous small underground storage tanks.

10. From December 1944 to 1989, Hanford produced about two-thirds of the nation's weapons-useable plutonium. This was accomplished by irradiating uranium fuel in production reactors located along the Columbia River. The irradiated fuel was then chemically dissolved in separations plants. Plutonium 239 was then processed into metallic oxide form for shipment to other DOE sites for finishing and placement in weapons. Useable uranium extracted in the separations process was recycled into new reactor fuel.

11. The chemical separations plants used varying processes over time. All produced a highly acidic and highly contaminated liquid waste stream that was directed into large underground storage tanks after the waste was neutralized by making the solutions strongly basic. This waste stream ("tank waste") remains at the Hanford site today, with a current volume of approximately 53 million gallons. It is the focus of an ongoing multi-billion dollar cleanup effort, with severe and irreversible environmental consequences hanging in the balance. Because of the nature of the waste and the way it is currently being stored, the cleanup effort is a series of interrelated and interdependent actions, the final piece of which is disposal of immobilized high-level radioactive waste at a deep geologic repository. I will describe these particulars below.

B. Description of Hanford's Tank Waste

12. The radioactive and chemical make up, volume, and consistency of Hanford's tank waste is heterogeneous. It is the product of various processing approaches, the neutralization of the waste with large volumes of sodium hydroxide intended to make the waste compatible with the carbon steel tanks, evaporation campaigns conducted to reduce the volume of waste, and additional reprocessing to recover uranium, cesium, and strontium. The neutralization of waste was done by adding large amounts of sodium hydroxide, which caused the waste to be highly basic and to separate into different radioactive and chemical

layers. The evaporation campaigns caused the waste to precipitate and reduce the physical volume, and the various processing and reprocessing approaches added various chemicals to the waste. The tank waste thus varies widely in physical form from tank-to-tank and within tanks themselves, taking on the forms of vapor, supernate liquid, slurry, sludge, and saltcake with interstitial liquid.

13. Hanford's tank waste can best be described as a witch's brew of a wide range of chemicals and radioactive elements. The waste contains at least 46 identified radionuclides. Because these radionuclides are the result of reprocessing spent nuclear fuel, tank waste is presumptively considered high-level waste under Nuclear Waste Policy Act unless key radionuclides are removed in sufficient concentrations to allow the separated waste to be disposed in something other than a deep geologic repository.

14. In addition, Hanford's tank waste includes at least 26 hazardous waste constituents, including heavy metals and volatile organic compounds. All of these constituents are potentially harmful to human health and the environment. Because of the presence of these hazardous waste constituents, the State of Washington regulates Hanford tank waste as "mixed waste" under Washington's Hazardous Waste Management Act (HWMA), Chapter 70.105 Wash. Rev. Code, and the HWMA's implementing Dangerous Waste Regulations (Wash. Admin. Code [WAC] 173-303). This regulation, in turn, is part of a state hazardous waste

program authorized to stand in lieu of federal hazardous waste law under RCRA, 42 U.S.C. § 6926(b). *See* 51 Fed. Reg. 3,782 (1986); 52 Fed. Reg. 35,556 (1987); 55 Fed. Reg. 33,695 (1990); 59 Fed. Reg. 55,322 (1994); and 61 Fed. Reg. 7,736 (1996).

15. All of Hanford's tank waste is considered by Washington to be "land disposal restricted" waste under RCRA and the HWMA. As a result, it must be treated to specified land disposal restriction standards before disposal. WAC 173-303-140(2)(a) (incorporating by reference 40 C.F.R. § 268.1(b)). However, due to the nature of the radioactive constituents in the waste, there is currently no treatment capacity for tank waste at Hanford. The tank waste instead continues to be stored in violation of the prohibition on storing land disposal restricted waste under the HWMA and RCRA. WAC 173-303-140(2)(a) (incorporating by reference 40 C.F.R. § 268.50).

16. The 53 million gallons of waste in Hanford tank systems accounts for 60 percent of the high-level waste DOE is responsible for nationwide. This is an enormous quantity of waste. As a visual aid, DOE's own documents estimate that if the contents of the tanks were placed within an area with the footprint the size of a football field, they would form a column of high-level waste 150-feet tall.

C. Description of the Hanford Tank Waste System

17. Currently, Hanford's tank waste is largely being stored in 177 underground tanks located in the central portion of the Hanford site. The tanks are grouped in 18 areas or "farms." A tank farm can contain from 2 to 18 tanks with associated pipes, valve pits, and diversion boxes.

18. Of the 177 tanks, 28 are double-shell tanks (DSTs) that currently comply with RCRA and HWMA standards for hazardous waste tanks. The DSTs are buried beneath about seven feet of soil.

19. The remaining 149 tanks are single-shell tanks (SSTs). These tanks were constructed between 1944 and 1964 with an expected operating life of approximately 25 years. The SSTs currently hold approximately 30 million gallons of tank waste. The SSTs are buried beneath 6-11 feet of soil.

20. All 149 SSTs have been identified to the State of Washington by DOE as "unfit for use" pursuant to RCRA and the HWMA (40 C.F.R. § 265.191, incorporated by reference in WAC 173-303-400(3)). *Single Shell Tank System Integrity Assessment Report*, RPP-10435, Revision 0 (June 27, 2002) and transmittal letter from James E. Rasmussen, Energy Office of River Protection, to Michael Wilson, Department of Ecology.

21. An additional significant part of the tank system is the ancillary equipment and the tank waste in that portion of the system. Hanford has the most

extensive ancillary equipment system in the nation, and perhaps the world. The ancillary equipment includes 145 miles of pipelines, 61 miscellaneous tanks, 6 vaults, 72 diversion boxes, 26 valve pits, 349 tank pits, 49 other pits, 3 evaporators, and 10 other above ground facilities. The ancillary equipment currently holds a significant portion of high-level waste near the surface (as much as an additional 2.5 million gallons).

22. Near-term action is necessary to retrieve Hanford's tank waste. Numerous Energy documents state that 67 of the 149 SSTs are "known or suspected leakers." *See, e.g., U.S. Department of Energy, Office of River Protection 2-Year Progress Report to Congress*, DOE/ORP-2000-27 (Dec. 2000). The first known leakers were tanks TY-106 and U-101 in 1959. Tank T-106 is listed as having leaked the largest known quantity of waste, 115,000 gallons. Five of the 67 leakers suffered catastrophic failures, defined as either structural failure or loss of 50,000 gallons or more. There are seven tanks that have leaked between 20,000 and 50,000 gallons: C-101, S-104, SX-106, SX-108, TY-105, TY-106, and U-101. There is at least one known or suspected leaker in each tank farm, and 8 of the 12 SST farms contain more than 5 known or suspected leakers. Taken together, the SSTs have leaked an estimated total of approximately 1 million gallons of high-level mixed waste into surrounding soils.

23. These leaks from tanks and associated ancillary equipment have resulted in vadose zone contamination at high concentrations, and some past leaks are already impacting groundwater at levels significantly above drinking water standards in these areas. There is future risk to the public as these contaminants move away from the tank farm areas. Many of the contaminants will be pervasive in the environment for thousands of years to come. It is clear that in some cases, remedial actions will be needed to protect human health and environment from just the past tank leaks alone. Contaminants from past leaks that have migrated to the soil and the groundwater are present in high enough concentrations that it is possible they could migrate to the Columbia River and be present adjacent to the river in concentrations above acceptable limits.

24. Further leaks could occur in the future from both DOE's SST and DST systems. Today, the average SST is 42 years past its design life. As DOE has admitted, future tank failures can be expected as the SSTs exceed their design lives by longer and longer periods. Such leaks may occur during retrieval, and from infiltration of rainwater resolubilizing the tank waste and moving it out the bottom of the tanks or from associated ancillary equipment. In addition, some of the DSTs have exceeded or are approaching the end of their design life and by 2028, most will be at the end of their design life. Future failures in the DSTs can be expected as more of the tanks exceed their design life. For its own planning

purposes, DOE has assumed that one DST may fail in 2017 and one additional DST will fail every five years thereafter.

D. Regulatory Status of Tank Waste Retrieval, Treatment, and Disposal

25. To address Hanford's multiple environmental compliance issues, including prolonged storage of high-level waste, the Environmental Protection Agency, and DOE entered into the Hanford Federal Facility Agreement and Consent Order (HFFACO) in 1989. Among other things, the HFFACO is a compliance order issued pursuant to RCRA and HWMA. HFFACO Article I. The HFFACO establishes numerous milestones (schedules and associated regulatory requirements) for cleanup of the Hanford site and for bringing Hanford facilities into compliance with applicable requirements.

26. These HFFACO milestones include requirements for retrieving waste from and closing the unfit-for-use SST system and for treating all of Hanford's tank waste to meet RCRA/HWMA land disposal treatment standards. Currently, the HFFACO requires that DOE retrieve high-level waste from all 149 of Hanford's SSTs by 2018 and that it complete the treatment of that waste by 2028.

27. In November 2008, Washington filed suit against the Secretary of Energy and DOE alleging that DOE had missed, or was certain to miss, HFFACO milestones for retrieving waste from SSTs (including the 2018 end date), for constructing and initiating a Waste Treatment Plant (WTP) to begin treating

Hanford's tank waste, and for completing treatment of all of Hanford's tank waste by 2028. *Washington v. Chu*, No. CV-08-5085-FVS (U.S.D.C., Eastern District of Washington). A proposed settlement of this case has been reached between Washington and DOE, under which a consent decree would be entered with the district court to govern SST retrieval, WTP construction, and WTP initial operations from the present-to-approximately 2022 timeframe. In addition, the HFFACO would be modified to, among other things, extend the current SST retrieval end date to no later than 2040 and extend the current tank waste treatment end date to no later than 2047. The proposed settlement has undergone public notice-and-comment, but has not yet been executed by the parties.

28. As mentioned above, accomplishing this work—and averting severe environmental consequences—is keyed on a number of interrelated and interdependent actions. In short, retrieving waste from Hanford's SSTs is currently tied to the construction and operation of the WTP complex. The WTP complex, in turn, is being designed and constructed to meet performance standards specific to the Yucca Mountain repository.

E. Plan for Treating and Disposing of Tank Waste

29. Hanford lacks sufficient compliant (DST) storage capacity to allow for the continued uninterrupted retrieval of waste from all of Hanford's SSTs. In fact, there is currently insufficient capacity to allow for the transfer of more than a

limited amount of the waste now stored in the SSTs. To date, DOE's strategy for addressing this situation has been to by and large rely on the prospective future treatment capacity of the WTP to remove waste from the DST and SST systems. DOE has expected that over time, this will free up DST capacity, which in turn will allow for the continued transfer of waste retrieved from the SSTs to the DSTs.

30. Under this strategy, the WTP is the lynchpin for completing the Hanford tank waste mission. It is vital to both treating tank waste in satisfaction of RCRA/HWMA treatment standards and creating the "throughput" necessary to allow SSTs to continue being retrieved.

31. The WTP is a $12.3 billion facility, with several major facilities and ancillary support components. Currently, approximately $5.2 billion has already been expended. This includes design, engineering, construction, management costs, and fees.

32. The WTP will consist of four major components: the Pretreatment Facility; the Low Activity Waste Vitrification Facility; the High Level Waste Vitrification Facility; and the Analytical Laboratory (LAB).

33. The Pretreatment (PT) Facility will separate radioactive tank waste into high-level waste and low-activity waste fractions and transfer each waste type to the respective vitrification facility for immobilization. As of December 2009, overall PT Facility completion is at 48 percent; engineering and design is

77 percent complete, and construction is 29 percent complete. The budget for this component of the WTP is $4.09 billion, with $1.97 billion having already been expended.

34. The Low-Activity Waste (LAW) Facility will vitrify low-activity waste from the PT Facility. Waste will be mixed with glass formers, vitrified into glass at an average daily rate of 30 metric tons, and placed in stainless-steel containers that will be disposed on site in the Integrated Disposal Facility. As of December 2009, overall LAW Facility completion is at 68 percent; engineering and design is 92 percent complete, and construction is 57 percent complete. The budget for this component of WTP is $1.68 billion, with $1.14 billion already having been expended.

35. The High-Level Waste (HLW) Facility will receive the high-level waste fraction from the PT Facility. The concentrate is sampled and analyzed to determine the optimum blend of glass formers to add to the waste that will produce a vitrified waste form that is compliant with disposal requirements as outlined in the *Waste Acceptance System Requirements Document,* Revision 5, May 31, 2007, (WASRD) and other relevant documents, and also meets the required production rates. As of December 2009, overall HLW Facility completion is at 49 percent; engineering and design is 83 percent complete, and

construction is 24 percent complete. The budget for this component of the WTP is $2.57 billion, with $1.26 billion having already been expended.

36. The Analytical Laboratory (LAB) will support WTP operations by analyzing feed, vitrified waste, and effluent streams. As of December 2009, overall LAB completion is at 48 percent; engineering and design is 79 percent complete; construction is 59 percent complete. The budget for this component of the WTP is $.64 billion, with $.31 billion having already been expended.

37. Upon the conclusion of treatment, the WTP will produce two output streams. The bulk of the chemicals and some of the radioactive elements will be captured in the low-activity fraction (10 percent of the radioactivity and 90 percent of the volume) and vitrified as Immobilized Low Activity Waste (ILAW). ILAW will be disposed on the Hanford site at a facility called the Integrated Disposal Facility. This facility is already constructed.

38. The remaining high-level radioactive fraction (90 percent of the radionuclides and 10 percent of the volume) will be vitrified as Immobilized High Level Waste (IHLW). As further outlined below, Washington and DOE have presumed and planned for IHLW to be disposed of in a deep geologic repository.

39. From the beginning, the WTP treatment approach was developed in consideration of the Nuclear Waste Policy Act. The current basis for ILAW to be disposed in near surface facilities, rather than a deep geologic repository licensed

by NRC, comes from a series of technical letters between DOE and the NRC in the 1980s and 1990s. These letters defined that ILAW disposal at Hanford can proceed if, among other things, tank wastes have been processed to remove key radionuclides to maximum extent technically and economically practical based on specific pretreatment, with vitrification of the low activity fraction. The remaining high level fraction was always assumed to require disposal in a deep geologic repository.

40. This exchange informed development of the 1996 Tank Waste Remediation System (TWRS) EIS and its associated Record of Decision (ROD). The TWRS ROD determined that the tank waste would be treated to generate separate low-activity waste and high-level waste outputs. It further indicated that the high-level waste output, in which the bulk of the radionuclides would be concentrated, would be disposed of offsite in a national geologic repository to permanently isolate the wastes from humans and the environment to the greatest extent practicable and provide for protection of public health and the environment. Attachment 1 (62 Fed. Reg. 8693) at 8693-95, 8698-700.[1] By act of Congress, this repository is currently sited at Yucca Mountain, Nevada.

[1] Attached hereto as Attachment 1 is a true and correct copy of the Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland Washington, 62 Fed. Reg. 8693 (Feb. 26, 1997).

41. DOE's subsequent planning documents also assume Hanford's IHLW among the inventories destined for the Yucca Mountain repository. For example, the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (February 2002) (YM FEIS) assumes IHLW inventories ranging from 8,315 canisters to 22,280 canisters generated from the WTP. This is approximately 63% of the high-level waste planned for disposal at the repository. Attachment 2 (YM FEIS, Vol. 2, App. A, Section 1.1.4.1) at A-8.[2]

42. Based on this key planning assumption, the WTP has and is being designed and constructed to satisfy performance standards specific to the Yucca Mountain facility. DOE's contract to provide design, engineering, and construction services for the WTP facilities specifies that DOE's WASRD is a "primary requirements reference" for the contract's statement of work. Attachment 3 (WTP Contract at Section C, Item 1.2.1.3) at C-100.[3] The contract further specifies that the WTP and its IHLW output must meet key performance measures defined by the WASRD, including (but not limited to):

---

[2] Attached hereto as Attachment 2 are true and correct copies of relevant experts from the YM FEIS.

[3] Attached hereto as Attachment 3 are true and correct copies of relevant excerpts of the WTP Contract DE-AC-AC27-01RV14136 (WTP Contract).

- As a general requirement, IHLW must meet the requirements established in the WASRD. Attachment 3 (Item 1.2.2.1.1, Product and Disposal Requirements) at C-101.

- Specific dimensional requirements of the canister system, to accommodate the final waste-form disposal at the repository. Attachment 3 (Item 1.2.2.1.2, Canister System) at C-101.

- Specific weight percent in IHLW of 25 components. Attachment 3 (Table TS-1.1, Minimum component Limits in High-Level Waste Glass) at C-102.

- Sampling and analysis requirements must support process control, environmental compliance and waste form qualification for DOE approval, based on the WASRD and other source documents. Attachment 3 (Item (18), Analytical Laboratory Facility Design) at C-50.

43. The WASRD document, in turn, establishes the waste acceptance technical requirements for DOE's Civilian Radioactive Waste Management System, which manages waste destined for disposal at the Yucca Mountain repository. The WASRD is "the agreed upon reference source of waste acceptance criteria to which Federal Waste Custodians must conform for their wastes to be received by the repository." Attachment 4 (WASRD, Section 1.1) at 1.[4] Among other matters, the waste acceptance elements of the WASRD have been developed to specifically comply with the "applicable provisions of 10 CFR Part 63, 'Disposal of High-Level Radioactive Wastes in a Geologic Repository at

---

[4] Attached hereto as Attachment 4 are true and correct copies of relevant experts from the *Waste Acceptance System Requirements Document,* Revision 5, May 31, 2007 (WASRD).

Yucca Mountain, Nevada.' " Attachment 4 (WASRD, Section 3.1) at 9. For example, the WASRD specifies high-level waste requirements to satisfy Yucca Mountain-specific standards in the following areas:

- Durability and Phase Stability of Vitrified HLW
- HLW Canister Design and Materials of Construction
- Dimensional Envelope for HLW Canisters
- Filled HLW Canister Weights
- Capability to Lift HLW Canisters Vertically with Remote Handling Fixtures
- HLW Canister Sealing
- HLW Canister Labeling
- HLW Canister Drop
- Free Liquid in Canisters Containing HLW
- Radionuclide Content in High-Level Waste
- Criticality Potential in Canisters Containing HLW
- HLW Canister Surface Contamination
- Thermal Output in Canisters Containing HLW

Attachment 4 (WASRD, Section 4.8) at 30-33. In short, the WTP is being built to produce IHLW that conforms to the Yucca Mountain-specific standards established by the NRC in 10 C.F.R. pt. 63.

44. Given the degree to which the WTP design and construction is tied to performance standards specific to Yucca Mountain, termination of the Yucca Mountain project would create significant uncertainty in Hanford's tank waste treatment and disposal mission. Due to the overall completion status of WTP (overall completion is at 52 percent; design and engineering is 78 percent complete, and construction is 48 percent complete), the ability to alter design and

construction of the complex is significantly foreclosed. The systems and components of the PT Facility, HLW Facility, and LAB are sufficiently complete to support the processing of high-level waste to meet disposal requirements outlined in the WASRD and other relevant documents. If the Yucca Mountain repository is terminated, significant regulatory, administrative, and technical issues will have to be revisited at Hanford. This could result in a construction tear-down and rebuild of the WTP to accommodate design and engineering changes necessary to meet another repository's waste acceptance criteria, with significant impacts to cost, scope, and the legally-binding compliance schedule overseen by Washington. Absent such changes, IHLW produced to satisfy Yucca Mountain-specific standards could become stranded at Hanford.

45. Termination (or significant delay) of the Yucca Mountain project would have other effects at Hanford. For the last several years, the plan for storing IHLW at Hanford has been to build a single integrated storage and shipping facility with only enough capacity to service a "just in time" approach that links IHLW production with interim storage and shipping. If a deep geologic repository is terminated or significantly delayed, DOE has indicated that a total of five IHLW storage facilities will need to be built to contain approximately 12,000 IHLW canisters. Attachment 5 (Draft TC&WM EIS, Readers Guide) at 5, Table 4

at 22.[5] Once vitrified, IHLW is not amenable to any further reprocessing. If the waste was to remain stored at Hanford past the design life of the interim IHLW storage facilities (60 years), further replacement interim IHLW storage facilities would need to be constructed. Attachment 5 (Draft TC&WM EIS, Readers Guide) at 11.

F. Other Hanford Spent Nuclear Fuel and High-Level Waste

46. In addition to the tank waste described above, there are more than 2,000 metric tons of spent nuclear fuel currently being stored at Hanford and assumed by DOE for disposal at the Yucca Mountain repository. Attachment 2 (YM FEIS, Vol. 2, App. A, Section A.2.2.3, Table A-20) at A-27. This amount includes not only spent fuel, but fuel that is failed and broken in various stages of decay (e.g., sludge form) after years of storage in cooling basins. Termination (or significant delay) of the Yucca Mountain project would affect the disposition of this waste.

47. Further, there are 1,335 capsules of cesium and 601 capsules of strontium currently stored at Hanford in the Waste Encapsulation Storage Facility. These capsules are considered high-level waste and must be disposed of in a deep

---

[5] Attached hereto as Attachment 5 are true and correct copies of relevant experts from the *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (Draft TC&WM EIS) (Oct. 2009).

geologic repository. DOE has included the capsules in the Hanford IHLW inventory destined for the Yucca Mountain repository described in Paragraph 41 above. The current plan is to either vitrify the capsules through the WTP (adding 340 IHLW canisters to the WTP's output), or find a way to ship them directly to a deep geologic repository. If additional canisters from the WTP are produced, the canisters would also need to be interim stored before being shipped to the repository. Without a deep geologic repository, Hanford and Washington are faced with indefinite long term storage of spent nuclear fuel, cesium and strontium capsules, and IHLW without a final disposal path identified. Termination (or significant delay) of the Yucca Mountain project would affect the disposition of this waste.

48. To the best of my knowledge, no final EIS prepared under NEPA analyzes the Hanford related impacts outlined in Paragraphs 44-47 above in the event the Yucca Mountain project is terminated or significantly delayed.

49. In its current *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*, DOE references termination of the Yucca Mountain project and the need to comply with NEPA before making decisions on alternatives to Yucca Mountain:

> *Notwithstanding the decision to terminate the Yucca Mountain program*, which was the development of a geologic repository for the disposal of HLW and SNF, DOE remains committed to meeting its

> obligations to manage and ultimately dispose of HLW and SNF. The Administration intends to convene a blue ribbon commission to evaluate alternative approaches for meeting these obligations. *Decisions reached through this process will need to be addressed at a later date subject to appropriate NEPA review.*

Attachment 5 (Draft TC&WM EIS, Summary) at S-13.

50. Finally, I am aware that approximately 581 metric tons of spent nuclear fuel (projected) is being stored at the Columbia Generating Station, a commercial nuclear power facility operated by Energy Northwest on land leased within the Hanford Reservation. DOE has included this waste among the inventories destined for the Yucca Mountain repository. Attachment 2 (YM FEIS, Vol. 2, App. A, Section A.1.1.4.1 Table A-7) at A-15. Termination (or significant delay) of the Yucca Mountain project would thus presumptively affect the disposition of this waste.

DATED this 12 day of April 2010, in Richland, Washington.

Suzanne L Dahl-Crumpler

SUZANNE L. DAHL-CRUMPLER

Subscribed and sworn to before me on April 12, 2010 by Suzanne L. Dahl-Crumpler.

Corina Manzano

Notary Public in and for the State of Washington, residing at Benton.

My appointment expires 09-20-2012.

CORINA MANZANO NOTARY PUBLIC COMMISSION EXPIRES 9-20-12 STATE OF WASHINGTON

NOTICES

DEPARTMENT OF ENERGY

Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, WA

Wednesday, February 26, 1997

***8693** AGENCY: Department of Energy.

ACTION: Record of decision.

SUMMARY: This Record of Decision addresses actions by the U.S. Department of Energy (DOE) to manage and dispose of radioactive, hazardous, and mixed waste within the Tank Waste Remediation System (TWRS) program at the Hanford Site in southeastern Washington State. DOE, in cooperation with the Washington State Department of Ecology (Ecology), issued a Final Environmental Impact Statement (EIS) entitled "Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement" (TWRS EIS) (DOE/EIS-0189, August 1996). The Final EIS evaluates alternatives for the management and disposal of mixed, radioactive, and hazardous waste currently stored or projected to be stored in 177 underground storage tanks and approximately 60 active and inactive miscellaneous underground storage tanks associated with the Hanford Site's tank farm operations, as well as the management and disposal of approximately 1,930 cesium and strontium capsules currently stored at the Hanford Site.

Based on the environmental impact analysis of the Final EIS and after evaluating costs, regulatory compliance requirements, technical uncertainties, worker and public health and safety, and public, agency, National Research Council, and Tribal Nation comments, DOE has decided to implement the preferred alternative identified in the Final EIS for retrieval, treatment, and disposal of tank waste the, "Phased Implementation alternative" and to defer the decision on disposition of cesium and strontium capsules.

The Phased Implementation alternative was selected because it provides a balance among short-and long-term environmental impacts, meets all regulatory requirements, addresses the technical uncertainties associated with remediation, and provides the flexibility necessary to accommodate future changes in the remediation plans in response to new information and technology development.

While carrying out this decision, DOE will continually evaluate new information relative to the tank waste remediation program. DOE will also conduct periodic independent scientific and technical expert reviews, which DOE believes are essential to the success of the TWRS program. Further, DOE intends to conduct formal evaluations of new information relevant to the tank waste remediation program at three key points over the next eight years under its National Environmental Policy Act (NEPA) regulations (10 CFR 1021.314), with an appropriate level of public involvement, to ensure that DOE stays on a correct course for managing and remediating the tank waste. Various informal reviews also will be conducted during this period.

DOE has decided to defer action on the cesium and strontium capsules to further evaluate potential beneficial uses of the capsules and study potential long-term environmental impacts. The capsules will continue to be managed in the Hanford Site Waste Encapsulation and Storage Facility. DOE will complete an evaluation for poten-

Attachment 1

tial future uses of the capsules within two years and will issue a Cesium and Strontium Management Plan that will address alternatives for beneficial uses. If no future uses are found and DOE determines that the capsules should be disposed of, DOE will select an alternative for disposal of the capsules and supplement this Record of Decision.

ADDRESSES: Addresses of DOE Public Reading Rooms and Information Repositories where the Final EIS, Record of Decision, and other relevant information are available for public review are listed at the end of this Record of Decision. The Final EIS and Record of Decision are also available for review on the Internet at www.hanford.gov/eis/twrseis.htm and on the DOE NEPA Web page (http://tis-nt.eh.doe.gov/nepa).

FOR FURTHER INFORMATION: Requests for copies of the Record of Decision or further information on the Final EIS or Record of Decision should be directed to Carolyn Haass, DOE Tank Waste Remediation System EIS NEPA Document Manager, U.S. Department of Energy, Richland Operations Office, P.O. Box 1249, Richland, WA 99352. Ms. Haass may be contacted by telephone at (509) 372-2731. Information on the DOE NEPA process may be requested from Carol M. Borgstrom, Director, Office of NEPA Policy and Assistance (EH-42), U.S. Department of Energy, 1000 Independence Avenue S.W., Washington, D.C. 20585. Ms. Borgstrom may be contacted by telephone at (202) 586-4600, or by leaving a message at (800) 472-2756.***8694**

SUPPLEMENTARY AGENCY INFORMATION:

Purpose and Need for Action

This Record of Decision addresses actions by DOE to manage and dispose of radioactive, hazardous, and mixed waste within the Tank Waste Remediation System (TWRS) program at the Hanford Site in southeastern Washington State. The waste includes approximately 212 million liters (56 million gallons) of waste stored or to be stored in underground storage tanks at the Hanford Site. DOE also will manage the cesium and strontium salts contained in approximately 1,930 capsules currently stored at the Site and, if they are determined to be waste, will dispose of the capsules. The tank waste and cesium and strontium capsules currently pose a low short-term risk to human health and the environment; however, storage costs are high, and the potential for an accident resulting in large releases of radioactive and chemical contaminants will increase as the facilities age.

DOE must implement long-term actions to safely manage and dispose of the tank waste, associated miscellaneous underground storage tanks, and the cesium and strontium capsules (if the cesium and strontium are determined to be waste) to permanently reduce potential risk to human health and the environment. These actions also are needed to ensure compliance with all applicable Federal and Washington State requirements regarding the management and disposal of radioactive, hazardous, and mixed waste.

Alternatives Considered in the Final EIS

The following describes the alternatives considered in the Final EIS and a discussion of their advantages and disadvantages.

In order to compare the alternatives for both the high- and low-activity fractions of the waste, vitrification was used as a representative technology to conduct the EIS analysis. DOE currently plans to implement parts of the Phased Implementation alternative through a privatization initiative whereby private companies will perform certain aspects of the remediation in an effort to use competition within the marketplace to bring new ideas and concepts to waste remediation and reduce project costs. Under current plans, the selected private companies will have the responsibility to treat the high-level waste using vitrification, and will have the option to immobilize the low-activity waste by either vitrification or other similar immobilization methods provided that the final waste form meets regulatory requirements. (DOE has issued contracts to two companies to design tank waste treatment facilities—both companies had proposed vitrifying low-activity waste.)

Tank Waste Alternatives Considered

Phased Implementation (Preferred Alternative)

The Phased Implementation alternative was identified in the Final EIS as the Preferred Alternative. Under the Phased Implementation alternative, the tank waste would continue to be safely stored until the waste is retrieved from the tanks for treatment and disposal by implementing a demonstration phase (Phase I) to verify that the treatment processes will function effectively and then by implementing a full-scale production phase (Phase II).

During Phases I and II, continued operations of the tank farm system and actions to address safety and regulatory compliance issues would be performed and would include:

- Upgrading tank farm infrastructure, including waste transfer, instrumentation, ventilation, and electrical systems;

- Monitoring tanks and equipment to support waste management and regulatory compliance requirements;

- Combining compatible waste types, interim stabilization of single-shell tank waste, continuing waste characterization, removing pumpable liquid from single-shell tanks, transferring newly generated waste from ongoing Site activities to double-shell tanks, operating the 242-A Evaporator and the Effluent Treatment Facility, and performing mitigative actions to resolve tank safety issues;

- Using rail or tanker truck systems to transport waste to the tank farms;

- Completing construction of and operating the new replacement cross-site transfer system to facilitate regulatory compliant waste transfers from 200 West to 200 East Area and continue operating the existing transfer pipeline system until the replacement system is operational; and

- Installing and operating an initial tank waste retrieval system to improve the capacity to consolidate double-shell tank waste and support mitigation of safety issues.

Phase I activities (Part A, development activities; Part B demonstration) activities would last for approximately 10 years and would include:

- Constructing demonstration-scale facilities to produce vitrified low-activity waste and vitrified high-level waste for future disposal;

- Installing and operating tank retrieval systems to retrieve selected waste (primarily liquid waste) for separations and immobilization, and selected tank waste for high-level waste vitrification;

- Transferring liquid waste to receiver tanks and transferring selected waste for high-level waste processing directly to the high-level waste facility;

- Performing separations to remove selected radionuclides (e.g., cesium) from the low-activity waste stream;

- Storing separated high-level waste at the treatment facilities or in the Canister Storage Building pending future high-level waste treatment;

- Returning a portion of the sludge, strontium, and transuranic waste from separations processes to the double-shell tanks for future retrieval and treatment during Phase II;

- Vitrifying the low-activity waste and high-level waste; and

- Transporting the low and high activity wastes to onsite interim storage facilities.

Phase II (full-scale production) activities would begin after completion of Phase I, last for approximately 30 years and would include:

- Constructing full-scale facilities to vitrify low-activity waste and vitrify high-level waste;

- Installing and operating tank retrieval systems to retrieve waste from all single-shell tanks, double-shell tanks, and miscellaneous underground storage tanks;

- Pretreating the waste by sludge washing and enhanced sludge washing followed by separations of the liquid and solids;

- Performing separations to remove selected radionuclides from the low-activity waste feed stream and transferring the waste to the high-level waste vitrification facility;

- Vitrifying the high-level waste stream and the low-activity waste stream;

- Packaging the high-level waste in canisters for onsite interim storage and future shipment to a national geologic repository; and

- Placing the immobilized low-activity waste in containers and placing the containers in onsite near-surface disposal facilities.

DOE also would continue to characterize the tank waste and perform technology development activities to reduce uncertainties associated with remediation, evaluate emerging technologies, and resolve regulatory compliance issues.

The principal advantages of the Phased Implementation alternative are ***8695** that it provides for retrieval of the waste, separation of the high- and low-activity waste constituents and immobilization of the waste. Separations processes would reduce the volume of high-level waste and eliminate the bulk of the contaminants in the low-activity waste stream. This alternative would permanently isolate the wastes from humans and the environment to the greatest extent practicable and provide for protection of public health and the environment by disposing of the bulk of the radionuclides offsite in a national geologic repository and isolating the low-activity waste through immobilization and disposal in onsite facilities. By using a phased approach, DOE will obtain additional information concerning the uncertainties associated with waste characteristics and the effectiveness of the retrieval, separations, and treatment technologies prior to constructing and operating full-scale facilities. Lessons learned from the demonstration phase, ongoing waste characterization, and technology development activities would be applied to Phase II, which may substantially improve the operating efficiency of the second phase and reduce construction and operating costs.

The principal disadvantage of this alternative is that it would involve slightly higher short-term impacts than the in situ and combination alternatives, though lower than the continued management alternatives. Short-term impacts include potential health impacts during Phases I and II from occupational, operational, and transportation accidents and radiation exposures to workers during normal operations. In addition, this alternative would disturb shrub-steppe habitat and may cause a short-term strain on public services during construction activities. This alternative would also cost more than the in situ alternatives.

Other Tank Waste Alternatives Considered

The Final EIS analyzed nine other alternatives for the tank waste. All of the alternatives considered include continuing the current tank farm operations to maintain the tanks and associated facilities until they are no longer needed for waste management. All of the alternatives (except No Action) include upgrading tank farm systems as identified for the Phased Implementation alternative. The following are the other alternatives addressed.

1. No Action

Perform minimum activities required for safe and secure management of the Hanford Site's tank waste with the current tank farm configuration during a 100-year period. This alternative would provide for continued storage and monitoring of tank waste. No construction or remediation activities would be performed under the No Action alternative.

The principal advantage of this alternative is that the short-term environmental impacts would be lower than other alternatives analyzed (except operational accidents which would be high due to the assumed 100-year operating period). The cost estimated for this alternative would be lower than most other alternatives. The degree of technical uncertainty associated with this alternative is low because it is a continuation of ongoing activities. Selection of this alternative would also allow time to develop new waste remediation technologies.

The principal disadvantage of this alternative is that it would result in the highest long-term environmental impacts. Because no action would be taken to immobilize or isolate the waste, the contaminants in the waste would migrate to the groundwater in a relatively short period of time, resulting in contamination of the groundwater far above accepted safe levels and drinking water standards. Persons consuming this contaminated groundwater would have a significant risk of contracting cancer. In addition, this alternative would not meet waste disposal laws, regulations, and policies. This alternative eventually would result in continued deterioration of the structural integrity of the tanks and an increased risk that an earthquake would cause a catastrophic release of tank contents to the environment and the potential for a large number of fatalities. Because all of the waste would remain in the tanks in an unstabilized form, there would be a significant human health risk to inadvertent intruders into the waste after any loss of administrative control of the Site.

2. Long-Term Management

Perform minimum activities required for safe and secure management of the Hanford Site's tank waste during the 100-year administrative control period. This alternative is similar to the No Action alternative, except that the waste transfer system would be upgraded and the double-shell tanks would be replaced twice during the assumed 100-year administrative control period to prevent the potential leakage of large volumes of liquid to the environment from the double-shell tanks. No waste remediation would be performed under this alternative.

The principal advantage of this alternative is the same as for the No Action alternative except that leaching of contaminants into the groundwater from the double-shell tanks would be delayed by 100 years due to the tank replacement program.

The principal disadvantages of this alternative are the same as for the No Action alternative except that the long-term impacts to the groundwater would be slightly lower than the No Action alternative.

3. In Situ Fill and Cap

Retrieve and evaporate liquid waste from the double-shell tanks, fill single-and double-shell tanks with gravel, fill miscellaneous tanks and ancillary equipment with grout, and cover the tank farms with a low permeability earthen surface barrier, disposing of all tank waste onsite.

The principal advantages of this alternative are that the short-term environmental impacts (accident fatalities, radiation exposures, and shrub-steppe habitat disturbance) would be low and the estimated cost would be lower than for all other alternatives. The degree of technical uncertainty associated with this alternative is low because it involves applying common technology, which has a high probability of achieving its projected level of effectiveness for most tanks.

The principal disadvantages of this alternative are that it would have relatively high long-term environmental impacts due to contaminants leaching into the groundwater where they could expose persons who might consume the groundwater, and it would not meet waste disposal laws, regulations, or policies. Because the actions taken for this alternative involve isolation but not immobilization of the waste, the contaminants would migrate to the groundwater over a long period of time and result in significant long-term impacts on public health and the environment. In addition, this alternative may not be feasible for those tanks that generate high levels of flammable gases because of the potential for sparks causing a fire in the tanks while filling with gravel. Other types of fill material may be necessary for these tanks. Because all of the waste except the liquid waste in the double-shell tanks would remain in the tanks in an unstabilized form, there would be a significant human health risk to inadvertent intruders into the waste ***8696** after any loss of administrative control of the Site.

4. In Situ Vitrification

Retrieve and evaporate liquid waste from the double-shell tanks, fill the tanks with sand, vitrify (melt to form glass) all of the tanks in place, and cover all of the tank farms with an earthen surface barrier to dispose of all tank waste onsite. This alternative would involve constructing tank farm confinement facilities to contain and collect the off-gasses generated during the vitrification process. The waste, tanks, and soil surrounding the tanks (including miscellaneous underground storage tanks) would be vitrified by using electricity to melt the soil and waste, which would solidify into a glass when cooled.

The principal advantages of this alternative are that the short- and long-term impacts would be relatively low. The short-term impacts such as occupational, operational, and transportation accidents would be lower because fewer personnel would be required to construct and operate the in situ vitrification systems. The long-term impacts would be low because the contaminants would be immobilized in glass, which would limit the leaching of contaminants to the groundwater.

The principal disadvantages of this alternative are that there is a high degree of technical uncertainty that the alternative would function as intended, and that, even if technically successful, would not produce a final waste form that would meet waste disposal laws, regulations, or policies. In situ vitrification has been performed on contaminated soil, but has not been used on the tank waste or at the scale needed to vitrify the large tanks.

5. Ex Situ No Separations

Retrieve waste from the single-shell, double-shell, and miscellaneous underground storage tanks, either vitrify or calcine (heat to temperatures below the melting point) the waste, and package the treated waste for interim onsite storage and eventual offsite disposal at a national geologic repository.

The principal advantages of this alternative are that the vitrification option would meet all regulatory requirements and both the vitrification and calcination options would result in disposal of all retrieved waste offsite at a national geologic repository. Because this alternative does not involve separations, the technical uncertainties are fewer than those associated with other ex situ alternatives that involve intermediate or extensive separations.

The principal disadvantages of this alternative are that the waste form (either soda-lime glass for vitrification or compacted powder for calcination) may not meet the current waste acceptance criteria at a national geologic repository and the volume of waste to be disposed of at a national geologic repository would be very large and would likely exceed the capacity of the first repository. The costs associated with disposing of all the waste at a national geologic repository make this the most expensive alternative.

6. Ex Situ Intermediate Separations

Retrieve waste from the single-shell, double-shell, and miscellaneous underground storage tanks and separate the waste into high-level and low-activity waste streams using sludge washing, enhanced sludge washing, and ion exchange, then vitrify the waste streams in separate facilities. Dispose of the low-activity waste onsite and the high-level waste offsite at a national geologic repository.

The principal advantages of this alternative are that it would meet all regulatory requirements and result in relatively low long-term impacts because the high-level waste would be disposed of offsite in a national geologic repository and the low-activity waste onsite would be immobilized and isolated in onsite disposal facilities covered with an earthen barrier.

The principal disadvantage of this alternative is that it involves a moderate level of technical uncertainty because the alternative would involve construction and operation of treatment facilities where some of the proposed technologies are first-of-a-kind or have not been demonstrated on Hanford Site tank waste. This alternative would involve a potential for higher short-term impacts than the in situ alternatives because of the nature and extent of the activities required for construction and operation of the full-scale waste treatment facilities. These impacts would include potential health impacts from occupational, operational, and transportation accidents and radiation exposures during normal operations.

7. Ex Situ Extensive Separations

Retrieve waste from the single-shell, double-shell, and miscellaneous underground storage tank waste and use a large number of complex chemical separations processes to separate the high-level waste components from the recovered tank waste. Vitrify the waste streams in separate facilities and dispose of the low-activity waste onsite and the high-level waste offsite at a national geologic repository.

The principal advantages of this alternative are that it would meet all regulatory requirements and, due to the extensive separations processes, would result in the smallest volume of high-level waste for offsite disposal. Due to the extent of the separations processes, the low-activity waste that would remain onsite would have lower radioactive contaminant concentrations than the other ex situ alternatives.

The principal disadvantages of this alternative are that it involves the highest degree of technical uncertainty and highest treatment cost among the ex situ alternatives because of the numerous complex separations processes. This alternative would involve slightly higher short-term impacts than the in situ and combination alternatives, though lower short-term impacts than the continued management alternatives. These impacts include potential health impacts from occupational, operational, and transportation accidents and radiation exposures during normal operations.

8. and 9. Ex Situ/In Situ Combination 1 (Alternative 8) Ex Situ/In Situ Combination 2 (Alternative 9)

Retrieve tank waste (approximately 50 percent of the waste volume for the Combination 1 alternative and 30 percent for the Combination 2 alternative based on long-term risks the contents of the various tanks pose to human health and the environment); separate the retrieved waste into high-level and low-activity waste streams using an intermediate level of separations; then vitrify the waste streams in separate facilities. Dispose of the low-activity waste onsite and the high-level waste at an offsite national geologic repository. Waste in tanks not selected for retrieval would be remediated identical to the In Situ Fill and Cap alternative.

The principal advantage of these alternatives is that they offer the opportunity to lower the remediation cost by remediating the waste in selected tanks based on waste characteristics and contribution to post-remediation risk. The waste that provides the greatest long-term potential human health risks would be remediated. The Combination 2 alternative would have lower remediation costs than the Combination 1 alternative because a smaller volume of waste would be processed. These alternatives would result in short-term impacts (occupational, operational, and transportation accidents and shrub-steppe habitat disturbance) that are generally lower than those for the ex situ alternatives because smaller ***8697** facilities and fewer personnel would be required to process a smaller volume of waste.

The principal disadvantages of these alternatives are that they would not meet waste disposal laws, regulations, and policies. The ex situ portion of these alternatives would have the same technical uncertainties as the Ex Situ Intermediate Separations alternative. The in situ portion of these alternatives would result in higher long-term impacts than the ex situ alternatives because the waste disposed of in situ would leach contaminants into the groundwater over a long period of time and expose persons who might consume the groundwater. The Combination 2 alternative would leave more waste disposed of in situ and result in higher long-term impacts than the Combination 1 alternative.

Environmentally Preferable Alternative—Tank Waste

Identifying environmental preferences among alternatives for the tank waste remediation program requires consideration of the short-term human health and environmental impacts, long-term human health and environmental impacts, and the associated uncertainties in the impact assessment process, including technology performance. There are alternatives that would result in low short-term impacts but relatively high long-term impacts, and identifying the environmentally preferable alternative(s) requires judgment concerning these impacts. Comparing short-term human health impacts with long-term human health impacts is complicated by the fact that short-term impacts can be estimated with a greater degree of certainty than long-term human health risks.

In making these comparisons, DOE considered that most estimated short-term impacts involve risks to workers during remediation that are voluntary and can be reduced by applying appropriate worker protection measures. In contrast, the estimated long-term impacts are involuntary in nature because they would result from inadvertent exposure of future populations to contaminant releases.

The In Situ Vitrification alternative would have lower human health and environmental impacts than the other alternatives, if this technology functioned adequately. This alternative would result in the lowest potential short-term human health impacts, other than the In Situ Fill and Cap alternative, and the lowest long-term human health and environmental impacts. However, in situ vitrification has never been performed at the scale necessary to remediate the Hanford tank waste and there is a high degree of technical uncertainty associated with this alternative. Even with extensive technology research and testing, it may not be feasible to develop this technology to the extent that it would function adequately. If this alternative did not function as designed, the long-term impacts on groundwater and future users of the groundwater would be higher. While the In Situ Fill and Cap alternative would result in the lowest short-term impacts, it also would have significant long-term impacts on the groundwater and future users of the groundwater.

On balance, the ex situ alternatives are environmentally preferable to in situ alternatives because they provide for the permanent isolation of contaminants from the human environment. Among the ex situ alternatives, Phased Implementation is environmentally preferable because it offers the best potential to reduce technology risks and uncertainties relevant to both short-term and long-term impacts, while also providing for treatment and disposal of tank wastes to the greatest extent technically and economically practicable.

Cesium and Strontium Capsules Alternatives Considered

For the purposes of analyzing impacts in the TWRS EIS, it was assumed that the cesium and strontium capsules will remain in the Waste Encapsulation and Storage Facility at the Hanford Site until ready for final disposition. The Waste Encapsulation and Storage Facility is being isolated from B Plant, which previously provided waste handling and utility support. B Plant is scheduled for deactivation.

No Action

No Action was identified in the Final EIS as the preferred alternative and includes the continued storage of the capsules in the Hanford Site Waste Encapsulation and Storage Facility for 10 years. The cesium and strontium capsules are currently classified as byproduct material and are therefore available for beneficial uses. If beneficial uses cannot be found, the capsules may be subject to management and disposal actions as high-level waste.

The principal advantage of the No Action alternative is that it allows DOE to evaluate potential commercial and medical uses for the cesium and strontium capsules rather than foreclosing these options by implementing a disposal alternative. This alternative also provides an opportunity for further study of long-term environmental impacts. DOE would reevaluate the preferred alternative after a determination is made on the potential for future use of cesium and strontium capsules.

The principal disadvantage of this alternative is that it would not result in the near-term disposal of the capsules. The high costs of storing the capsules would continue. The cost and impacts of disposal would be delayed until some time in the future, if appropriate uses for the capsules are not developed.

Onsite Disposal

Overpack the cesium and strontium capsules in canisters and dispose of them onsite in a newly constructed shallow drywell disposal facility.

The principal advantage of this alternative is that it is the only alternative that would allow near-term disposal of the capsules because it would not rely on the construction of a national geologic high-level waste repository, which may not be available until after the year 2015.

The principal disadvantage of this alternative is that it would not meet the requirements of the Resource Conservation and Recovery Act for hazardous waste or DOE policy for disposal of readily retrievable high-level waste. The capsules would be disposed of in a near-surface facility where they would be more accessible to inadvertent human intrusion until the cesium and strontium decayed to non-radioactive elements.

Overpack and Ship

Overpack the cesium and strontium capsules into canisters, place the canisters into Hanford Multi-Purpose Canisters for interim storage, and store the packaged capsules onsite pending offsite disposal at a national geologic repository.

The principal advantage of this alternative is that it would provide for offsite disposal of the capsules in compliance with all regulatory requirements.

The principal disadvantage of this alternative is that the capsules may not meet waste acceptance criteria at a national geologic repository.

Vitrify With Tank Waste

Remove capsule contents, vitrify with the high-level tank waste, and dispose of offsite at a national geologic repository.

The principal advantages of this alternative are that it would meet all regulatory requirements and the currently planned waste acceptance requirements for a national geologic repository. This alternative is dependent ***8698** on selecting one of the tank waste alternatives that includes a high-level waste vitrification facility, which would be used to vitrify the cesium and strontium.

Environmentally Preferable Alternative—Cesium and Strontium Capsules

All of the alternatives for remediation of the cesium and strontium capsules are estimated to result in low environmental impacts. There would be no occupational fatalities or increased incidences of cancer or fatal chemical exposures associated with normal operations. There would be no or low adverse impacts on surface waters or groundwater, soils, air quality, transportation networks, noise levels, visual resources, socioeconomic conditions, resource availability, or land use. The No Action, Overpack and Ship, and Vitrify with Tank Waste alternatives would have slightly lower impacts on shrub-steppe habitats than the Onsite Disposal alternative and a slightly lower risk of a fatal accident. Assuming that the capsules would meet waste acceptance criteria at a national geologic repository the Overpack and Ship alternative would result in slightly lower impacts than the other alternatives and is therefore the environmentally preferable alternative.

Decision

Tank Waste

Description of Alternative Selected

DOE has decided to implement the Phased Implementation alternative for the tank waste. The Phased Implementation alternative strikes an appropriate balance among potential short- and long-term environmental impacts, stakeholder interests, regulatory requirements and agreements, costs, managing technical uncertainties, and the recommendations received from other interested parties.

While carrying out this decision, DOE will continually evaluate new information relative to the tank waste remediation program. DOE also intends to conduct formal evaluations of new information relative to the tank waste remediation program at three key points over the next eight years under its NEPA regulations (10 CFR 1021.314), with an appropriate level of public involvement, to ensure that DOE stays on a correct course for managing and remediating the waste.

As remediation proceeds in the coming years, DOE will learn more about management and remediation of the tank waste and ways to protect public and worker health and the environment. Within this time frame, DOE will obtain additional information on the effectiveness of retrieval technologies, characteristics of the tank wastes, effectiveness of waste separation and immobilization techniques, and more definitive data on the costs of retrieval, separations, and immobilization of the waste. Formal reevaluations will incorporate the latest information on these topics. DOE will conduct these formal evaluations of the entire TWRS program at the following stages: (1) before proceeding into Privatization Phase I Part B (scheduled for May 1998); (2) prior to the start of hot operations of Privatization Phase I Part B (scheduled for December 2002/December 2003); and (3) before deciding to proceed with Privatization Phase II (scheduled for December 2005). In conducting these reviews, DOE will seek the advice of independent experts from the scientific and financial community, such as the National Academy of Sciences which will focus on the expected performance and the costs of waste treatment. DOE has established a TWRS Privatization Review Board consisting of Senior DOE representatives to provide on-going assistance and interactive oversight of the review of Part A deliverables and discussions with the contractors.

Informal evaluations also will be conducted as the information warrants. These formal and informal evaluations will help DOE to determine whether previous decisions need to be changed.

The Phased Implementation approach allows DOE to start remediating waste earlier than previously planned. With this approach, retrieval and processing of waste will begin on a small scale so that systems can be improved as knowledge is gained. This approach also permits DOE to continue research and development in critical areas, such as improved robotic retrieval systems, that may result in improved methods to reduce tank leaks during retrieval, and methods to remove residual waste that is difficult to retrieve.

The components of the demonstration phase (Phase I) will include: (1) continuing to safely manage the tank waste; (2) constructing and operating demonstration facilities; (3) collecting additional information through tank waste and vadose zone characterization; and (4) performing demonstrations of technologies that have the potential to reduce uncertainties associated with the TWRS program.

Continuing to safely manage the tank farms includes replacement of certain waste transfer piping and routine maintenance activities for tank farm instrumentation, ventilation, and electrical systems. Ongoing activities will include conducting environmental and safety related monitoring, removing pumpable liquids from the single-shell tanks, mitigating flammable gas safety hazards, and transferring currently stored waste and newly generated waste using the replacement cross-site transfer system, rail cars, and tanker trucks. DOE also plans to upgrade certain instrumentation, tank ventilation, and electrical system to upgrade the regulatory compliance status of the current facilities. The environmental impacts of these actions were not assessed in the TWRS EIS because the activities to be performed had not been sufficiently defined. DOE will evaluate the impacts of these actions in future NEPA analyses.

The demonstration phase, which will last approximately 10 years, includes the retrieval and treatment of a portion of the waste from the double-shell and single-shell tanks. The waste will be separated into low-activity waste and high-level waste through physical and chemical processes and then treated in demonstration-scale facilities. Vitrified high-level waste will be placed in interim storage at the Canister Storage Building pending future disposal at a national geologic repository. Immobilized low-activity waste will be prepared for future onsite disposal in existing grout vaults and similarly designed disposal facilities.

During the demonstration phase, DOE will conduct many activities to reduce the uncertainties associated with certain aspects of the project. For example, DOE will obtain extensive operational and cost data on a variety of issues by retrieving waste for treatment and constructing and operating the demonstration-scale facilities. DOE also will obtain more detailed information on the characteristics of the tank waste and potential impacts on groundwater by continuing to collect data through the existing tank waste and vadose zone characterization programs. Further, DOE will conduct a project known as the Hanford Tanks Initiative that will provide data on single-shell tank residual characteristics, single-shell tank retrieval technologies, tank residual removal technologies, and tank closure technologies. In addition, DOE will further investigate technologies that have the potential to reduce the uncertainties of the TWRS project, including evaluating alternative tank fill material for use during closure, demonstrating the effectiveness and efficiency of waste retrieval with sluicing technology, and evaluating a variety of other technologies through DOE's complex-wide technology ***8699** development programs. DOE also will prepare appropriate further NEPA documentation before making decisions on closure of the tank farms. This documentation will address the final disposition of the tanks, associated equipment, soils, and groundwater, and will integrate tank farm closure with tank waste remediation and other remedial action activities.

Phase II of the Phased Implementation alternative will begin after Phase I and will last approximately 30 years. Phase II will consist of continuing to safely manage the tank waste and constructing and operating full-scale facilities to treat the remainder of the tank waste. The tank waste will be retrieved and separated into low-activity waste and high-level waste. The low-activity waste will be immobilized and disposed of onsite in near-surface disposal facilities. The high-level waste will be vitrified, temporarily stored onsite, and transported offsite for disposal in a national geologic repository. DOE will use the lessons learned from the demonstration phase and the information obtained from further characterization and technology development activities to optimize operating efficiencies during Phase II and reduce construction and operating costs. DOE will continue to evaluate the path forward for the tank waste remediation program as additional data and technology development activities provide information relative to key technical and regulatory issues.

DOE currently plans to implement parts of this alternative through a privatization initiative whereby private companies will perform certain aspects of the remediation in an effort to use competition within the marketplace to bring new ideas and concepts to waste remediation and reduce project costs. The goal of privatization is to streamline the TWRS mission, transfer a share of the responsibility, accountability, and liability for successful performance to industry, improve performance, and reduce costs without sacrificing worker and public safety or environmental protection. On September 25, 1996, DOE issued contracts to two companies to initiate the design process for Phase I, Part A. Any of the contractors authorized to proceed to start Part B is anticipated to follow the same general approach described in the EIS for Phase I, Part B of the Phased Implementation alternative, including separating the waste into low-activity waste and high-level waste streams, vitrifying the high-level waste, and using high-temperature processes to immobilize low-activity waste. Both contractors' current plans include vitrifying low-activity waste upon approval to proceed with Phase I, Part B.

Before issuing these contracts DOE independently evaluated the environmental data and analyses submitted by the contractors and prepared a confidential environmental critique of the potential environmental impacts in accordance with DOE NEPA regulation 10 CFR 1021.216. After issuing the contracts, DOE prepared a publicly available environmental synopsis, based on the critique, to document the consideration given to environmental factors and to record that the relevant environmental consequences of reasonable alternatives have been evaluated in the selection process. This evaluation showed that the two proposals would have similar overall environmental impacts and that the impacts would be less than or approximately the same as the impacts described for Phase I of the Phased Implementation alternative. The environmental synopsis has been filed with the Environmental Protection Agency and is available at the DOE Public Reading Rooms and Information Repositories listed at the end of this Record of Decision. DOE will require the selected contractors to submit further environmental information and analysis and will use the additional information, as appropriate, to assist in the NEPA compliance process, including a determination under 10 CFR 1021.314 of the potential need for future NEPA analysis.

Basis for Selection

DOE has determined that through the many years of research and development throughout the DOE complex and specific studies on Hanford Site tank waste remediation, the technical uncertainties have been reduced to a manageable level. DOE has determined that the risks associated with proceeding with remediation are less than the risks of future releases of contaminants to the groundwater and of accidents in unremediated tanks that are deteriorating structurally. The cost of continuing to manage the unremediated tank waste facilities is high.

DOE has determined that it is necessary to retrieve the waste from the tanks to meet regulatory requirements, avoid future long-term releases to the groundwater that would threaten human health and the environment, and reduce health impacts to potential inadvertent intruders into the waste if administrative control of the Site were lost. An intermediate level of separating the waste into low-activity waste and high-level waste was selected because of the high disposal costs of alternatives with low levels of separation and the high degree of technical uncertainty associated with alternatives with extensive levels of separations. To address the remaining technical uncertainties that exist with the tank waste remediation program, the phased implementation approach was selected to provide the flexibility necessary to make midcourse adjustments to the remediation plans based on future characterization data, technology development, and technical and cost data developed during Phase I.

The Phased Implementation alternative provides for the permanent isolation of the waste from humans and the environment to the greatest extent practicable and protection of public health and the environment. A high percentage of the radionuclides will be disposed of offsite in a national geologic repository, which provides a high degree of permanent isolation of the most hazardous waste. Releases of contaminants to the groundwater at the Hanford Site will be reduced to the greatest extent practicable. The waste disposed of onsite will be isolated from humans and the environment by immobilizing the low-activity waste and placing it in near-surface disposal facilities covered with an earthen surface barrier.

The Phased Implementation alternative provides a balance among key factors that influenced the evaluation of the alternatives; short-term impacts to human health and the environment, long-term impacts to human health and the environment, managing the uncertainties associated with the waste characteristics and treatment technologies, costs, and compliance with regulatory requirements. It also provides a balance between the need to proceed with remediation and the potential advantages of delaying remediation to incorporate future technology developments. This alternative allows DOE to meet all regulatory requirements and reflects the values and concerns of many stakeholders.

Mitigation Measures

This decision adopts all practicable measures to avoid or minimize adverse environmental impacts that may result from the Phased Implementation alternative. These measures many of which are routine, include the following.

- All DOE nuclear facilities will be designed, constructed, and operated in compliance with the comprehensive set of DOE or commercial requirements that have been established to protect public health and the environment. These ***8700** requirements encompass a wide variety of areas, including radiation protection, facility design criteria, fire protection, emergency preparedness and response, and operational safety requirements;

- Measures will be taken to protect construction and operations personnel from occupational hazards and minimize occupational exposures to radioactive and chemical hazards;

- Emergency response plans will be developed to allow rapid response to potentially dangerous unplanned events;

- Water and other surface sprays will be used to control dust emissions, especially at borrow sites, gravel or dirt haul roads, and during construction earthwork;

- Areas for new facilities will be selected to minimize environmental impacts to the extent practicable;

- Pollution control or treatment will be used to reduce or eliminate releases of contaminants to the environment and meet regulatory standards;

- Extensive environmental monitoring systems will be implemented to continually monitor potential releases to the environment;

- All newly disturbed areas will be recontoured to conform with the surrounding terrain and revegetated with locally derived native plant species consistent with Sitewide biological mitigation plans;

- Historic, prehistoric, and cultural resource surveys will be performed for any undisturbed areas to be impacted;

- Potential impacts to shrub-steppe habitat and cultural resources will be among the factors considered in a NEPA analysis to support the site selection process for facilities and earthen borrow sites; and

- Consultation with Tribal Nations and government agencies will be performed throughout the planning process to address potential impacts to shrub-steppe habitat, religious sites, natural resources, and medicinal plants.

Mitigation measures will be refined and presented in the Tank Waste Remediation Mitigation Action Plan. Tribal Nations and agencies will be consulted, as appropriate, during preparation of the Mitigation Action Plan.

Cesium and Strontium Capsules

DOE has decided to defer the decision on the disposition of the cesium and strontium capsules for up to two years. In effect, DOE will implement the No Action alternative until a final disposition decision is made and implemented. The encapsulated cesium and strontium have potential value as commercial and medical irradiation or heat sources, and implementing disposal alternatives would foreclose options for these applications. DOE is evaluating the potential for commercial and medical uses. In addition, DOE is considering mixing the cesium with surplus plutonium; the cesium would serve as a radiation barrier and be immobilized with the plutonium. Mixing the cesium with the plutonium would enhance nuclear materials security by making future use of the plutonium by unauthorized persons very hazardous and difficult. DOE will reevaluate the decision on the disposition of the capsules after determinations are made on the potential for future use of cesium and strontium. DOE is preparing a Cesium and Strontium Management Plan that will address alternatives for beneficial uses of the capsules prior to final disposition. If DOE decides not to use the cesium and strontium for any of these purposes, one of the alternatives for permanent disposal of the capsules will be selected and DOE will supplement this Record of Decision. Before making such a decision, DOE intends to further study disposal alternatives to resolve uncertainties and better understand long-term impacts, as recommended by the National Research Council (see Appendix).

Comments on the Draft EIS and Agency Responses

DOE and Ecology received comments on the Draft EIS from 102 individuals, organizations, agencies, or Tribal Nations including the Washington State Department of Wildlife, Oregon State Department of Energy, Nez Perce Tribe, Yakama Indian Nation, and the Confederated Tribes of the Umatilla Indian Reservation. All comments received were addressed in the Final EIS, Volume Six, Appendix L, and revisions to the Final EIS were made, as appropriate, to address applicable comments. A complete copy of all comments received on the Draft EIS is available in each of the DOE Public Reading Rooms and Information Repositories at the locations listed at the end of this Record of Decision.

Comments Received After Publication of the Final EIS and DOE Responses

DOE received comments from the Washington State Department of Fish and Wildlife on the Final EIS and comments from the National Research Council on the Draft EIS after publication of the Final EIS. A summary of these comments and DOE's responses is attached as an appendix to this Record of Decision. These comments were considered in the preparation of this Record of Decision.

DOE Public Reading Rooms and Information Repositories

- University of Washington, Suzzallo Library, Government Publications Room, Seattle, WA 98185. (206) 685-9855, Monday-Thursday, 9 a.m. to 8 p.m.; Friday and Saturday, 9 a.m. to 5 p.m.

- Gonzaga University, Foley Center, E. 502 Boone, Spokane, WA 99258. (509) 328-4220 ext. 3829, Monday-Thursday, 8 a.m. to midnight, Friday, 8 a.m. to 9 p.m.; Saturday, 9 a.m. to 9 p.m.; Sunday, 11 a.m. to midnight.

- U.S. Department of Energy Reading Room, Washington State University, Tri-Cities Campus, 100 Sprout Road, Room 130W, Richland, WA 99352, (509) 376-8583, Monday-Friday, 10 a.m. to 4 p.m.

- Portland State University, Bradford Price Millar Library, Science and Engineering Floor, SW Harrison and Park, Portland, OR 97207, (503) 725-3690, Monday-Friday, 8 a.m. to 10 p.m.; Saturday, 10 a.m. to 10 p.m.; Sunday, 11 a.m. to 10 p.m.

- U.S. Department of Energy, Headquarters, Freedom of Information Public Reading Room, 1E-190 Forrestal Building, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586-6020, Monday-Friday, 9 a.m. to 4 p.m.

A copy of the Record of Decision is also available via the Internet at www.hanford.gov/eis/twrseis.htm and http://tis-nt.eh.doe.gov/nepa.

Issued in Washington, DC, this day, February 20, 1997.

Alvin Alm,

Assistant Secretary for Environmental Management.

Appendix—Comments Received After Publication of the Final EIS

The U.S. Department of Energy (DOE) received comments and recommendations from the National Research Council and the Washington State Department of Fish and Wildlife after publication of the Final Environmental Impact Statement (EIS). The following is a summary of these comments and DOE's responses.

National Research Council Comments

On March 4, 1996, DOE requested that the National Research Council (Council), Committee on Remediation of Buried and Tank Waste, review the Tank Waste Remediation System (TWRS) Draft EIS. DOE received the Council's comments and recommendations regarding the Draft EIS on September 6, 1996 (after the Final EIS had been published) in a report entitled "The Hanford Tanks: ***8701** Environmental Impacts and Policy Choices". Although this report was issued too late to be considered in the Final EIS, DOE did consider the Council's comments in the preparation of this Record of Decision.

DOE generally agrees with the comments and recommendations made by the Council. Because several other commentors on the Draft EIS identified similar concerns, many of the Council's comments and recommendations were incorporated in the Final EIS prior to receipt of the Council's report. DOE believes the Record of Decision reflects stakeholder values regarding the need for action, provides a balance among short- and long-term environmental impacts, meets regulatory requirements and agreements, and addresses technical uncertainties, while also accommodating, to the extent possible, the underlying concern of the Council regarding the need for phased decision making.

The following is a summary of the National Research Council's comments and DOE's responses.

Comment 1: Uncertainties, both stated and unstated, concerning the Hanford wastes, the environment, and the remediation processes are found throughout the DEIS. Significant uncertainties exist in the areas of technology, costs, performance, regulatory environment, future land use, and health and environmental risks. Among the issues that remain uncertain are:

- Effectiveness in practice of technologies to remove and treat waste from tanks,

- Costs of operations and offsite waste disposal,

- Future policy and regulatory environment,

- Characterization of tank wastes,

- Relation between tank waste removal, remediation of the surrounding environment, and ultimate land use at the site, and

- Long-term risks associated with various alternatives for treating and processing the tank wastes, both in relation to residues left on site and risks transferred offsite when processed wastes are moved to a national geologic repository.

The preferred Phased Implementation alternative presented in the DEIS does not adequately address all of the uncertainties that make it difficult to decide how to complete remediation of the tanks. During Phase I, cesium and technetium, the most troublesome elements in a vitrifier, are to be removed from the high-level waste that is sent to the pilot vitrification plant, potentially limiting the value of information obtained from the pilot plant operations. This may also delay a decision on the final waste form for these elements.

Plans for building a pilot plant should proceed, but in the context of a phased decision strategy that does not preclude processing of wastes other than the double-shell tank supernatant or producing waste forms other than the glass currently planned.

Response 1: DOE agrees with the Council that there are substantial uncertainties associated with the tank waste remediation program. In response to similar comments, DOE revised the EIS to enhance the discussion of uncertainties, including the relevance of the uncertainties in the evaluation of alternatives. The Final EIS provides an extensive discussion on uncertainties in Appendix K, which includes DOE's detailed evaluation of the uncertainties and impacts associated with the tank waste remediation program alternatives. In light of the uncertainties related to the remediation of tank waste, DOE has committed to reevaluate the program as DOE continues to learn from these activities to ensure that DOE will stay on a correct course for managing the tank wastes.

The Council placed particular emphasis on recommending the use of a "phased decision strategy" because of the technical uncertainties in tank waste management. DOE has decided to implement the Phased Implementation alternative, which DOE believes will achieve many of the goals of the phased decision strategy recommended by the Council. DOE believes that the many years of technology evaluations throughout the DOE Complex have reduced the uncertainties to a manageable level, and the risks of proceeding with remediation are less than the risks of further releases of contaminants from the tanks and the potential for accidents in unremediated tanks. In addition, the cost of continuing to manage the tank waste in facilities that have exceeded their design life are high. DOE believes the Phased Implementation alternative provides adequate flexibility to accommodate changes in the tank waste remediation program as additional information is developed. Responses to the Council's other comments, below, provide additional detail on how DOE intends to reduce the technical uncertainties while proceeding with the Phased Implementation alternative.

Phase I of the Phased Implementation alternative includes both low-activity and high-level waste treatment and immobilization. Any radionuclides separated from the low-activity waste feed stream, including cesium and technetium, will be vitrified in the high-level waste facility. This will provide important information on the performance of the separations process and of vitrification of troublesome elements like cesium and technetium.

By performing Phase I of the Phased Implementation alternative and proceeding with other technology development projects and tank waste characterization, the uncertainties associated with the tank waste program will be reduced further. Initiatives that DOE is pursuing to reduce uncertainties in support of the TWRS program include:

- The Hanford Tanks Initiative, which will provide data on characterization of tank residuals, technologies for waste retrieval, technologies for removing tank residuals, and criteria for closing tanks;

- Completion of the tank waste characterization program, which will provide data relative to tank waste safety issues and the contents of the tanks;

- Determination of the level of contamination in the vadose zone;

- Development of a comprehensive plan to integrate tank waste remediation with tank farm closure and other remediation activities related with the TWRS program;

- Integration of TWRS program implementation with the plans for developing a national geologic repository for high-level waste;

- Demonstrations of the efficiency and effectiveness of retrieval sluicing technology to support the tank waste remediation activities; and

- Demonstrations of various tank waste separations and treatment processes.

Comment 2: The DEIS surveyed a wide range of remediation options, including strategies in which tanks with varying contents are treated differently. However, the committee believes that additional alternatives for management of the tank wastes need to be explored in parallel, using a phased decision strategy like the one outlined in this report. Such a strategy would provide flexibility in the event that specific, preferred technologies or management approaches do not perform as anticipated or that innovative waste management and remediation technologies emerge. Among additional options that should be analyzed are (1) in-tank waste stabilization methods that are intermediate between in situ vitrification and filling of the tanks with gravel, (2) subsurface barriers that could contain leakage from tanks, and (3) selective partial removal of wastes from tanks, with subsequent stabilization of ***8702** residues, using the same range of treatment technologies as in the alternatives involving complete removal of wastes.

When funding is constrained, it is more difficult to devote resources to the continued development of backup options. However, considering the uncertainty in the cost and performances of the technologies required for the preferred alternative, a time period during which funding is constrained is precisely the wrong time to drop work on alternatives that might achieve satisfactory results at a significantly lower cost. Having such alternatives available could allow remediation to proceed expeditiously, even if funding constraints prevent timely implementation of the currently preferred alternative.

Response 2: As discussed in the response to comment 1, DOE agrees that significant uncertainties exist in the tank waste remediation program and that the strategy selected needs to be flexible to respond to new information and the results of research and development efforts. Additional alternatives and refinements of alternatives need to be developed and evaluated.

The Council's report recommends a "phased decision strategy," while DOE's preferred alternative is the "Phased

Implementation alternative." There are important similarities and differences between these two approaches. Under the Council's phased decision strategy, the first phase would identify and develop alternative approaches to remediate the tank waste. Decisions on alternatives for subsequent phases would be deferred until information from the first phase is evaluated. This approach has the advantage of not prematurely foreclosing options enabling DOE to further study and develop technologies and that might reduce cost and/or risk. It has the disadvantage of leaving the total cost, schedule, and final outcome highly uncertain. Under DOE's Phased Implementation alternative, the complete path forward for tank waste remediation has been determined, while recognizing that the path can be modified as new information becomes available. However, DOE has committed to conduct formal and informal reviews with the intent to mitigate the concern of making long-term decisions in the near-term.

The DOE Phased Implementation decision addresses current regulatory requirements and cleanup commitments while maintaining the flexibility necessary to modify the TWRS program if emerging information (e.g., new characterization data, technology breakthroughs, etc.) indicates there is a need to change the direction of the program. At the same time, technology development activities, such as the Hanford Tanks Initiative, will continue, in order to provide alternative paths if preferred technologies do not perform as anticipated. In addition to current programs, the Conference Report for the Energy and Water Development Appropriations Act, 1997 recommends up to $15 million in technology development activities to support the tank waste program.

Other activities, which are critical to the overall TWRS program, will be conducted by DOE throughout Phase I. These activities include single-shell tank waste retrieval, developing methods for quantifying and characterizing the waste residuals left in the tanks following retrieval, and studying the leakage rate of tank wastes during the retrieval process. Contractors will have access to technologies being developed by other DOE programs and will be able to use these technologies if appropriate.

The Final EIS evaluated possible alternatives for remediating the tank waste. There are, as the Council noted, a great number of variations or combinations of alternatives; DOE could not evaluate all such combinations in the EIS. Rather, DOE evaluated a complete range of reasonable tank waste management options, and thereby obtained adequate information for the strategic choice of direction made in this ROD. The use of alternate fill material for tank closure was not evaluated directly, but such alternatives are qualitatively within the range of alternatives analyzed in detail, and DOE was adequately informed about them for the purposes of this EIS. These alternatives will be addressed more directly in future NEPA analysis on tank closure. In this EIS, DOE considered the use of subsurface barriers as a potential mitigation measure during tank waste retrieval. Subsurface barriers were also evaluated in a Feasibility Study completed in 1995. Additional development work is being performed by DOE, and if promising new developments occur, DOE will reconsider the application of subsurface barriers for the tanks. Two alternatives for partial retrieval of the wastes that were similar to the selective partial retrieval alternative that the Council recommended be analyzed were included in the alternatives analyzed. DOE will continue to reevaluate these and other alternatives as more information becomes available.

In situ disposal of single-shell tank wastes and in-tank stabilization of tanks with residuals (not removed by retrieval) have been the subject of previous studies and were evaluated as part of the Systems Engineering Study for the Closure of Single-Shell Tanks. Alternatives for closing tanks with residual waste were evaluated in the Engineering Study of Tank Fill Alternatives for Closure of Single-Shell Tanks released in September 1996. Additional studies supporting stabilization of tanks with residual waste remaining following completion of retrieval operations are planned during Fiscal Year 1997 and Fiscal Year 1998 as part of the Hanford Tanks Initiative.

In addition to the two ex situ/in situ tank waste disposal alternatives that were evaluated in the TWRS EIS, selective partial removal of wastes from tanks, using a risk-based approach, was evaluated in the study entitled "Remediation and Cleanout Levels for Hanford Site Single-Shell Tanks" (Westinghouse Hanford Company, 1995, WHC-SD-WM-TI-711).

This Record of Decision adopts a long-term strategy that will focus efforts on achieving the ultimate TWRS remediation goals while continuing to characterize tank wastes, evaluate new technologies and improve risk assessments. DOE believes that its past studies have reduced the uncertainties enough to enable DOE to make a decision on a long-term tank waste remediation strategy. Although this approach differs from the phased decision strategy recommended by the Council, DOE intends to implement its decision in a manner that is flexible enough to accommodate appropriate mid-course corrections in the tank waste remediation strategy, based on lessons learned in the pilot studies or from other new information.

Comment 3: The scope of the DEIS also has significant limitations. Because the DEIS does not address remediation of the tanks themselves and associated environmental contamination, the alternatives it considers for tank waste remediation are not defined well enough. In addition, the connections between tank remediation alternatives and other cleanup activities at the Hanford Site are not taken into account. Because tank waste remediation alternatives are analyzed and evaluated in isolation from other geographically-related contamination at the Hanford Site, information about risks and costs in the DEIS is difficult to place in a proper perspective.

Response 3: DOE agrees with the Council's observation that there is a ***8703** need to integrate remediation of the tank waste with future tank closure decisions and other geographically related remedial actions at the Hanford Site. The Final EIS addresses tank farm closure and other geographically related contamination and remediation activities to the extent possible with current information and to the extent necessary for DOE to make decisions concerning tank waste remediation. The EIS presents (1) information relative to closure to provide the public and decision makers with information on how decisions made now may affect future decisions on closure; (2) information on which alternatives would preclude the future selection of clean closure for the tank farms; and (3) information on cumulative impacts, including the effects of other site activities. This information provides a context for understanding the strategic decisions, now ripe, that are the focus of this EIS. To support the analysis, DOE used closure of a landfill as a representative closure scenario for each alternative, thus providing for a meaningful comparison of the alternatives. DOE intends to prepare a comprehensive plan to integrate tank waste remediation with tank farm closure activities and other Hanford Site remediation programs.

Comment 4: Decisions regarding tank remediation must consider risk, cost, and technical feasibility. Where risks are involved, care should be taken to present a range of potential risks, including expected or most likely estimates as well as the upper-bound estimates presented in the DEIS. While upper-bound estimates may give confidence that actual impacts will not exceed those presented in the DEIS from a worst-case perspective, the inherent uncertainties in risk assessments can distort the comparison of alternatives. This is of particular concern when the upper-bound estimates are derived from a cascade of parameters, much of which was also derived on an upper-bound basis.

While the committee recognizes the utility of quantitative risk assessment in the comparison of remedial alternatives, the limitations of analysis must be underscored. Given the complexity of the Hanford tank farms, many of the potential uncertainties cannot be measured, quantified, or expressed through statistically derived estimates. According to the 1996 National Research Council report Understanding Risk, the 1996 U.S. Environmental Protection Agency report Proposed Guidelines for Carcinogen Risk Assessment, and a recent draft report by the

Commission on Risk Assessment and Risk Management, characterization of risk should be both qualitative and quantitative. In this case, qualitative information should include a range of informed views on the risks and the evidence that supports them, the risk likelihood, and the magnitude of uncertainty. Such evaluations of risk should be based on deliberative scientific processes that clarify the concerns of interested and affected parties to prevent avoidable errors, provide a balanced understanding of the state of knowledge, and ensure broad participation in the decision-making process.

Response 4: DOE agrees with these comments and has modified the EIS accordingly in response to similar comments on the Draft EIS received during the public comment period. For example, DOE believes that characterization of the risk should be quantitative when possible and qualitative when parameters are uncertain by more than an order of magnitude. The Final EIS presents the "expected", or "nominal" ranges of risk and upper-bound estimates, and includes (in Appendix E) detailed analysis of uncertainties.

Comment 5: It should be expected that the environmental regulations governing the tank wastes, and the Hanford Site in general, will change over the time during which waste management and environmental remediation occur. DOE should work with the appropriate entities to ensure that future regulatory changes and the future selection of tank remediation approaches are on convergent paths. The development, testing, and analysis of alternatives during the first phase should continue unconstrained by current regulatory requirements and should examine currently untested technologies.

Response 5: DOE agrees that ongoing dialogue with the regulators is necessary to making sound tank waste management decisions. DOE continues to work with the Federal and State regulatory authorities and with the stakeholders to share evolving information regarding impacts and technologies. Toward that end, DOE developed the reasonable alternatives to be analyzed in the EIS on a scientific and engineering basis, then evaluated the alternatives for compliance with regulations. Only four of the ten alternatives addressed in the EIS could be implemented consistent with existing Federal and State regulations. The Record of Decision, however, selects a compliant approach.

Comment 6: Concerning the management and disposal of the cesium and strontium capsules and of the miscellaneous underground storage tanks, the committee found that the DEIS lacks enough substantive information for an evaluation of the proposed remediation strategies. Over 99 percent of the tank wastes is in the single-shell and double-shell tanks, and that is where the greatest potential for health and environmental risk exists. However, the extremely high concentration of radioactivity and the nature of the materials in the capsules necessitate a more thorough discussion of their treatment, disposal, and environmental impact. There are serious deficiencies in the attention given to the long-term changes in the chemical and isotopic composition of the cesium and strontium capsules. The large number and wide distribution of the miscellaneous underground storage tanks make a more complete discussion of their management necessary.

Response 6: DOE agrees with the Council that there is not enough substantive information regarding the cesium and strontium capsules to make a long-term decision on their final disposition. DOE also wants to evaluate potential beneficial uses of the capsules and has decided to defer any disposition of the capsules. In the meanwhile, a Cesium and Strontium Management Plan is currently being prepared by DOE that will address alternatives for beneficial uses of the capsules prior to final disposition. As part of the plan, DOE will continue to collect and analyze information regarding the capsules to reduce uncertainties and better understand long-term impacts, and to ensure that the long-term decision is appropriate.

With regard to the miscellaneous underground storage tanks, DOE believes, based on currently available information, that the waste contained in the miscellaneous underground storage tanks is similar to the waste contained in the single-shell tanks. Because the miscellaneous underground storage tanks represent a small percentage (0.5 percent) of the overall waste volume, the potential long-term impacts posed by the miscellaneous underground storage tanks are within the range of impacts calculated for the single-shell tanks and double-shell tanks. The short-term and long-term impacts associated with the miscellaneous underground storage tanks for activities such as waste retrieval and transfer were analyzed in the EIS.

Comment 7: The proper approach to decision making for tank farm cleanup is to use a phased decision strategy in which some cleanup activities would proceed in the first phase while ***8704** important information gaps are filled concurrently to define identified remediation alternatives more clearly, and possibly to identify new and better ones. As part of this strategy, periodic independent scientific and technical expert reviews should be conducted so that deficiencies may be recognized and midcourse corrections be made in the operational program.

Response 7: DOE agrees with the Council that periodic independent scientific and technical expert reviews are essential to the success of the TWRS program. While carrying out the current decisions, DOE will continually evaluate new information relative to the tank waste remediation program. DOE also intends to conduct formal evaluations of new information relative to the tank waste remediation program at three key points over the next eight years under its NEPA regulations (10 CFR 1021.314), with an appropriate level of public involvement, to ensure that DOE will stay on a correct course for managing and remediating the waste. As remediation proceeds in the coming years, DOE will learn more about management and remediation of the tank waste and ways to protect public and worker health and the environment. Within this time frame, DOE will obtain additional information on the effectiveness of retrieval technologies, characteristics of the tank wastes, effectiveness of waste separation and immobilization techniques, and more definitive data on the costs of retrieval, separations, and immobilization of the waste. These formal reevaluations will incorporate the latest information on these topics. DOE will conduct these formal evaluations of the entire TWRS program at the following stages: (1) before proceeding into Privatization Phase I Part B (scheduled for May 1998); (2) prior to the start of hot operations of Privatization Phase I Part B (scheduled for December 2002/December 2003); and (3) before deciding to proceed with Privatization Phase II (scheduled for December 2005). In conducting these reviews, DOE will seek the advice of independent experts from the scientific and financial community, such as the National Academy of Sciences which will focus on performance criteria and the costs of waste treatment. DOE has established a TWRS Privatization Review Board consisting of Senior DOE representatives to provide on-going assistance and interactive oversight of the review of Part A deliverables and discussions with the contractors.

Informal evaluations also will be conducted as the information warrants. These formal and informal evaluations will help DOE to determine whether previous decisions need to be changed.

Washington State Department of Fish and Wildlife Comment

Comment: The Washington State Department of Fish and Wildlife recommends that the following language be included in the Record of Decision:

"The site selection of the precise location of remediation facilities for the selected alternative shall be subject to future supplemental NEPA analysis. This supplemental NEPA analysis shall commit to a supplemental Mitigation Action Plan. The Mitigation Action Plan and supplemental Mitigation Action Plan will be prepared in consultation with the Washington State Department of Fish and Wildlife and the U.S. Fish and Wildlife Service, with input from the Hanford Site's Natural Resource Trustee Council."

"Impacts to State priority shrub-steppe habitat would be one of the evaluation criteria used in site selection. The site selection process would include the following hierarchy of measures:

- Avoid priority shrub-steppe habitat to the extent feasible by locating or configuring project elements in pre-existing disturbed areas.

- Minimize project impacts to the extent feasible by modifying facility layouts and/or altering construction timing."

"Compensatory mitigation measures for the loss of shrub-steppe habitat shall be identified and implemented in the supplemental NEPA analysis and Mitigation Action Plan."

Response: DOE believes that the following approach satisfies the substance of these comments.

The EIS (Section 5.20) describes both mitigation measures that are integral parts of all of the alternatives (Section 5.20.1) and further mitigation measures that could be implemented when indicated or appropriate (Section 5.20.2). In selecting the preferred alternative DOE has committed to all of the mitigation measures in Section 5.20.1, which include measures to restore newly disturbed areas. As the State requested, the Record of Decision commits to conducting NEPA analysis for site selection of facilities.

DOE intends to implement those further measures described in Section 5.20.2 as may be necessary to mitigate potential impacts on priority shrub-steppe habitat, and will consider the potential for such impacts as a factor in the site selection process for TWRS facilities. The site selection process will include the following hierarchy of measures: (1) avoid undisturbed shrub-steppe areas to the extent feasible; (2) minimize impacts to the extent feasible; (3) restore temporarily disturbed areas; (4) compensate for unavoidable impacts by replacing habitat; and (5) manage critical habitat on a Sitewide basis.

DOE believes that mitigation of impacts to habitats of special importance to the ecological health of the region is most effective when planned and implemented on a sitewide basis. Recognizing this, DOE is preparing a sitewide biological management plan to protect these resources. Under this sitewide approach, the potential impacts of all projects would be evaluated and appropriate mitigation would be developed based on the cumulative impacts to the ecosystem. Mitigation to reduce the ecological impacts from TWRS remediation would be performed in compliance with the sitewide biological management plan. Mitigation would focus on disturbance of contiguous, mature sagebrush-dominated shrub-steppe habitat. Compensation (habitat replacement) would occur where DOE deems appropriate. Specific mitigation ratios, sites, and planting strategies (e.g., plant size, number, and density) for TWRS facilities and operations would be defined in the TWRS Mitigation Action Plan, which would be revised for each specific TWRS facility siting decision. The Mitigation Action Plan would be prepared in consultation with the Washington State Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, and Tribal Nations, with input from the Hanford Site's Natural Resources Trustees Council. DOE will make the Mitigation Action Plan publicly available before taking action that is the subject of a mitigation commitment.

[FR Doc. 97-4696 Filed 2-25-97; 8:45 am]

BILLING CODE 6450-01-P

62 FR 8693-02, 1997 WL 77915 (F.R.)

Final

Environmental Impact Statement

for a

Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Volume II

Appendixes A through O

U.S. Department of Energy

Office of Civilian Radioactive Waste Management

DOE/EIS-0250

February 2002

Attachment 2

Appendix A

Inventory and Characteristics of Spent Nuclear Fuel, High-Level Radioactive Waste, and Other Materials

TABLE OF CONTENTS

Section — Page

A. Inventory and Characteristics of Spent Nuclear Fuel, High-Level Radioactive Waste, and Other Materials A-1

A.1 Introduction A-1
A.1.1 Inventory Data Summary A-2
A.1.1.1 Sources A-2
A.1.1.2 Present Storage and Generation Status A-4
A.1.1.3 Final Waste Form A-6
A.1.1.4 Waste Characteristics A-6
A.1.1.4.1 Mass and Volume A-6
A.1.1.4.2 Radionuclide Inventories A-8
A.1.1.4.3 Chemical Composition A-9
A.1.1.4.4 Thermal Output A-9
A.1.1.4.5 Canister Data A-10

A.2 Materials A-11
A.2.1 Commercial Spent Nuclear Fuel A-11
A.2.1.1 Background A-11
A.2.1.2 Sources A-11
A.2.1.3 Present Status A-11
A.2.1.4 Final Spent Nuclear Fuel Form A-13
A.2.1.5 Spent Nuclear Fuel Characteristics A-13
A.2.1.5.1 Mass and Volume A-14
A.2.1.5.2 Amount and Nature of Radioactivity A-14
A.2.1.5.3 Chemical Composition A-20
A.2.1.5.4 Thermal Output A-20
A.2.1.5.5 Physical Parameters A-21
A.2.2 DOE Spent Nuclear Fuel A-21
A.2.2.1 Background A-21
A.2.2.2 Sources A-25
A.2.2.3 Present Storage and Generation Status A-26
A.2.2.4 Final Spent Nuclear Fuel Form A-27
A.2.2.5 Spent Nuclear Fuel Characteristics A-28
A.2.2.5.1 Mass and Volume A-28
A.2.2.5.2 Amount and Nature of Radioactivity A-28
A.2.2.5.3 Chemical Composition A-28
A.2.2.5.4 Thermal Output A-33
A.2.2.5.5 Quantity of Spent Nuclear Fuel Per Canister A-33
A.2.2.5.6 Spent Nuclear Fuel Canister Parameters A-33
A.2.3 High-Level Radioactive Waste A-36
A.2.3.1 Background A-36
A.2.3.2 Sources A-37
A.2.3.2.1 Hanford Site A-37
A.2.3.2.2 Idaho National Engineering and Environmental Laboratory A-38
A.2.3.2.3 Savannah River Site A-38
A.2.3.2.4 West Valley Demonstration Project A-38
A.2.3.3 Present Status A-38

Section | Page
A.2.3.3.1 Hanford Site A-38
A.2.3.3.2 Idaho National Engineering and Environmental Laboratory A-38
A.2.3.3.3 Savannah River Site A-39
A.2.3.3.4 West Valley Demonstration Project A-39
A.2.3.4 Final Waste Form A-39
A.2.3.5 Waste Characteristics A-39
A.2.3.5.1 Mass and Volume A-39
A.2.3.5.2 Amount and Nature of Radioactivity A-40
A.2.3.5.3 Chemical Composition A-43
A.2.3.5.4 Thermal Output A-46
A.2.3.5.5 Quantity of Waste Per Canister A-48
A.2.3.5.6 High-Level Radioactive Waste Canister Parameters A-48
A.2.3.5.7 Nonstandard Packages A-49
A.2.4 Surplus Weapons-Usable Plutonium A-50
A.2.4.1 Background A-50
A.2.4.2 Sources A-51
A.2.4.3 Present Storage and Generation Status A-51
A.2.4.4 Final Waste Form A-51
A.2.4.5 Material Characteristics A-51
A.2.4.5.1 Mixed-Oxide Fuel A-51
A.2.4.5.2 Immobilized Plutonium A-53
A.2.5 Commercial Greater-Than-Class-C Low-Level Waste A-57
A.2.5.1 Background A-57
A.2.5.2 Sources A-58
A.2.5.3 Present Status A-58
A.2.5.4 Final Waste Form A-59
A.2.5.5 Waste Characteristics A-59
A.2.6 Special-Performance-Assessment-Required Low-Level Waste A-61
A.2.6.1 Background A-61
A.2.6.2 Sources A-61
A.2.6.3 Present Status A-62
A.2.6.4 Final Waste Form A-64
A.2.6.5 Waste Characteristics A-64

References A-64

LIST OF TABLES

Table | Page
A-1 Use of Appendix A radioactivity inventory data in EIS chapters and appendixes A-3
A-2 Selected radionuclide inventory for the Proposed Action A-9
A-3 Commercial nuclear power reactors in the United States and their projected years of operation A-12
A-4 Sites with existing or planned independent spent fuel storage installations A-13
A-5 Average spent nuclear fuel parameters A-13
A-6 Representative commercial spent nuclear fuel characteristics for accident analyses A-14
A-7 Proposed Action spent nuclear fuel inventory A-15

Table		Page
A-8	Inventory Modules 1 and 2 spent nuclear fuel inventory	A-16
A-9	Radionuclide activity for average pressurized-water reactor fuel assemblies	A-17
A-10	Radionuclide activity for average boiling-water reactor fuel assemblies	A-17
A-11	Total projected radionuclide inventories	A-18
A-12	Radionuclide activity for representative pressurized-water reactor fuel assemblies	A-21
A-13	Radionuclide activity for representative boiling-water reactor fuel assemblies	A-22
A-14	Stainless-steel-clad spent nuclear fuel inventory	A-22
A-15	Elemental distribution of average pressurized-water reactor fuel	A-23
A-16	Elemental distribution of average boiling-water reactor fuel	A-24
A-17	Average assembly thermal profiles	A-24
A-18	Reference characteristics for unirradiated typical fuel assemblies	A-25
A-19	DOE spent nuclear fuel categories	A-26
A-20	National Spent Nuclear Fuel Database projection of DOE spent nuclear fuel locations and inventories to 2035	A-27
A-21	Radionuclide activity by DOE spent nuclear fuel category	A-29
A-22	Chemical composition of DOE spent nuclear fuel by category	A-34
A-23	Maximum heat generation for DOE spent nuclear fuel	A-35
A-24	Required number of canisters for disposal of DOE spent nuclear fuel	A-35
A-25	Preliminary naval canister design parameters	A-36
A-26	Physical characteristics of high-level radioactive waste at the Idaho National Engineering and Environmental Laboratory	A-40
A-27	High-level radioactive waste mass and volume summary	A-40
A-28	Radionuclide distribution for Hanford Site high-level radioactive waste	A-41
A-29	Radionuclide distribution for Idaho National Engineering and Environmental Laboratory high-level radioactive waste	A-42
A-30	Radionuclide distribution for Savannah River Site high-level radioactive waste	A-43
A-31	Radionuclide distribution for West Valley Demonstration Project high-level radioactive waste	A-44
A-32	Expected chemical composition of Hanford high-level radioactive waste glass	A-44
A-33	Expected glass matrix chemical composition at Idaho Nuclear Technology and Engineering Center	A-45
A-34	Ceramic waste matrix chemical composition at Argonne National Laboratory-West	A-45
A-35	Expected metal waste matrix chemical composition at Argonne National Laboratory-West	A-46
A-36	Expected Savannah River Site high-level radioactive waste chemical composition	A-47
A-37	Expected West Valley Demonstration Project chemical composition	A-47
A-38	Idaho National Engineering and Environmental Laboratory waste stream thermal output	A-47
A-39	Approximate mass of high-level radioactive waste glass per canister	A-48
A-40	Parameters of the proposed standard canister for Hanford high-level radioactive waste disposal	A-49
A-41	Parameters of nonstandard packages from Savannah River Site	A-50
A-42	Parameters of nonstandard packages from West Valley Demonstration Project	A-50
A-43	Estimated spent nuclear fuel quantities for disposition of two-thirds of the surplus weapons-usable plutonium in mixed-oxide fuel	A-52
A-44	Assumed design parameters for typical mixed-oxide assembly	A-52

Table		Page
A-45	Radionuclide activity for typical pressurized-water reactor spent mixed-oxide assembly	A-53
A-46	Radionuclide activity for high-burnup pressurized-water reactor spent mixed-oxide assembly	A-53
A-47	Elemental distribution of typical burn-up pressurized-water reactor spent mixed-oxide assembly	A-54
A-48	Elemental distribution of high burn-up pressurized-water reactor spent mixed-oxide assembly	A-54
A-49	Mixed-oxide spent nuclear fuel thermal profile	A-55
A-50	Number of canisters required for immobilized plutonium disposition	A-56
A-51	Average total radioactivity of immobilized plutonium ceramic in a single canister in 2010	A-56
A-52	Chemical composition of baseline ceramic immobilization form	A-57
A-53	Thermal generation from immobilized plutonium ceramic in a single canister in 2010	A-57
A-54	Greater-Than-Class-C waste volume by generator source	A-59
A-55	Commercial Greater-Than-Class-C waste radioactivity by nuclide	A-60
A-56	Sealed-source Greater-Than-Class-C waste radioactivity by nuclide	A-60
A-57	Other generator Greater-Than-Class-C waste radioactivity by nuclide	A-61
A-58	Typical chemical composition of Greater-Than-Class-C wastes	A-61
A-59	Estimated Special-Performance-Assessment-Required low-level waste volume and mass by generator source	A-62
A-60	Hanford Special-Performance-Assessment-Required low-level waste radioactivity by nuclide	A-62
A-61	Idaho National Engineering and Environmental Laboratory (including Argonne National Laboratory-West) Special-Performance-Assessment-Required low-level waste radioactivity by nuclide	A-62
A-62	Oak Ridge National Laboratory Special-Performance-Assessment-Required low-level waste radioactivity by nuclide	A-63
A-63	Radioactivity of naval Special-Performance-Assessment-Required waste	A-63
A-64	Typical chemical composition of Special-Performance-Assessment-Required low-level waste	A-63

LIST OF FIGURES

Figure		Page
A-1	Locations of commercial and DOE sites and Yucca Mountain	A-5
A-2	Proposed Action spent nuclear fuel and high-level radioactive waste inventory	A-7
A-3	Inventory Module 2 volume	A-8
A-4	Proposed Action radionuclide distribution by material type	A-9
A-5	Thermal generation	A-10
A-6	Average thermal profiles over time	A-25

APPENDIX A. INVENTORY AND CHARACTERISTICS OF SPENT NUCLEAR FUEL, HIGH-LEVEL RADIOACTIVE WASTE, AND OTHER MATERIALS

A.1 Introduction

This appendix describes the inventory and characteristics of the spent nuclear fuel and high-level radioactive waste that the U.S. Department of Energy (DOE) anticipates it would place in a monitored geologic repository at Yucca Mountain. It includes information about other highly radioactive material that DOE could dispose of in the proposed repository. It also provides information on the background and sources of the material, present storage conditions, the final disposal forms, and the amounts and characteristics of the material. The data provided in this appendix are the best available estimates of projected inventories.

The Proposed Action inventory evaluated in this environmental impact statement (EIS) consists of 70,000 metric tons of heavy metal (MTHM), comprised of 63,000 MTHM of commercial spent nuclear fuel and 7,000 MTHM of DOE materials. The DOE materials consist of 2,333 MTHM of spent nuclear fuel and 4,667 MTHM (8,315 canisters) of solidified high-level radioactive waste. The inventory includes surplus weapons-usable plutonium, which would be in the forms of spent mixed-oxide fuel and immobilized plutonium.

The Nuclear Waste Policy Act, as amended (also called the NWPA), prohibits the U.S. Nuclear Regulatory Commission from approving the emplacement of more than 70,000 MTHM in the first repository until a second repository is in operation [Section 114(d)]. However, in addition to the Proposed Action, this EIS evaluates the cumulative impacts for two additional inventories (referred to as Inventory Modules 1 and 2):

- The Module 1 inventory consists of the Proposed Action inventory plus the remainder of the total projected inventory of commercial spent nuclear fuel (for maximum projections, see Section A.2.1.5.1), high-level radioactive waste, and DOE spent nuclear fuel. Emplacement of Inventory Module 1 wastes in the repository would raise the total amount emplaced above 70,000 MTHM. As mentioned above, emplacement of more than 70,000 MTHM of spent nuclear fuel and high-level radioactive waste would require legislative action by Congress unless a second licensed repository was in operation.
- Inventory Module 2 includes the Module 1 inventory plus the inventories of the candidate materials, commercial Greater-Than-Class-C low-level radioactive waste and DOE Special-Performance-Assessment-Required waste. There are several reasons to evaluate the potential for disposing of these candidate materials in a monitored geologic repository in the near future. Because both materials exceed Class C low-level radioactive limits for specific radionuclide concentrations as defined in 10 CFR Part 61, they are generally unsuitable for near-surface disposal. Also, the Nuclear Regulatory Commission specifies in 10 CFR 61.55(a)(2)(iv) the disposal of Greater-Than-Class-C waste in a repository unless the Commission approved disposal elsewhere. Further, during the scoping process for this EIS, several commenters requested that DOE evaluate the disposal of other radioactive waste types that might require isolation in a repository. Disposal of Greater-Than-Class-C and Special-Performance-Assessment-Required wastes at the proposed Yucca Mountain Repository could require a determination by the Nuclear Regulatory Commission that these wastes require permanent isolation. The present 70,000-MTHM limit on waste at the Yucca Mountain Repository could have to be addressed either by legislation or by opening a second licensed repository.

A.1.1.3 Final Waste Form

Other than drying or potential repackaging, treating is not necessary for commercial spent nuclear fuel. Therefore, the final form would be spent nuclear fuel either as bare intact assemblies or in sealed canisters. Bare intact fuel assemblies are those with structural and cladding integrity such that they can be handled and shipped to the repository in an approved shipping container for repackaging in a waste package in the Waste Handling Building. Other assemblies would be shipped to the repository in canisters that were either intended or not intended for disposal. Canisters not intended for disposal would be opened and their contents repackaged in waste packages in the Waste Handling Building.

For most of the DOE spent nuclear fuel categories, the fuel would be shipped in disposable canisters (canisters that can be shipped and are suitable for direct insertion into waste packages without being opened) in casks licensed by the Nuclear Regulatory Commission. Uranium oxide fuels with intact zirconium alloy cladding are similar to commercial spent nuclear fuel and could be shipped either in DOE standard canisters or as bare intact assemblies. Uranium metal fuels from Hanford and aluminum-based fuels from the Savannah River Site could require additional treatment or conditioning before shipment to the repository. If treatment was required, these fuels would be packaged in DOE disposable canisters. Category 14 sodium-bonded fuels are also expected to require treatment before disposal.

High-level radioactive waste shipped to the repository would be in stainless-steel canisters. The waste would have undergone a solidification process that yielded a leach-resistant material, typically a glass form called borosilicate glass. In this process, the high-level radioactive waste is mixed with glass-forming materials, heated and converted to a durable glass waste form, and poured into stainless-steel canisters (DIRS 104406-Picha 1997, Attachment 4, p. 2). Ceramic and metal waste matrices would be sent to the repository from Argonne National Laboratory-West in Idaho. The ceramic and metal matrices would be different solidified mixtures that also would be in stainless-steel canisters. These wastes would be the result of the electrometallurgical treatment of sodium bonded fuels.

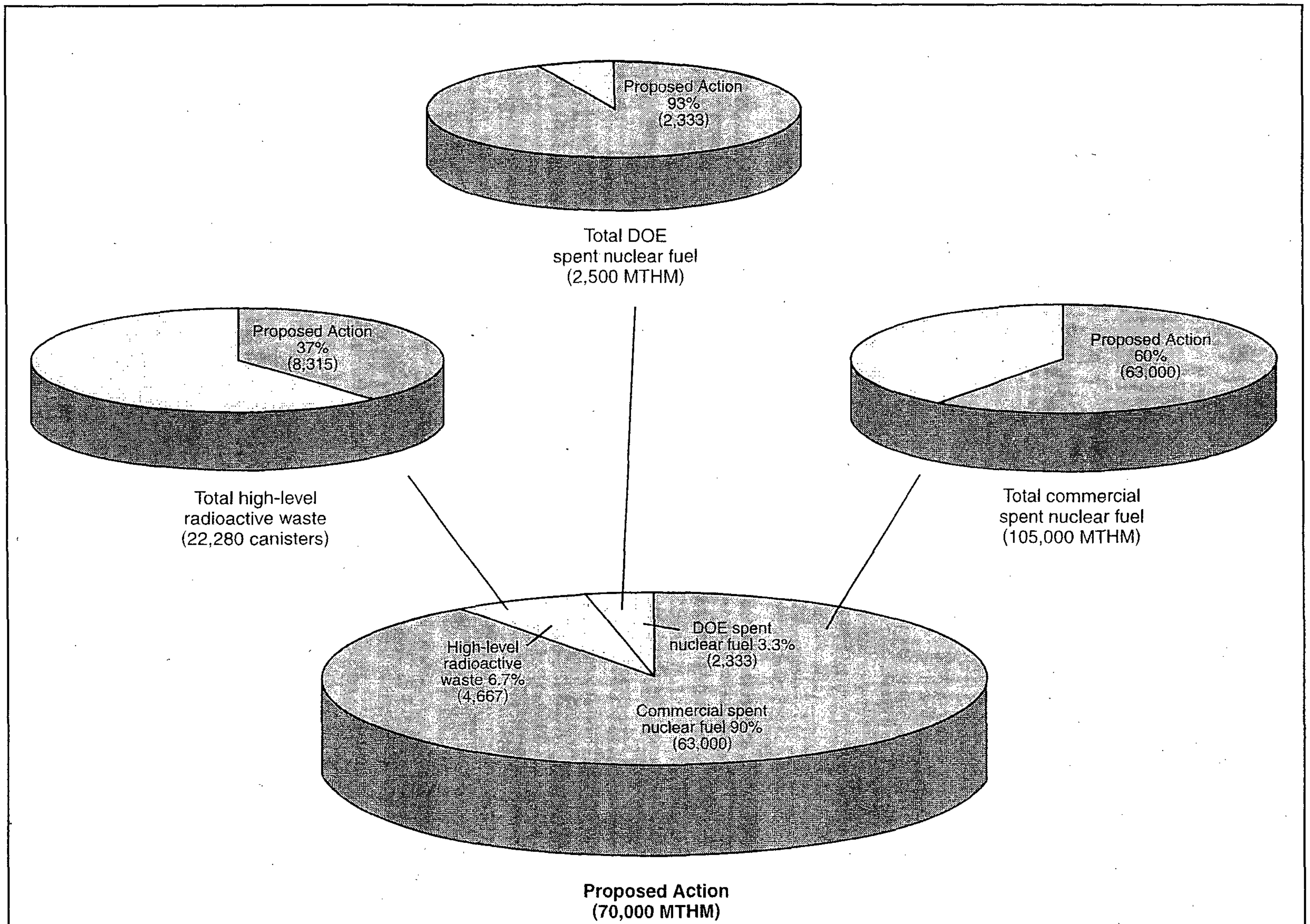
As briefly described in Section A.1.1.1, the surplus weapon-usable plutonium could be sent to the repository in two different waste forms—spent mixed-oxide fuel assemblies or an immobilized plutonium ceramic form in a high-level radioactive waste canister and surrounded by high-level radioactive waste. The spent mixed-oxide fuel assemblies would be very similar to conventional low-enriched uranium assemblies and DOE would treat them as such. The immobilized plutonium would be placed in small cans, inserted in the high-level radioactive waste canisters, and covered with molten borosilicate glass (can-in-canister technique). The canisters containing immobilized plutonium and high-level radioactive waste would be externally identical to the normal high-level radioactive waste canisters.

A.1.1.4 Waste Characteristics

A.1.1.4.1 *Mass and Volume*

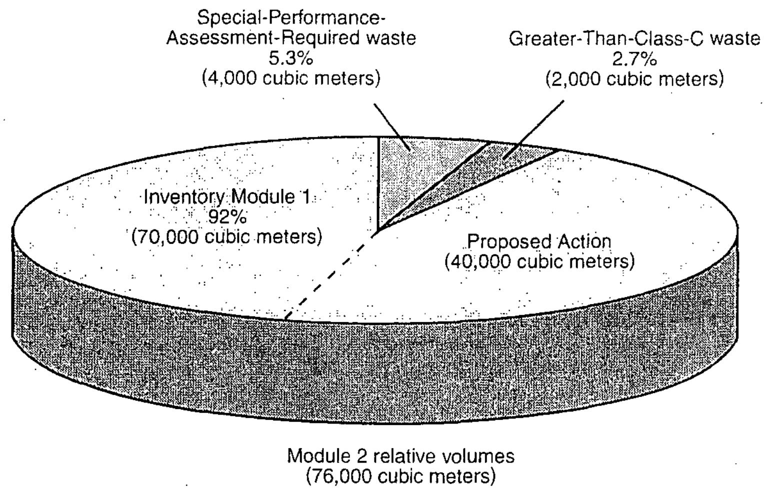
As discussed in Section A.1, the Proposed Action includes 70,000 MTHM in the forms of commercial spent nuclear fuel, DOE spent nuclear fuel, high-level radioactive waste, and surplus weapons-usable plutonium. Figure A-2 shows percentages of MTHM included in the Proposed Action and the relative amounts of the totals of the individual waste types included in the Proposed Action. As stated above, the remaining portion of the wastes is included in Inventory Module 1. Because Greater-Than-Class-C and Special-Performance-Assessment-Required wastes are measured in terms of volume, Figure A-3 shows the relative volume of the wastes in Inventory Module 2 compared to the inventory in Module 1.

The No-Action Alternative (see Chapter 7 and Appendix K) used this information to estimate the mass and volume of the spent nuclear fuel and high-level radioactive waste at commercial and DOE sites in five regions of the contiguous United States.



Sources: DIRS 103493-DOE (1997, page 32); DIRS 148240-Dirkmaat (1998, all); DIRS 104406-Picha (1997, Attachment 1, page 1); DIRS 104407-Picha (1998, Attachment 1).

Figure A-2. Proposed Action spent nuclear fuel and high-level radioactive waste inventory.



To convert cubic meters to cubic yards, multiply by 1.3079.

Sources: DIRS 148240-Dirkmaat (1998, all); DIRS 101798-DOE (1994, all); DIRS 101815-DOE (1997, p. 1-8); DIRS 104394-Heath (1998, Appendixes B and C); DIRS 104406-Picha (1997, Attachment 1, p. 1); DIRS 104407-Picha (1998, Attachment 1); DIRS 104411-Picha (1998, all).

Figure A-3. Inventory Module 2 volume.

The mass and volume data for commercial spent nuclear fuel are based on annual tracking of current inventories and projections of future generations. Because increases in spent nuclear fuel inventories due to plant life extensions have been factored into the Module 1 and 2 inventories, DOE anticipates few changes in the overall mass and volume projections for this waste type. The data projections for DOE spent nuclear fuel are fairly stable because most of the projected inventory already exists, as opposed to having a large amount projected for future generation. Mass and volume data for high-level radioactive waste estimates are not as reliable. Most high-level radioactive waste currently exists as a form other than solidified borosilicate glass. The solidification processes at the Savannah River Site and West Valley Demonstration Project began in the mid-1990s; therefore, their resulting masses and volumes are known. However, the processes at the Idaho National Engineering and Environmental Laboratory and the Hanford Site have not started. Therefore, there is some uncertainty about the mass and volume that would result from those processing operations. For this analysis, DOE assumed that the high-level radioactive waste from the Hanford Site and the Idaho National Engineering and Environmental Laboratory would represent approximately 63 and 6 percent of the total high-level radioactive waste inventory, respectively, in terms of the number of canisters.

A.1.1.4.2 *Radionuclide Inventories*

The primary purpose of presenting these data is to quantify the radionuclide inventory expected in the projected waste types. These data were used for accident scenario analyses associated with transportation, handling, and repository operations.

In a comparison of the relative amounts of radioactivity in a particular waste type, radionuclides of concern depend on the analysis being performed. For example, cesium-137 is the primary radionuclide of concern when reviewing preclosure impacts and shielding requirements. For postclosure impacts, the repository performance assessment identified technetium-99 and neptunium-237 as the nuclides that provide the greatest impacts. Plutonium-238 and -239 are shown in Chapter 7 to contribute the most to doses for the No-Action Alternative. Table A-2 presents the inventory of each of these radionuclides included in the Proposed Action. Figure A-4 shows that at least 92 percent of the total inventory of each of these radionuclides is in commercial spent nuclear fuel.

Table A-3. Commercial nuclear power reactors in the United States and their projected years of operation.[a]

Unit name	Reactor type[b]	State	Operations period[c]
Arkansas Nuclear One 1[d]	PWR	AR	1974-2034
Arkansas Nuclear One 2	PWR	AR	1978-2018
Beaver Valley 1	PWR	PA	1976-2016
Beaver Valley 2	PWR	PA	1978-2018
Big Rock Point	BWR	MI	1963-1997
Braidwood 1	PWR	IL	1987-2026
Braidwood 2	PWR	IL	1988-2027
Browns Ferry 1	BWR	AL	1973-2013
Browns Ferry 2	BWR	AL	1974-2014
Browns Ferry 3	BWR	AL	1976-2016
Brunswick 1	BWR	NC	1976-2016
Brunswick 2	BWR	NC	1974-2014
Byron 1	PWR	IL	1985-2024
Byron 2	PWR	IL	1987-2026
Callaway	PWR	MO	1984-2024
Calvert Cliffs 1[d]	PWR	MD	1974-2034
Calvert Cliffs 2[d]	PWR	MD	1976-2036
Catawba 1	PWR	SC	1985-2024
Catawba 2	PWR	SC	1986-2026
Clinton	BWR	IL	1987-2026
Comanche Peak 1	PWR	TX	1990-2030
Comanche Peak 2	PWR	TX	1993-2033
Cooper Station	BWR	NE	1974-2014
Crystal River 3	PWR	FL	1977-2016
D. C. Cook 1	PWR	MI	1974-2014
D. C. Cook 2	PWR	MI	1977-2017
Davis-Besse	PWR	OH	1977-2017
Diablo Canyon 1	PWR	CA	1984-2021
Diablo Canyon 2	PWR	CA	1985-2025
Dresden 1	BWR	IL	1959-1978
Dresden 2	BWR	IL	1969-2006
Dresden 3	BWR	IL	1971-2011
Duane Arnold 1	BWR	IA	1974-2014
Edwin I. Hatch 1	BWR	GA	1974-2014
Edwin I. Hatch 2	BWR	GA	1978-2018
Fermi 2	BWR	MI	1985-2025
Fort Calhoun 1	PWR	NE	1973-2013
Ginna	PWR	NY	1969-2009
Grand Gulf 1	BWR	MS	1984-2022
Haddam Neck	PWR	CT	1968-1996
Hope Creek	BWR	NJ	1986-2026
Humboldt Bay	BWR	CA	1962-1976
H.B. Robinson 2	PWR	SC	1970-2010
Indian Point 1	PWR	NY	1962-1974
Indian Point 2	PWR	NY	1973-2013
Indian Point 3	PWR	NY	1976-2015
James A. FitzPatrick/ Nine Mile Point	BWR	NY	1974-2014
Joseph M. Farley 1	PWR	AL	1977-2017
Joseph M. Farley 2	PWR	AL	1981-2021
Kewaunee	PWR	WI	1973-2013
LaCrosse	BWR	WI	1967-1987
LaSalle 1	BWR	IL	1970-2022
LaSalle 2	BWR	IL	1970-2023
Limerick 1	BWR	PA	1985-2024
Limerick 2	BWR	PA	1989-2029
Maine Yankee	PWR	ME	1972-1996
McGuire 1	PWR	NC	1981-2021
McGuire 2	PWR	NC	1983-2023
Millstone 1	BWR	CT	1970-2010
Millstone 2	PWR	CT	1975-2015
Millstone 3	PWR	CT	1986-2025
Monticello	BWR	MN	1971-2010
Nine Mile Point 1	BWR	NY	1969-2009
Nine Mile Point 2	BWR	NY	1987-2026
North Anna 1	PWR	VA	1978-2018
North Anna 2	PWR	VA	1980-2020
Oconee 1[d]	PWR	SC	1973-2033
Oconee 2[d]	PWR	SC	1973-2033
Oconee 3[d]	PWR	SC	1974-2034
Oyster Creek	BWR	NJ	1969-2009
Palisades	PWR	MI	1972-2007
Palo Verde 1	PWR	AZ	1985-2024
Palo Verde 2	PWR	AZ	1986-2025
Palo Verde 3	PWR	AZ	1987-2027
Peach Bottom 2	BWR	PA	1973-2013
Peach Bottom 3	BWR	PA	1974-2014
Perry 1	BWR	OH	1986-2026
Pilgrim 1	BWR	MA	1972-2012
Point Beach 1	PWR	WI	1970-2010
Point Beach 2	PWR	WI	1973-2013
Prairie Island 1	PWR	MN	1974-2013
Prairie Island 2	PWR	MN	1974-2014
Quad Cities 1	BWR	IL	1972-2012
Quad Cities 2	BWR	IL	1972-2012
Rancho Seco	PWR	CA	1974-1989
River Bend 1	BWR	LA	1985-2025
Salem 1	PWR	NJ	1976-2016
Salem 2	PWR	NJ	1981-2020
San Onofre 1	PWR	CA	1967-1992
San Onofre 2	PWR	CA	1982-2013
San Onofre 3	PWR	CA	1983-2013
Seabrook 1	PWR	NH	1990-2026
Sequoyah 1	PWR	TN	1980-2020
Sequoyah 2	PWR	TN	1981-2021
Shearon Harris	PWR	NC	1987-2026
South Texas Project 1	PWR	TX	1988-2016
South Texas Project 2	PWR	TX	1989-2023
St. Lucie 1	PWR	FL	1976-2016
St. Lucie 2	PWR	FL	1983-2023
Summer 1	PWR	SC	1982-2022
Surry 1	PWR	VA	1972-2012
Surry 2	PWR	VA	1973-2013
Susquehanna 1	BWR	PA	1982-2022
Susquehanna 2	BWR	PA	1984-2024
Three Mile Island 1	PWR	PA	1974-2014
Trojan	PWR	OR	1975-1992
Turkey Point 3	PWR	FL	1972-2012
Turkey Point 4	PWR	FL	1973-2013
Vermont Yankee	BWR	VT	1973-2012
Vogtle 1	PWR	GA	1987-2027
Vogtle 2	PWR	GA	1989-2029
Columbia Generating Station	BWR	WA	1984-2023
Waterford 3	PWR	LA	1985-2024
Watts Bar 1	PWR	TN	1996-2035
Wolf Creek	PWR	KS	1985-2025
Yankee-Rowe	PWR	MA	1963-1991
Zion 1	PWR	IL	1973-1997
Zion 2	PWR	IL	1974-1996

a. Source: DIRS 103493-DOE (1997, Appendix C).

b. PWR = pressurized-water reactor; BWR = boiling-water reactor.

c. As defined by current shutdown or full operation through license period (as of 1997), except as noted in Footnote d.

d. These plants have recently been granted 20-year operating license extensions. Several additional plants have applied for operating license extensions, and others could do so in the future.

Table A-7. Proposed Action spent nuclear fuel inventory (MTHM).[a]

Site	Fuel type[b]	1995 actual	1996-2011[c]	Total[d]	Equivalent assemblies	Site	Fuel type[b]	1995 actual	1996-2011[c]	Total[d]	Equivalent assemblies
Arkansas Nuclear One	PWR	643	466	1,109	2,526	Monticello	BWR	147	280	426	2,324
Beaver Valley	PWR	437	581	1,018	2,206	North Anna	PWR	570	613	1,184	2,571
Big Rock Point	BWR	44	14	58	439	Oconee	PWR	1,098	767	1,865	4,028
Braidwood	PWR	318	711	1,029	2,424	Oyster Creek	BWR	374	325	699	3,824
Browns Ferry	BWR	840	1,092	1,932	10,402	Palisades	PWR	338	247	585	1,473
Brunswick	Both	448	448	896	4,410	Palo Verde	PWR	556	1,118	1,674	4,082
Byron	PWR	404	664	1,068	2,515	Peach Bottom	BWR	908	645	1,554	8,413
Callaway	PWR	280	422	702	1,609	Perry	BWR	178	274	452	2,470
Calvert Cliffs	PWR	641	501	1,142	2,982	Pilgrim	BWR	326	201	527	2,853
Catawba	PWR	465	683	1,148	2,677	Point Beach	PWR	529	347	876	2,270
Clinton	BWR	174	303	477	2,588	Prairie Island	PWR	518	348	866	2,315
Comanche Peak	PWR	176	821	998	2,202	Quad Cities	BWR	813	464	1,277	6,953
Cooper	BWR	175	277	452	2,435	Rancho Seco	PWR	228	--[e]	228	493
Crystal River	PWR	280	232	512	1,102	River Bend	BWR	176	356	531	2,889
D. C. Cook	PWR	777	656	1,433	3,253	Salem/Hope Creek	Both	793	866	1,659	7,154
Davis-Besse	PWR	243	262	505	1,076	San Onofre	PWR	722	701	1,423	3,582
Diablo Canyon	PWR	463	664	1,126	2,512	Seabrook	PWR	133	292	425	918
Dresden	BWR	1,557	590	2,146	11,602	Sequoyah	PWR	452	570	1,023	2,218
Duane Arnold	BWR	258	208	467	2,545	Shearon Harris	Both	498	252	750	2,499
Edwin I. Hatch	BWR	755	692	1,446	7,862	South Texas Project	PWR	290	722	1,012	1,871
Fermi	BWR	155	368	523	2,898	St. Lucie	PWR	601	419	1,020	2,701
Fort Calhoun	PWR	222	157	379	1,054	Summer	PWR	225	301	526	1,177
Ginna	PWR	282	180	463	1,234	Surry	PWR	660	534	1,194	2,604
Grand Gulf	BWR	349	506	856	4,771	Susquehanna	BWR	628	648	1,276	7,172
H. B. Robinson	PWR	145	239	384	903	Three Mile Island	PWR	311	236	548	1,180
Haddam Neck	PWR	355	65	420	1,017	Trojan	PWR	359	--	359	780
Humboldt Bay	BWR	29	--	29	390	Turkey Point	PWR	616	458	1,074	2,355
Indian Point	PWR	678	486	1,164	2,649	Vermont Yankee	BWR	387	222	609	3,299
James A. FitzPatrick/ Nine Mile Point	BWR	882	930	1,812	9,830	Vogtle	PWR	335	745	1,080	2,364
						Columbia Generating Station	BWR	243	338	581	3,223
Joseph M. Farley	PWR	644	530	1,174	2,555						
Kewaunee	PWR	282	169	451	1,172						
La Crosse	BWR	38	--	38	333	Waterford	PWR	253	247	500	1,217
La Salle	BWR	465	487	952	5,189	Watts Bar	PWR	--	251	251	544
Limerick	BWR	432	711	1,143	6,203	Wolf Creek	PWR	226	404	630	1,360
Maine Yankee	PWR	454	82	536	1,421	Yankee-Rowe	PWR	127	--	127	533
McGuire	PWR	714	725	1,439	3,257	Zion	PWR	841	211	1,052	2,302
Millstone	Both	959	749	1,709	6,447	***Totals***		***31,926***	***31,074***	***63,000***	***218,700***

a. Source: DIRS 155725-CRWMS M&O (1998, all).
b. PWR = pressurized-water reactor; BWR = boiling-water reactor.
c. Projected.
d. To convert metric tons to tons, multiply by 1.1023.
e. -- = no spent nuclear fuel production.

determined that 51 radionuclides represent all of the health-significant species that can contribute to a radiological dose if released in an accident. The derivation of the list of radionuclides of interest in terms of impacts to the public is described in Appendix H, Section H.2.1.4.1. Tables A-9 and A-10 list these radionuclides and their inventories for average pressurized-water and boiling-water reactor spent nuclear fuel assemblies. The inventories are presented at the average decay years for each of the assemblies.

Table A-11 combines the average inventories (curies per MTHM) with the projected totals (63,000 MTHM and 105,000 MTHM) to provide a total projected radionuclide inventory for the Proposed Action and additional modules.

Table A-8. Inventory Modules 1 and 2 spent nuclear fuel inventory (MTHM).[a]

Site	Fuel type[b]	1995 actual	1996-2046[c]	Total[d]	Equivalent assemblies
Arkansas Nuclear One	PWR	643	1,007	1,650	3,757
Beaver Valley	PWR	437	1,395	1,832	3,970
Big Rock Point	BWR	44	14	58	439
Braidwood	PWR	318	1,969	2,287	5,385
Browns Ferry	BWR	840	2,508	3,348	18,024
Brunswick	Both	448	992	1,440	7,355
Byron	PWR	404	1,777	2,181	5,139
Callaway	PWR	280	1,008	1,288	2,953
Calvert Cliffs	PWR	641	1,069	1,710	4,466
Catawba	PWR	465	1,752	2,217	5,168
Clinton	BWR	174	910	1,084	5,876
Comanche Peak	PWR	176	2,459	2,635	5,816
Cook	PWR	777	1,379	2,155	4,892
Cooper	BWR	175	587	762	4,106
Crystal River	PWR	280	525	805	1,734
Davis-Besse	PWR	243	582	825	1,757
Diablo Canyon	PWR	463	1,725	2,187	4,878
Dresden	BWR	1,557	984	2,541	13,740
Duane Arnold	BWR	258	434	692	3,776
Fermi	BWR	155	1,005	1,160	6,429
Fort Calhoun	PWR	222	312	534	1,485
Ginna	PWR	282	283	565	1,507
Grand Gulf	BWR	349	1,261	1,610	8,976
H. B. Robinson	PWR	145	364	509	1,197
Haddam Neck	PWR	355	65	420	1,017
Hatch	BWR	755	1,517	2,272	12,347
Humboldt Bay	BWR	29	--	29	390
Indian Point	PWR	678	1,005	1,683	3,787
James A. FitzPatrick/ Nine Mile Point	BWR	882	2,018	2,900	15,732
Joseph M. Farley	PWR	644	1,225	1,869	4,070
Kewaunee	PWR	282	330	612	1,591
La Crosse	BWR	38	--	38	333
La Salle	BWR	465	1,398	1,863	10,152
Limerick	BWR	432	1,958	2,390	12,967
Maine Yankee	PWR	454	82	536	1,421
McGuire	PWR	714	1,813	2,527	5,720
Millstone	Both	959	1,695	2,655	8,930

Site	Fuel type[b]	1995 actual	1996-2046[c]	Total[d]	Equivalent assemblies
Monticello	BWR	147	390	537	2,924
North Anna	PWR	570	1,384	1,955	4,246
Oconee	PWR	1,098	1,576	2,674	5,774
Oyster Creek	BWR	374	470	844	4,619
Palisades	PWR	338	395	733	1,845
Palo Verde	PWR	556	3,017	3,573	8,712
Peach Bottom	BWR	908	1,404	2,312	12,523
Perry	BWR	178	732	910	4,974
Point Beach	PWR	529	614	1,143	2,961
Prairie Island	PWR	518	692	1,210	3,234
Quad Cities	BWR	813	1,020	1,834	9,982
Pilgrim	BWR	326	444	770	4,170
Rancho Seco	PWR	228	--[e]	228	493
River Bend	BWR	176	956	1,132	6,153
Salem/Hope Creek	Both	793	2,452	3,245	11,584
San Onofre	PWR	722	1,321	2,043	5,144
Seabrook	PWR	133	831	964	2,083
Sequoyah	PWR	452	1,393	1,845	4,001
Shearon Harris	Both	498	707	1,205	3,535
South Texas Project	PWR	290	2,029	2,319	4,286
St. Lucie	PWR	601	1,010	1,611	4,265
Summer	PWR	225	732	958	2,141
Surry	PWR	660	1,029	1,689	3,682
Susquehanna	BWR	628	1,745	2,373	13,338
Three Mile Island	PWR	311	513	825	1,777
Trojan	PWR	359	--	359	780
Turkey Point	PWR	616	905	1,520	3,334
Vermont Yankee	BWR	387	434	822	4,451
Vogtle	PWR	335	2,122	2,458	5,378
Columbia Generating Station	BWR	243	924	1,167	6,476
Waterford	PWR	253	685	938	2,282
Watts Bar	PWR	--	893	893	1,937
Wolf Creek	PWR	226	1,052	1,278	2,759
Yankee-Rowe	PWR	127	--	127	533
Zion	PWR	841	211	1,052	2,302
Totals		*31,926*	*73,488*	*105,414*	*359,963*

a. Source: DIRS 155725-CRWMS M&O (1998, all).
b. PWR = pressurized-water reactor; BWR = boiling-water reactor.
c. Projected.
d. To convert metric tons to tons, multiply by 1.1023.
e. -- = no spent nuclear fuel production.

DOE used the fuel characteristics derived in Section A.2.1.5 and listed in Table A-6 to establish the fission product and radionuclide inventories of the pressurized-water and boiling-water reactor representative fuel assemblies used for accident analyses. For these analyses, DOE included a radionuclide contribution from activated corrosion products deposited on the surfaces of spent nuclear fuel assemblies during reactor operation. This material is called *crud*.

DOE used the fuel assembly surface concentration values in *Reexamination of Spent Fuel Shipment Risk Estimates* (DIRS 152476-Sprung et. al. 2000, all) to develop the radioactive inventory from crud. The crud contains eight radionuclides. However, because all of these radionuclides except cobalt-60 decay rapidly, after storage (aging) for 5 years or longer, cobalt-60 is the only significant radionuclide remaining. The surface concentration values at discharge from the reactor range from 2 to 140 microcuries per square centimeter for pressurized-water reactor fuel assemblies and from 11 to 595 microcuries per square centimeter for boiling-water reactor assemblies, based on measurements of fuel rods (DIRS 152476-Sprung et al. 2000, p. 7-48; DIRS 103696-Sandoval 1991, all). Due to the wide range in concentration values and the limited number of measurements, DOE elected to use the maximum (cobalt-60) crud concentration numbers (DIRS 152476-Sprung et al. 2000, p. 7-48).

Table A-19. DOE spent nuclear fuel categories.[a,b,c]

	DOE SNF category	Typically from	Description of fuel
1.	Uranium metal	N-Reactor	Uranium metal fuel compounds with aluminum or zirconium alloy cladding
2.	Uranium-zirconium	HWCTR	Uranium alloy fuel compounds with zirconium alloy cladding
3.	Uranium-molybdenum	Fermi	Uranium-molybdenum alloy fuel compounds with zirconium alloy cladding
4.	Uranium oxide, intact	Commercial PWR	Uranium oxide fuel compounds with zirconium alloy or stainless-steel cladding in fair to good condition
5.	Uranium oxide, failed/ declad/aluminum clad	TMI core debris	Uranium oxide fuel compounds: (1) without cladding; (2) clad with zirconium alloy, Hastelloy, nickel-chromium, or stainless steel in poor or unknown condition; or (3) nondegraded aluminum clad
6.	Uranium-aluminide	ATR	Uranium-aluminum alloy fuel compounds with aluminum cladding
7.	Uranium-silicide	FRR MTR	Uranium silicide fuel compounds with aluminum cladding
8.	Thorium/uranium carbide, high-integrity	Fort St. Vrain	Thorium/uranium carbide fuel compounds with graphite cladding in good condition
9.	Thorium/uranium carbide, low-integrity	Peach Bottom	Thorium/uranium carbide fuel compounds with graphite cladding in unknown condition
10.	Plutonium/uranium carbide, nongraphite	FFTF carbide	Uranium carbide or plutonium-uranium carbide fuel compounds with or without stainless-steel cladding
11.	Mixed oxide	FFTF oxide	Plutonium/uranium oxide fuel compounds in zirconium alloy, stainless-steel, or unknown cladding
12.	Uranium/thorium oxide	Shippingport LWBR	Uranium/thorium oxide fuel compounds with zirconium alloy or stainless-steel cladding
13.	Uranium-zirconium hydride	TRIGA	Uranium-zirconium hydride fuel compounds with or without Incalloy, stainless-steel, or aluminum cladding
14.	Sodium-bonded	EBR-II driver and blanket, Fermi-I blanket	Uranium and uranium-plutonium metallic alloy with predominantly stainless-steel cladding
15.	Naval fuel	Surface ship/ submarine	Uranium-based with zirconium alloy cladding
16.	Miscellaneous	Not specified	Various fuel compounds with or without zirconium alloy, aluminum, Hastelloy, tantalum, niobium, stainless-steel or unknown cladding

a. Source: DIRS 104385-Fillmore (1998, all).

b. Abbreviations: SNF = spent nuclear fuel; HWCTR = heavy-water cooled test reactor; PWR = pressurized-water reactor; TMI = Three Mile Island; ATR = Advanced Test Reactor; FRR MTR = foreign research reactor – material test reactor; FFTF = Fast Flux Test Facility; LWBR = light-water breeder reactor; TRIGA = Training Research Isotopes—General Atomic; EBR-II = Experimental Breeder Reactor II.

c. For ongoing repository performance analyses, the 16 DOE fuel categories have been reduced to 11 categories (DIRS 118968-DOE 2000, all) since the publication of the Draft EIS. The reduction reflects a better understanding of the behavior of DOE fuels under repository conditions and allows the combining of some of the 16 DOE fuel categories. The reduced DOE fuel categories will help streamline future repository analyses of DOE fuels.

A.2.2.3 Present Storage and Generation Status

Table A-20 lists storage locations and inventory information on DOE spent nuclear fuels. During the preparation of the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DIRS 101802-DOE 1995, all), DOE evaluated and categorized

Table A-20. National Spent Nuclear Fuel Database projection of DOE spent nuclear fuel locations and inventories to 2035.[a,b]

	Fuel category and name	Storage Site	No. of units[c]	Mass (kilograms)[d]	Volume (cubic meters)[e]	Fissile mass (kilograms)	Equivalent uranium mass (kilograms)	MTHM
1.	Uranium metal[f]	INEEL	85	4,500	0.7	13	1,700	1.7
		Hanford	100,000	2,160,000	200	25,000	2,100,000	2100
		SRS	350	120,000	18	110	17,000	17
		Totals	*100,435*	*2,284,500*	*218.7*	*25,123*	*2,118,700*	*2119*
2.	Uranium-zirconium	INEEL	69	120	0.7	34	40	0.04
3.	Uranium-molybdenum	INEEL	29,000	4,600	0.3	970	3,800	3.8
4.	Uranium oxide, intact	INEEL	14,000	150,000	41	2,200	80,000	80
		Hanford	87	44,000	11	240	18,000	18
		Totals	*14,087*	*194,000*	*52*	*2,440*	*98,000*	*99*
5.	Uranium oxide, failed/declad/aluminum clad	INEEL	2,000	340,000	140	2,200	83,000	84
		Hanford	13	270	4.2	4	160	0.2
		SRS	7,600	58,000	96	2,600	3,200	3.2
		Totals	*9,613*	*398,270*	*240.2*	*4,804*	*86,360*	*87*
6.	Uranium-aluminide	SRS	18,000	130,000	150	6,000	8,800	8.7
7.	Uranium-silicide	SRS	7,400	47,000	53	1,200	12,000	12
8.	Thorium/uranium carbide, high-integrity	FSV	1,500	190,000	130	640	820	15
		INEEL	1,600	130,000	82	350	440	9.9
		Totals	*3,100*	*320,000*	*212*	*990*	*1,260*	*25*
9.	Thorium/uranium carbide, low-integrity	INEEL	810	55,000	17	180	210	1.7
10.	Plutonium/uranium carbide, nongraphite	INEEL	130	140	0	10	73	0.08
		Hanford	2	330	0.1	11	64	0.07
		Totals	*132*	*470*	*0.1*	*21*	*137*	*0.2*
11.	Mixed oxide	INEEL	2,000	6,100	2.4	240	2,000	2.1
		Hanford	620	110,000	33	2,400	8,000	10
		Totals	*2,620*	*116,100*	*35.1*	*2,640*	*10,000*	*12*
12.	Uranium/thorium oxide	INEEL	260	120,000	18	810	810	50
13.	Uranium-zirconium hydride	INEEL	9,800	33,000	8.1	460	2,000	2
		Hanford	190	660	33	7	36	0.04
		Totals	*9,990*	*33,660*	*8.3*	*467*	*2,036*	*2*
15.	Naval fuel[g]	INEEL	300	4,400,000	888	64,000	65,000	65
16.	Miscellaneous	INEEL	1,500	33,000	11	360	5,500	7.7
		Hanford	73	1,700	0.2	30	130	0.2
		SRS	8,800	9,200	8.2	550	2,900	2.9
		Totals	*10,373*	*43,900*	*19.4*	*940*	*8,530*	*11*
Grand totals			***210,000***	***8,150,000***	***1,900***	***110,000***	***2,420,000***	***2,500***

a. Source: DIRS 148240-Dirkmaat (1998, all).
b. Abbreviations: SNF = spent nuclear fuel; INEEL = Idaho National Engineering and Environmental Laboratory; SRS = Savannah River Site; FSV = Fort St. Vrain.
c. Unit is defined as an assembly, bundle of elements, can of material, etc., depending on the particular spent nuclear fuel category.
d. To convert kilograms to pounds, multiply by 2.2046; to convert metric tons to tons, multiply by 1.1023.
e. To convert cubic meters to cubic yards, multiply by 1.3079.
f. N-Reactor fuel is stored in aluminum or stainless-steel cans at the K-East and K-West Basins. The mass listed in this table does not include the storage cans.
g. Information supplied by the Navy (DIRS 104356-Dirkmaat 1997, Attachment, p. 2).

all the materials listed in the table as spent nuclear fuel, in accordance with the definition in the Nuclear Waste Policy Act, as amended.

A.2.2.4 Final Spent Nuclear Fuel Form

For all spent nuclear fuel categories except 14, the expected final spent nuclear fuel form does not differ from the current or planned storage form. Before its disposal in the repository, candidate material would be in compliance with approved acceptance criteria.

Table A-23. Maximum heat generation for DOE spent nuclear fuel (watts per handling unit).[a,b]

	Category and fuel type	Maximum heat generation
1.	Uranium metal	18
2.	Uranium zirconium	90
3.	Uranium molybdenum	4
4.	Intact uranium oxide	1,000
5.	Failed/declad/aluminum clad uranium oxide	800
6.	Uranium aluminide	480
7.	Uranium silicide	1,400
8.	High-integrity thorium/uranium carbide	250
9.	Low-integrity thorium/uranium carbide	37
10.	Nongraphite plutonium/uranium carbide	1,800
11.	Mixed oxide	1,800
12.	Thorium/uranium oxide	600
13.	Uranium zirconium hydride	100
14.	Sodium-bonded	N/A[c]
15.	Naval fuel	4,250
16.	Miscellaneous	1,000

a. Sources: DIRS 104354-Dirkmaat (1997, Attachment, pp. 74 to 77); DIRS 104377-Dirkmaat (1998, Table A.2.2-3); DIRS 156933-Fillmore (2001, all).
b. Handling unit is a canister.
c. N/A = not applicable. Assumed to be treated and therefore part of high-level radioactive waste inventory (see Section A.2.2.1).

Table A-24. Required number of canisters for disposal of DOE spent nuclear fuel.[a,b]

	Hanford		INEEL		SRS	Naval	
Category	18-inch	25.3-inch	18-inch	24-inch	18-inch	Short	Long
1		440	6		9		
2			8				
3			70				
4	14	20	179	16			
5	1		406		425		
6					750		
7					225		
8			503[c]				
9			60				
10	2		3				
11	324		43				
12			24	47			
13	3		97				
14[d]							
15						200	100
16	5		39		2		
Totals	***349***	***460***	***1,438***	***63***	***1,411***	***200***	***100***

a. Sources: DIRS 104356-Dirkmaat (1997, Attachment, p. 2); Dirkmaat (DIRS 148240-1998, all).
b. INEEL = Idaho National Engineering and Environmental Laboratory; SRS = Savannah River Site.
c. Includes 334 canisters from Fort St. Vrain.
d. Assumed to be treated and therefore part of high-level radioactive waste inventory (see Section A.2.2.1).

Table A-25. Preliminary naval canister design parameters.[a]

Parameter	Short canister	Long canister
Maximum outside diameter (centimeters)[b,c]	169	169
Maximum outer length (centimeters)	475	539
Minimum loaded weight (metric tons)[d]	27	27
Maximum loaded weight (metric tons)	45	45

a. Source: DIRS 104354-Dirkmaat (1997, Attachment, pp. 86 to 88).
b. To convert centimeters to inches, multiply by 0.3937.
c. Right circular cylinder.
d. To convert metric tons to tons, multiply by 1.1023.

A.2.3 HIGH-LEVEL RADIOACTIVE WASTE

High-level radioactive waste is the highly radioactive material resulting from the reprocessing of spent nuclear fuel. DOE stores high-level radioactive waste at the Hanford Site, the Savannah River Site, and the Idaho National Engineering and Environmental Laboratory. Between 1966 and 1972, commercial chemical reprocessing operations at the Nuclear Fuel Services plant near West Valley, New York, generated a small amount of high-level radioactive waste at a site presently owned by the New York State Energy Research and Development Authority. These operations ceased after 1972. In 1980, Congress passed the West Valley Demonstration Project Act, which authorizes DOE to conduct, with the Research and Development Authority, a demonstration of solidification of high-level radioactive waste for disposal and the decontamination and decommissioning of demonstration facilities (DIRS 102588-DOE 1992, Chapter 3). This section addresses defense high-level radioactive waste generated at the DOE sites (Hanford Site, Idaho National Engineering and Environmental Laboratory, and Savannah River Site) and commercial high-level radioactive waste generated at the West Valley Demonstration Project.

A.2.3.1 Background

In 1985, DOE published a report in response to Section 8 of the Nuclear Waste Policy Act (of 1982) that required the Secretary of Energy to recommend to the President whether defense high-level radioactive waste should be disposed of in a geologic repository along with commercial spent nuclear fuel. That report, *An Evaluation of Commercial Repository Capacity for the Disposal of Defense High-Level Waste* (DIRS 103492-DOE 1985, all), provided the basis, in part, for the President's determination that defense high-level radioactive waste should be disposed of in a geologic repository. Given that determination, DOE decided to allocate 10 percent of the capacity of the first repository for the disposal of DOE spent nuclear fuel (2,333 MTHM) and high-level radioactive waste (4,667 MTHM) (DIRS 104384-Dreyfuss 1995, all; DIRS 104398-Lytle 1995, all).

Calculating the MTHM quantity for spent nuclear fuel is straightforward. It is determined by the actual heavy metal content of the spent fuel. However, an equivalence method for determining the MTHM in defense high-level radioactive waste is necessary because almost all of its heavy metal has been removed. A number of alternative methods for determining MTHM equivalence for high-level radioactive waste have been considered over the years. Four of those methods are described in the following paragraphs.

Historical Method. Table 1-1 of DIRS 103492-DOE (1985) provided a method to estimate the MTHM equivalence for high-level radioactive waste based on comparing the radioactive (curie) equivalence of commercial high-level radioactive waste and defense high-level radioactive waste. The method relies on the relative curie content of a hypothetical (in the early 1980s) canister of defense high-level radioactive waste from the Savannah River, Hanford, or Idaho site, and a hypothetical canister of vitrified waste from reprocessing of high-burnup commercial spent nuclear fuel. Based on commercial high-level radioactive waste containing 2.3 MTHM per canister (heavy metal has not been removed from commercial waste) and defense high-level radioactive waste estimated to contain approximately 22 percent of the radioactivity of a canister of commercial high-level radioactive waste, defense high-level radioactive waste was estimated to contain the equivalent of 0.5 MTHM per canister. Since 1985, DOE has used this 0.5 MTHM equivalence per canister of defense high-level radioactive waste in its consideration of the potential impacts of the disposal of defense high-level radioactive waste, including the analysis presented in this EIS. With this method, less than 50 percent of the total inventory of high-level radioactive waste could be disposed of in the repository within the 4,667 MTHM allocation for high-level radioactive waste. There has been no determination of which waste would be shipped to the repository, or the order of shipments.

Spent Nuclear Fuel Reprocessed Method. Another method of determining MTHM equivalence, based on the quantity of spent nuclear fuel reprocessed, would be to consider the MTHM in the high-level radioactive waste to be the same as the MTHM in the spent nuclear fuel before it was reprocessed. Using this method, less than 5 percent of the total inventory of high-level radioactive waste could be disposed of in the repository within the 4,667 MTHM allocation for high-level radioactive waste.

Total Radioactivity Method. Another method, the total radioactivity method, would establish equivalence based on a comparison of radioactivity inventory (curies) of defense high-level radioactive waste to that of a standard MTHM of commercial spent nuclear fuel. For this equivalence method the standard spent nuclear fuel characteristics are based on pressurized-water reactor fuel with uranium-235 enrichment of 3.11 percent and 39.65 gigawatt-days per MTHM burnup. Using this method, 100 percent of the total inventory of high-level radioactive waste inventory could be disposed of in the repository within the 4,667 MTHM allocation for high-level radioactive waste.

Radiotoxicity Method. Yet another method, the radiotoxicity method, uses a comparison of the relative radiotoxicity of defense high-level radioactive waste to that of a standard MTHM of commercial spent nuclear fuel, and is thus considered an extension of the total radioactivity method. Radiotoxicity compares the inventory of specific radionuclides to a regulatory release limit for that radionuclide, and uses these relationships to develop an overall radiotoxicity index. For this equivalence, the standard spent nuclear fuel characteristics are based on pressurized-water reactor fuel with uranium-235 enrichment of 3.11 percent, 39.65 gigawatt-days per MTHM burnup. Using this method, 100 percent of the total inventory of high-level radioactive waste could be disposed of in the repository within the 4,667 MTHM allocation for high-level radioactive waste.

A recent report (DIRS 103495-Knecht et al. 1999, all) describes four equivalence calculation methods and notes that, under the Total Radioactivity Method or the Radiotoxicity Method, all DOE high-level radioactive waste could be disposed of under the Proposed Action. Using different equivalence methods would shift the proportion of high-level radioactive waste that could be disposed of between the Proposed Action and Inventory Module 1 analyzed in Chapter 8, but would not change the cumulative impacts analyzed in this EIS. Regardless of the equivalence method used, the EIS analyzes the impacts from disposal of the entire inventory of high-level radioactive waste in inventory Module 1.

A.2.3.2 Sources

A.2.3.2.1 *Hanford Site*

The Hanford high-level radioactive waste materials discussed in this EIS include tank waste, strontium capsules, and cesium capsules (DIRS 104406-Picha 1997, Table RL-1). DOE has not declared other miscellaneous materials or waste at Hanford, either existing or forecasted, to be candidate high-level radioactive waste streams. Before shipment to the repository, DOE would vitrify the high-level radioactive waste into a borosilicate glass matrix and pour it into stainless-steel canisters.

A.2.3.2.2 *Idaho National Engineering and Environmental Laboratory*

The Idaho National Engineering and Environmental Laboratory has proposed three different high-level radioactive waste stream matrices for disposal at the proposed Yucca Mountain Repository—glass, ceramic, and metal. The glass matrix waste stream would come from the Idaho Nuclear Technology and Engineering Center and would consist of wastes generated from the treatment of irradiated nuclear fuels. The ongoing Argonne National Laboratory-West electrometallurgical treatment of DOE sodium-bonded fuels will generate both ceramic and metallic high-level radioactive waste matrices. DOE is developing the *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement* (see DIRS 155100-DOE 1999, all), to support decisions on managing the high-level radioactive waste at the Idaho Nuclear Technology and Engineering Center.

A.2.3.2.3 *Savannah River Site*

Savannah River Site high-level radioactive waste consists of wastes generated from the treatment of irradiated nuclear fuels. These wastes include various chemicals, radionuclides, and fission products that DOE maintains in liquid, sludge, and saltcake forms. The Defense Waste Processing Facility at the Savannah River Site mixes the high-level radioactive waste with glass-forming materials, converts it to a durable borosilicate glass waste form, pours it into stainless-steel canisters, and seals the canisters with welded closure plugs (DIRS 104406-Picha 1997, Attachment 4, p. 2).

Another source of high-level radioactive waste at the Savannah River Site is the immobilized plutonium addressed in Section A.2.4.

A.2.3.2.4 *West Valley Demonstration Project*

The West Valley Demonstration Project is responsible for solidifying high-level radioactive waste that remains from the commercial spent nuclear fuel reprocessing plant operated by Nuclear Fuel Services. The Project mixes the high-level radioactive waste with glass-forming materials, converts it to a durable borosilicate glass waste form, pours it into stainless-steel canisters, and seals the canisters with welded closure plugs.

A.2.3.3 Present Status

A.2.3.3.1 *Hanford Site*

The Hanford Site stores high-level radioactive waste in underground carbon-steel tanks. This analysis assumed that before vitrification, strontium and cesium capsules currently stored in water basins at Hanford would be blended with the liquid high-level radioactive waste. To date, Hanford has immobilized no high-level radioactive waste. Before shipping waste to a repository, DOE would vitrify it into an acceptable glass form. DOE has scheduled vitrification to begin in 2007 with an estimated completion in 2028.

A.2.3.3.2 *Idaho National Engineering and Environmental Laboratory*

Most of the high-level radioactive waste at the Idaho Nuclear Technology and Engineering Center (formerly the Idaho Chemical Processing Plant) is in calcined solids (calcine) stored at the Idaho National Engineering and Environmental Laboratory. The calcine, an interim waste form, is in stainless-steel bins in concrete vaults. Before shipment to a repository, DOE proposes to immobilize the high-level radioactive waste in a vitrified (glass) waste form. The Idaho Nuclear Technology and Engineering Center proposes to implement its vitrification program in 2020 and complete it in 2035 (DIRS 103497-INEEL 1998, pp. A-39 to A-42).

As discussed in Section A.2.2.1, Argonne National Laboratory-West began electrometallurgical treatment of EBR-II reactor fuel in 2000. The ceramic and metallic waste forms being produced will be stored onsite.

A.2.3.3.3 *Savannah River Site*

DOE stores high-level radioactive waste in underground tanks at the Savannah River Site. High-level radioactive waste that has been converted to a borosilicate glass form and DOE projects completion of the vitrification of the stored high-level radioactive waste by 2027 (DIRS 157008-DOE 2001, all).

A.2.3.3.4 *West Valley Demonstration Project*

High-level radioactive waste is stored in underground tanks at the West Valley site. High-level radioactive waste that has been converted into a borosilicate glass waste form is stored onsite. West Valley plans to complete its vitrification program by the Fall of 2002 (DIRS 102588-DOE 1992, Chapter 3).

A.2.3.4 Final Waste Form

The final waste form for high-level radioactive waste from the Hanford Site, Savannah River Site, Idaho Nuclear Technology and Engineering Center, and West Valley Demonstration Project would be a vitrified glass matrix in a stainless-steel canister.

The waste forms from Argonne National Laboratory-West will be ceramic and metallic waste matrices and will be in stainless-steel canisters similar to those used for Savannah River Site and Idaho Nuclear Technology and Engineering Center glass wastes.

A.2.3.5 Waste Characteristics

A.2.3.5.1 *Mass and Volume*

Hanford Site. The estimated volume of borosilicate glass generated by high-level radioactive waste disposal actions at Hanford will be 15,700 cubic meters (554,000 cubic feet); the estimated mass of the glass is 44,000 metric tons (48,500 tons) (DIRS 104407-Picha 1998, Attachment 1). The volume calculation assumes that strontium and cesium compounds from capsules currently stored in water basins would be blended with tank wastes before vitrification with no increase in product volume. This volume of glass could require as many as 14,500 canisters, nominally 4.5 meters (15 feet) long with a 0.61-meter (2-foot) diameter (DIRS 104407-Picha 1998, Attachment 1).

Idaho National Engineering and Environmental Laboratory. Table A-26 lists the volumes, masses, densities, and estimated number of canisters for the three proposed waste streams.

Savannah River Site. Based on Revision 8 of the High-Level Waste System Plan (DIRS 101904-Davis and Wells 1997, all), the Savannah River Site would generate an estimated 5,978 canisters of high-level radioactive waste (DIRS 104406-Picha 1997, Attachment 1). The canisters have a nominal outside diameter of 0.61 meter (2 feet) and a nominal height of 3 meters (10 feet). They would contain a total of approximately 4,240 cubic meters (150,000 cubic feet) of glass. The estimated total mass of high-level radioactive waste for repository disposal would be 11,600 metric tons (12,800 tons) (DIRS 104406-Picha 1997, Attachment 1). DOE has addressed the additional high-level radioactive waste canisters that DOE

SOLICITATION, OFFER AND AWARD

1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) > | RATING | PAGE 1 OF PAGES 1

2. CONTRACT NO.	3. SOLICITATION NO.	4. TYPE OF SOLICITATION	5. DATE ISSUED	6. REQUISITION/PURCHASE NUMBER
DE-AC27-01RV14136	DE-RP27-00RV14136	[ ] SEALED BID (IFB) [X] NEGOTIATED (RFP)	August 31, 2000	27-00RV14136.000

7. ISSUED BY CODE	8. ADDRESS OFFER TO (If other than Item 7)
U.S. Department of Energy Office of River Protection Office of Business Management and Administration, H6-60 2440 Stevens Drive (or P. O. Box 450) Richland, WA 99352	Same as Block 7 ATTN: Michael K. Barrett, Contracting Officer

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder"

SOLICITATION

9. Sealed offers in original and __*__ copies for furnishing the supplies or services in the Schedule will be received at the place specified in Item 8, or if handcarried, in the depository located in ** until ** (Hour) local time ** (Date)

* See Section L Provision entitled "INSTRUCTIONS - GENERAL"

** See Section L Provision entitled "TIME, DATE AND PLACE OFFERS AND OTHER WRITTEN PROPOSAL INFORMATION ARE DUE"

CAUTION - LATE Submissions, Modifications, and Withdrawals: See Section L, Provision No. 52.214-7 or 52.215-1. All offers are subject to all terms and conditions contained in this solicitation.

10. FOR INFORMATION CALL: >	A. NAME	B. TELEPHONE (NO COLLECT CALLS) AREA CODE	NUMBER	EXT.	C. E-MAIL ADDRESS
	Michael K. Barrett	509	373-4143		michael_k_barrett@rl.gov

11. TABLE OF CONTENTS

(X)	SEC.	DESCRIPTION	PAGE(S)	(X)	SEC.	DESCRIPTION	PAGE(S)
		PART I - THE SCHEDULE				PART II - CONTRACT CLAUSES	
X	A	SOLICITATION/CONTRACT FORM	1	X	I	CONTRACT CLAUSES	9
X	B	SUPPLIES OR SERVICES AND PRICES/COSTS	9			PART III - LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACH.	
X	C	DESCRIPTION/SPECS./WORK STATEMENT	119	X	J	LIST OF ATTACHMENTS	18
X	D	PACKAGING AND MARKING	1			PART IV - REPRESENTATIONS AND INSTRUCTIONS	
X	E	INSPECTION AND ACCEPTANCE	2	X	K	REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS	14
X	F	DELIVERIES OR PERFORMANCE	2				
X	G	CONTRACT ADMINISTRATION DATA	5	X	L	INSTRS., CONDS., AND NOTICES TO OFFERORS	39
X	H	SPECIAL CONTRACT REQUIREMENTS	19	X	M	EVALUATION FACTORS FOR AWARD	5

OFFER *(Must be fully completed by offeror)*

NOTE: Item 12 does not apply if the solicitation includes the provisions at 52.214-16, Minimum Bid Acceptance Period

12. In compliance with the above, the undersigned agrees, if this offer is accepted within *** calendar days *(60 calendar days unless a different period is inserted by the offeror)* from the date for receipt of offers specified above, to furnish any or all items upon which prices are offered at the price set opposite each item, delivered at the designated point(s), within the time specified in the schedule

*** See Section L Provision entitled "OFFER ACCEPTANCE PERIOD"

13. DISCOUNT FOR PROMPT PAYMENT *(See Section I, Clause No. 52.232-8)* >	10 CALENDAR DAYS %	20 CALENDAR DAYS %	30 CALENDAR DAYS %	CALENDAR DAYS %

14. ACKNOWLEDGEMENT OF AMENDMENTS (The offeror acknowledges receipt of amendments to the SOLICITATION for offerors and related documents numbered and dated:	AMENDMENT NO.	DATE	AMENDMENT NO.	DATE
	1	9/27/00		
	2	10/6/00		
	3	10/11/00		

15A. NAME AND ADDRESS OF OFFEROR CODE FACILITY	16. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)
Bechtel National, Inc. 45 Fremont Street San Francisco, CA 94105	Ron Naventi, Senior Vice President

15B. TELEPHONE NO. AREA CODE	NUMBER	EXT.	15C. CHECK IF REMITTANCE ADDRESS IS DIFFERENT FROM ABOVE - ENTER SUCH ADDRESS IN SCHEDULE	17. SIGNATURE	18. OFFER DATE
415	768-2374		[ ]	Original Signature of R. F. Naventi on File	20-Oct-00

AWARD *(To be completed by Government)*

19. ACCEPTED AS TO ITEMS NUMBERED	20. AMOUNT	21. ACCOUNTING AND APPROPRIATION
All	See Section B.4	89X0242.91 39EW01J20

22. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION	23. SUBMIT INVOICES TO ADDRESS SHOWN IN (4 copies unless otherwise specified) >	ITEM
[ ] 10 U.S.C. 2304(c)( ) [ ] 41 U.S.C. 253(c)( )		See Section G.4

24. ADMINISTERED BY (If other than Item 7) CODE	25. PAYMENT WILL BE MADE BY CODE
	See Section G.4

26. NAME OF CONTRACTING OFFICER (Type or print)	27. UNITED STATES OF AMERICA	28. AWARD DATE
Harry L. Boston, Acting Manager Office of River Protection	Orignial Signature of H. L. Boston on File (Signature of Contracting Officer)	12/11/00

IMPORTANT - Award will be made on this Form, or on Standard Form 26, or by other authorized official written notice.

Attachment 3

SECTION C

STATEMENT OF WORK

SECTION C

STATEMENT OF WORK

TABLE OF CONTENTS

C.1 INTRODUCTION 1
C.2 CONTRACT APPROACH 3
C.3 INTERACTIONS WITH THE WASTE TREATMENT AND IMMOBILIZATION CONTRACTOR 4
C.4 ENVIRONMENT, SAFETY, QUALITY, AND HEALTH 7
C.5 DESCRIPTION OF CONTRACT REQUIREMENTS AND DELIVERABLES 10
C.6 STANDARDS 21
Standard 1: Management Products and Controls 22
Standard 2: Research, Technology, and Modeling 34
Standard 3: Design 44
Standard 4: Construction, Procurement, and Acceptance Testing 54
Standard 5: Commissioning 57
Standard 6: Product Qualification, Characterization, and Certification 71
Standard 7: Environment, Safety, Quality, and Health 78
Standard 8: Safeguards and Security 88
C.7 FACILITY SPECIFICATION 90
C.8 OPERATIONAL SPECIFICATIONS 99
Specification 1: Immobilized High-Level Waste Product 100
Specification 2: Immobilized Low-Activity Waste Product 104
Specification 3: Reserved 110
Specification 4: Reserved 111
Specification 5: Reserved 112
Specification 6: Reserved 113
Specification 7: Low-Activity Waste Envelopes Definition 114
Specification 8: High-Level Waste Envelope Definition 117
Specification 9: Liquids or Slurries Transferred to DOE Tanks by Pipeline 121
Specification 10: Reserved 123
Specification 11: Reserved 124
Specification 12: Procedure to Determine the Waste Feed Treatment Approach 125
Specification 13: Waste Product Inspection and Acceptance 126
C.9 INTERFACE CONTROL DOCUMENTS 129

floors shall be identified. All crane structures, filter housings, and facility mechanical systems shall be identified. *Seismic analysis for the facilities for* Pretreatment, HLW Vitrification, LAW Vitrification, and support facilities shall be completed in accordance with DOE and Ecology requirements to support structural analysis, definition of the facility, the Limited Work Authorization Request, and Construction Authorization Request.

(17) Mechanical Flow Diagrams: The Contractor shall prepare mechanical handling diagrams for the Pretreatment, HLW Vitrification, LAW Vitrification, Analytical Laboratory, and Balance of Facilities. The diagrams shall be prepared with sufficient detail to support the hazards analysis review and the operations research model. The diagrams shall identify mechanical equipment and each step and sequence of the operation.

(18) Analytical Laboratory Facility Design: The Contractor shall further develop and provide the sampling and analysis requirements to support process control, environmental compliance and waste form qualification for DOE approval (Table C.5-1.1, Deliverable 3.6). The information shall include sample locations, sample purpose, analysis requirements, and frequency and turnaround times. Results of the assessment of process tank capacities and process operations will be used to verify and establish the specification and design of the Analytical Laboratory to support the WTP.

Reserve capacity in the Analytical Laboratory, to the extent there is any, shall be utilized for "limited technology testing" or increase throughput (e.g., Pretreatment, LAW and HLW capacity changes). Limited technology testing includes investigation of anticipated WTP operational performance, evaluation of process upsets, process improvements, analytical methods optimization, and qualification of new instruments.

Limited technology testing capabilities shall include: compositional and physical property analysis of the waste feeds; and small scale testing of the cross-flow filtration, sludge washing and leaching, cesium (Cs) ion exchange, and LAW and HLW glass melting processes. Testing of the waste feeds shall be completed to confirm planned operational flowsheets for the tank wastes to be treated in the WTP. Testing may be done in alternative facilities with prior DOE approval.

The Contractor shall identify samples from WTP operations that will be analyzed at non-WTP analytical facilities. The definitions of the outsourced samples shall include sample type and analyses required. The identification of the outsourced samples is to be included in the Sampling and Analyses Plan used to support the requirements definition for the Analytical Laboratory.

The Analytical Laboratory Facility design shall incorporate features and capability necessary to ensure efficient WTP operations and meet all permitting, process control, authorization basis, and waste form qualification requirements.
The design should be validated with information from tank utilization modeling of the process tankage, and operational research modeling of the treatment process, as appropriate.

(19) Site Layout Drawings: The Contractor shall complete all site layout drawings, which shall include the exterior arrangement of all facilities and structures on the site in relation to one another, and their exterior interface points with all piping and electrical systems. The drawings shall identify all above-grade and below-grade structures, piping, and electrical systems. The drawings will reflect requirements

Commissioning following:

- The Contractor's completion of a management assessment to evaluate the readiness of facilities and personnel to initiate cold commissioning based upon the Minimum Core Requirements identified in DOE Order 425.1C, *Startup and Restart of Nuclear Facilities*. The results of the management assessment shall be provided to DOE.

- Identification of the status of the authorization basis implementation, permits and safety program implementation, and any remaining construction scope that requires completion before simulant introduction.

The Contractor shall not proceed with introduction of simulants without DOE approval. The Contractor shall notify DOE that Cold Commissioning has commenced.

(3) Testing:

(i) Waste Form Qualification Tests: The Contractor shall complete WTP waste form qualification testing during cold commissioning to demonstrate the production of acceptable non-radioactive products (ILAW and IHLW) and secondary wastes in accordance with the Secondary Wastes Compliance Plan (Table C.5-1.1, Deliverable 6.1), ILAW Product Compliance Plan (Table C.5-1.1, Deliverable 6.3), and IHLW Waste Form Compliance Plan (Table C.5-1.1, Deliverable 6.2). Applicable process unit operations, sampling and analysis, process control systems, and operating procedures shall be utilized in these qualification tests in a manner that represents planned operations with actual wastes. Test results will be evaluated and documented as part of the waste form qualification reports identified in Standard 6, *Product Qualification, Characterization, and Certification*.

(ii) Cold Commissioning Capacity Tests:

Cold commissioning testing shall be conducted to demonstrate the capacity of the WTP as noted in Table C.6-5.1. Waste form products and secondary wastes will be produced in accordance with the qualification strategies and requirements identified in the Secondary Wastes Compliance Plan (Table C.5-1.1, Deliverable 6.1), ILAW Product Compliance Plan (Table C.5-1.1, Deliverable 6.3), and IHLW Waste Form Compliance Plan (Table C.5-1.1, Deliverable 6.2), and meet the relevant specification and interface requirements. The results shall be provided to DOE for review and approval. (Table C.5-1.1, Deliverable 5.4).

The Cold Commissioning Capacity Tests shall test the individual facility operations in terms of function and capacity. Applicable facility system components, both process and mechanical, shall be tested.

The water washing, caustic, and oxidative leaching process steps shall be performed consistent with the process model used to develop Table C.6-5.1 and the process steps as defined in Standard 2, Deliverable 2.10. Leaching effectiveness is not a criterion for acceptability of Cold Commissioning Capacity Test results.

Specification 1: Immobilized High-Level Waste Product

1.1 Scope: This Specification defines requirements for the IHLW product, a waste product. The IHLW product is a vitrified borosilicate glass waste form for ultimate disposal in the proposed geologic repository.

1.2 Requirements:

1.2.1 References:

1.2.1.1 CRD. DOE/RW-0406. Revision 8. September 12, 2007. *Civilian Radioactive Waste Management Systems Requirements Document*, ICN 1. U.S. Department of Energy, Office of Civilian Radioactive Waste Management. Washington, D.C.

1.2.1.2 DOE Manual 435.1-1 CHG-1. July 9, 1999. *Radioactive Waste Management Manual.* U.S. Department of Energy, Washington, D.C.

1.2.1.3 WASRD. DOE/RW-0351. Revision 5. May 31, 2007. *Waste Acceptance System Requirements Document (WASRD).* U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D.C. **(M047) (M114)**

1.2.1.4 WAPS. DOE/EM-0093. Revision 2. December 1996. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms,* U.S. Department of Energy, Washington D.C. **(M047) (M114)**

1.2.1.5 IICD. DOE/RW-0511. Revision 4. March 7, 2008. Integrated Interface Control Document, Volume 1. *High-Level Radioactive Waste and U.S. Department of Energy and Naval Spent Nuclear Fuel to the Civilian Radioactive Waste Management System.* U.S. Department of Energy, Washington D.C.

1.2.1.6 MOA. Revision 2. February 2007. *Memorandum of Agreement for Acceptance of Spent Nuclear Fuel and High-Level Nuclear Waste (MOA) between Environmental Management (EM) U.S. Department of Energy (DOE), Washington, DC. and Office of Civilian Radioactive Waste Management (DOE-RW or OCRWM).* U.S. Department of Energy, Washington, D.C. **(M114)**

1.2.1.7 QARD. DOE/RW-0333P. Revision 20. January 2008. *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program (QARD).* U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, D.C.

1.2.1.8 40 CFR 268. "Land Disposal Restrictions." *Code of Federal Regulations.* U.S. Environmental Protection Agency, Washington, D.C.

1.2.1.9 WAC 173-303. "Dangerous Waste Regulations." *Washington Administrative Code*, as amended.

1.2.1.10 HWMA. *Hazardous Waste Management Act.*

1.2.1.11 RCRA. *Resource Conservation and Recovery Act.*

1.2.2 Product Requirements:

1.2.2.1 Immobilized High-Level Waste:

1.2.2.1.1 Product and Disposal Requirements: The IHLW product shall meet the requirements established in the *Waste Acceptance Product Specifications* (WAPS) and the supporting documents *Waste Acceptance Systems Requirements Document* (WASRD), and Integrated Interface Control Document (IICD). The WAPS, WASRD, and IICD identify the requirements of DOE-RW for acceptance of IHLW for disposal at a federal geologic repository. A *Memorandum of Agreement for Acceptance of Department of Energy Spent Nuclear Fuel and High-Level Nuclear Waste*, (MOA) sets forth, specifies, and lists the programmatic protocols, technical data, specifications and requirements for producing an acceptable IHLW waste form for disposal at a federal geologic repository. The *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program* (QARD) establishes the minimum QA requirements for compliance with the US Department of Energy, Office of Civilian Radioactive Waste Management (DOE-RW, or OCRWM). These requirements must be met before the IHLW waste glass canisters will be accepted by the DOE Office of River Protection (ORP) for onsite interim storage and later formal acceptance by DOE-RW for final disposal.

1.2.2.1.2 Canister System: The reference canister system used to contain the IHLW product shall be a 4.5-meter long by 0.61-meter diameter canister system with a neck and flange design similar to that used at the West Valley Demonstration Project.

1. "Fill Height: Fill height shall be equivalent to at least 87 percent of the volume of the empty canister. The average fill height over all the canisters shall be at least 95 percent of the volume of the empty canister."
2. "Maximum Heat Generation Rate: The maximum heat generation rate for any single canister shall not exceed 1500 watts per canister when delivered to DOE."
3. "Surface Contamination Limitations: Removable contamination on the external surfaces of the package shall not exceed 3,670 Bq/m^2 for alpha and 36,700 Bq/m^2 for beta-gamma. **(M047)**

1.2.2.1.3 Condition at Delivery: At time of delivery to DOE, the HLW form shall stand upright without support on a flat horizontal surface and properly fit into a right-circular, cylindrical cavity (64-cm diameter and 4.51-m length).

1.2.2.1.4 Dangerous and Hazardous Waste Requirements: The WTP shall be designed, constructed, and operated so that the IHLW product does not designate as characteristic or criteria for dangerous waste or extremely hazardous waste pursuant to WAC 173-303-070, and is not restricted from land disposal pursuant to WAC 173-303-140 and 40 CFR 268, "Land Disposal Restrictions."

1.2.2.1.5 Product Loading: Loading of non-volatile components in Envelope D shall be achieved such that the concentration of at least one of the waste components or waste component combinations in Table TS-1.1, *Minimum Component Limits in High-Level Waste Glass*, exceeds its minimum weight percent in HLW glass as identified in Table TS-1.1 (e.g., for a high-iron waste, the waste product shall incorporate at least 12.5 weight percent [wt%] iron oxide from the waste into the glass). The product loading shall not cause the limits in any other requirement of this specification to be violated. Product waste loading shall be calculated on an average basis for each batch transfer of Waste Envelope D. The waste loading may be adjusted downward if necessary to comply with Universal Treatment Standards leaching requirements.

1.2.3 Handling Requirements:

1.2.3.1 Product Handling: The canister shall have a point of connection that allows vertical upward, vertical downward, and horizontal motion while attached to a hoist and grapple.

1.3 Quality Assurance: A QA Program for the IHLW form development, qualification, characterization, and certification is required and shall be consistent with DOE/RW-0333P. **(M152)**

1.4 Inspection and Acceptance: The DOE-approved IHLW Waste Form Compliance Plan (Table C.5-1.1, Deliverable 6.2), described in Standard 6, *Product Qualification, Characterization, and Certification*, defines the content and delivery of documentation required to demonstrate compliance with the requirements of this specification. Product inspection and acceptance shall be performed in accordance with Specification 13, *Waste Product Inspection and Acceptance*, and the required IHLW QA Program.

Table TS-1.1 Minimum Component Limits in High-Level Waste Glass

Component	Weight Percent in HLW Glass
Fe_2O_3	12.5
Al_2O_3	11.0
$Na_2O + K_2O$	15.0
ZrO_2	10.0
UO_2	8.0
ThO_2	4.0
CaO	7.0
MgO	5.0
BaO	4.0
CdO	3.0
NiO	3.0
PbO	1.0
TiO_2	1.0
Bi_2O_3	2.0
P_2O_5	3.0
F	1.7
$Al_2O_3 + ZrO_2$	14.0
$Al_2O_3 + ZrO_2 + Fe_2O_3$	21.0
MgO + CaO	8.0

Component	Weight Percent in HLW Glass
Cr_2O_3	0.5
SO_3	0.5
Ag_2O	0.25
$Rh_2O_3 + Ru_2O_3 + PdO$	0.25
Any single waste oxide (exclusive of Si) not specifically identified in Specification 8, TS-8.1 and 8.4	0.2
Total of all other waste oxides (exclusive of Si) not specifically identified in this table.	8.0

DOC.20070522.0007

DOE/RW-0351 QA: QA

Office of Civilian Radioactive Waste Management

Civilian Radioactive Waste Management System

Waste Acceptance System Requirements Document

Revision 5

Effective Date: 31 May 2007

Preparer: M. A. Popa 18 May 07
Date

Approval: Steven E Hornberg for CAK 5/18/2007
C.A. Kouts
Director
Waste Management Office
Date

Attachment 4

4.4.2 Capability to Lift Naval SFCs....24

4.4.3 Naval SFC Sealing....24

4.4.4 Naval SFC Labeling....24

4.4.5 Naval SFC Drop....24

4.4.6 Free Liquid in Canisters Containing Naval SNF....24

4.4.7 Particulate Content in Naval SFCs....24

4.4.8 Naval SFC Criticality Potential....25

4.4.9 Thermal Output....25

4.4.10 Fires and Explosions Caused by Naval SFC Contents....25

4.4.11 Naval SFC Cleanliness Requirement....25

4.4.12 Naval SNF Post Closure Performance....26

4.5 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN IN DISPOSABLE CANISTERS....27

4.6 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN IN NON-DISPOSABLE CANISTERS....28

4.7 SPECIFIC REQUIREMENTS FOR UNCANISTERED DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN....29

4.7.1 Uncanistered DOE SNF of Commercial Origin....29

4.8 SPECIFIC REQUIREMENTS FOR HIGH-LEVEL WASTE....30

4.8.1 Durability and Phase Stability of Vitrified HLW....30

4.8.2 HLW Canister Design and Materials of Construction....31

4.8.3 Dimensional Envelope for HLW Canisters....31

4.8.4 Filled HLW Canister Weights....31

4.8.5 Capability to Lift HLW Canisters Vertically with Remote Handling Fixtures.31

4.8.6 HLW Canister Sealing....32

4.8.7 HLW Canister Labeling 32
4.8.8 HLW Canister Drop 32
4.8.9 Free Liquid in Canisters Containing HLW 32
4.8.10 Radionuclide Content in High-Level Waste 32
4.8.11 Criticality Potential in Canisters Containing HLW 32
4.8.12 HLW Canister Surface Contamination 33
4.8.13 Thermal Output in Canisters Containing HLW 33

4.9 TRANSPORTATION CASK SYSTEM INTERFACE 34

5. TECHNICAL INFORMATION NEEDS 35
5.1 COMMERCIAL SNF 35
5.2 DOE SNF 35
5.3 NAVAL SNF 36
5.4 HLW 36
5.4.1 Prior to the Start of Production 36
5.4.2 During Production 37
5.4.3 Prior to Delivery 37
5.4.4 At Delivery 38

6. CONFORMANCE VERIFICATION 39

7. PROJECTED INITIAL ACCEPTANCE CAPACITY AND OVERALL SCHEDULE41

8. REFERENCES 45
8.1 DOCUMENTS CITED 45
8.2 CODES, STANDARDS, AND REGULATIONS 47

1. INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this document is to establish waste acceptance technical requirements for the U.S. Department of Energy's (DOE) Civilian Radioactive Waste Management System (CRWMS). These requirements and functions consist of two types: (a) internal CRWMS requirements derived from the Civilian Radioactive Waste Management System Requirements Document (CRD) (DOE 2006a) as illustrated in Figure 1, and (b) acceptance criteria imposed by the CRWMS on spent nuclear fuel (SNF) and high-level waste (HLW) delivered into the CRWMS.

The purpose also includes, in addition to the CRWMS-related requirements that flow down to the Waste Acceptance System Requirements Document (WASRD) from the CRWMS, requirements and functions that, by mutual agreement with external organizations, are described, codified, and regulated by the WASRD. These other functions and requirements include:

- Federal Waste Custodians require their contractors to conform to WASRD requirements;
- The WASRD is the agreed upon reference source of waste acceptance criteria to which Federal Waste Custodians must conform for their wastes to be received by the repository;
- The WASRD is the agreed upon reference source for conformance verification criteria (this effort is in its very earliest stages);
- The WASRD is the reference for the details of Office of Civilian Radioactive Waste Management (RW)/ Office of Environmental Management (EM) agreement on technical information needs to support receipt;
- The WASRD is the official reference for the Integrated Acceptance Schedule (also in its early stages).

The scope of the WASRD is all SNF and HLW bound for the repository.

3. REQUIREMENTS ON THE CRWMS

3.1 PRIMARY REGULATORY REQUIREMENTS

This section identifies the primary requirements on the CRWMS as established by the federal laws and regulations that define them.

The Waste Acceptance element shall comply with the applicable provisions of 42USC10101 et seq "The Nuclear Waste Policy Act of 1982" as amended.

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR (Code of Federal Regulations) Part 20, "Standards for Protection Against Radiation."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 73, "Physical Protection of Plants and Materials."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 75, "Safeguards on Nuclear Materials-Implementation of U.S./IAEA (International Atomic Energy Agency) Agreement."

The Waste Acceptance element shall accept nuclear waste in accordance with 10 CFR Part 961, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste."

The Waste Acceptance element shall comply with the applicable provisions of 29 CFR Part 1910, "Occupational Safety and Health Standards."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 21, "Reporting of Defects and Noncompliance."

3.2 WASTE ACCEPTANCE ELEMENT PERFORMANCE REQUIREMENTS

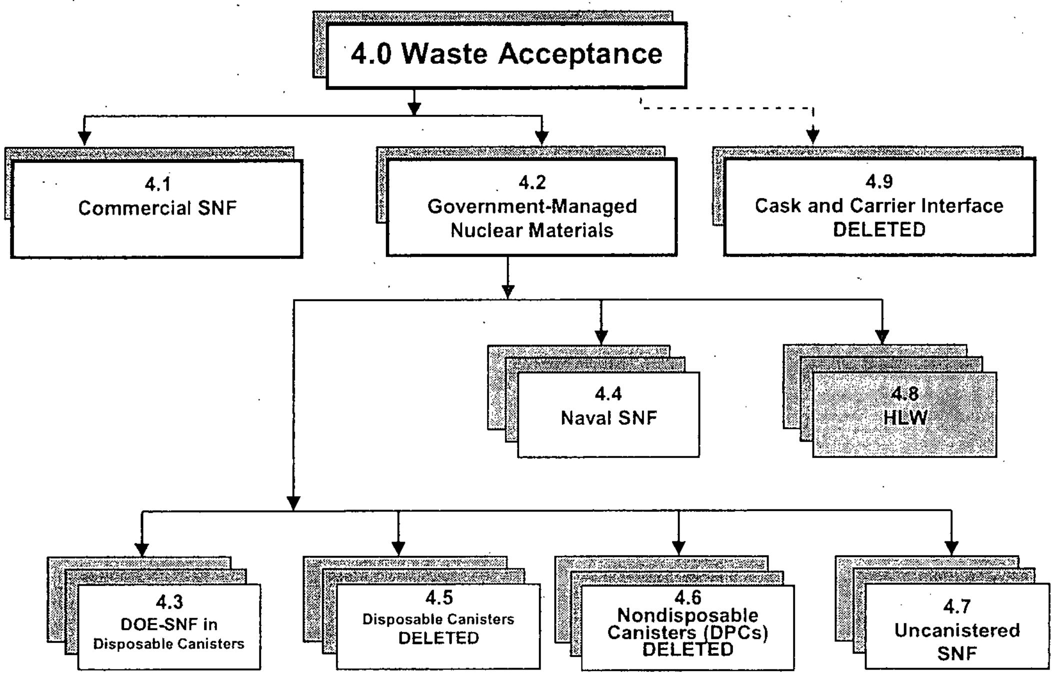
This section contains the requirements allocated to the Waste Acceptance Element by the CRD.

A. The Waste Acceptance Element shall collect necessary information in support of CRWMS activities. The type of data required includes, but is not limited to, the following:

1. Contracts and Fees Information - Purchaser Contracts; Custodian and Producer Agreements and changes thereto; records of fee payments;

2. Planning and Scheduling Information - Delivery Commitment Schedules, Delivery

4.8 SPECIFIC REQUIREMENTS FOR HIGH-LEVEL WASTE



This section covers additional acceptance criteria for defense HLW, vitrified plutonium waste form, and commercial HLW in addition to those in Section 4.2 that collectively represent the acceptance criteria for canistered vitrified HLW. At this time, the composition of the vitrified plutonium waste form is not finalized. Once the final composition is determined, additional requirements will be added to this section, as necessary, specific to the vitrified plutonium waste form.

4.8.1 Durability and Phase Stability of Vitrified HLW

A. The standard vitrified HLW form shall be borosilicate glass sealed inside an austenitic stainless steel canister(s) with a concentric neck and lifting flange.

B. Product Consistency

1. The Producer shall demonstrate control of waste form production by comparing production samples or process control information, separately or in combination to the Environmental Assessment benchmark glass (Jantzen 1993) using the Product Consistency Test (ASTM C1285-97) or equivalent.

2. For acceptance, the mean concentrations of lithium, sodium, and boron in the leachate, after normalization for the concentrations in the glass, shall be less than those of the benchmark glass.

4.8.2 HLW Canister Design and Materials of Construction

The HLW canister materials shall preclude chemical, electrochemical, or other reactions (such as internal corrosion) of the canister or waste package such that there will be no adverse effect on normal handling, transportation, storage, emplacement, containment, isolation, or on performance under abnormal occurrences such as a canister drop accident and premature failure in the repository.

4.8.3 Dimensional Envelope for HLW Canisters

At time of delivery, the canistered HLW form shall stand upright without support on a flat horizontal surface and fit without forcing into a right-circular, cylindrical cavity (64 cm [25 in] diameter and 3.01 m [9.88 ft] length or alternatively 64 cm [25 in] diameter and 4.51 m [14.8 ft] length). HLW canister dimensions are found in the Integrated Interface Control Document, Volume 1 (DOE 2007b).

4.8.4 Filled HLW Canister Weights

The weight of filled HLW canister shall not exceed 9,260 pounds (4,200 kg).

4.8.5 Capability to Lift HLW Canisters Vertically with Remote Handling Fixtures

For canisters of HLW accepted into the CRWMS:

A. The Producer shall provide a grapple design suitable for use in loading or unloading a transportation cask with a standard 3.0 m [9.9 ft] HLW canister or a standard 4.5 m [15 ft] canister;

B. The grapple, when attached to the hoist and engaged with the flange, shall be capable of moving the canistered waste form in the vertical direction;

C. The grapple shall be capable of being remotely engaged with and remotely disengaged from the HLW canister flange;

D. The grapple shall be capable of being engaged or disengaged while remaining within the projected diameter of the waste form canister;

E. The grapple shall include safety features that prevent inadvertent release of a suspended canistered waste form.

4.8.6 HLW Canister Sealing

Canisters shall be sealed and leak tight. Canister gas leak rates shall be less than 1×10^{-4} ref-cc/sec (6.10×10^{-6} in^3/sec.) (DOE 1996).

4.8.7 HLW Canister Labeling

Canisters shall have a legible, unique identifier that is permanently attached to the canister and is traceable to the permanent records of the canister and its contents.

4.8.8 HLW Canister Drop

The HLW canisters shall be capable of withstanding a drop of 7 meters (23.0 ft) onto a flat, essentially unyielding surface without breaching or dispersing radionuclides.

4.8.9 Free Liquid in Canisters Containing HLW

Sealed HLW canisters shall contain no residual water beyond that condensing from water vapor inside the canister as it cools.

4.8.10 Radionuclide Content in High-Level Waste

Radionuclide estimate waste form requirements are listed in sections 5.4.1.B(2), 5.4.3.C and the NRC Form 741.

4.8.11 Criticality Potential in Canisters Containing HLW

A. Preclosure Criticality:

For acceptance, HLW producers shall provide qualified data to ensure RW can demonstrate preclosure safety requirements relating to criticality, as described below. Specific technical information needs are identified in Section 5.4.1.B(10).

To meet 10 CFR Part 63 preclosure safety requirements, it must be demonstrated that the HLW and its canister, in conjunction with the facility systems, structures, and components, shall provide the basis for ensuring subcriticality at the time of delivery to the geologic repository and during all subsequent handling operations, including all event sequences that are important for criticality and have at least one chance in 10,000 of occurring before permanent closure. To provide assurance of subcriticality, the methodology will account for the biases and uncertainties in both the calculations and experimental data used in the development of the effective neutron multiplication factor (k_{eff}), and will also include a technically justified administrative margin (Δkm) following the guidance in Fuel Cycle Safety & Safeguards-Interim Staff Guidance-10.

B. Post Closure Criticality:

For acceptance, HLW producers shall provide qualified data to ensure RW can demonstrate postclosure safety requirements relating to criticality, as described below. Specific technical information needs are identified in Section 5.4.1.B(10). Postclosure criticality analyses are based on performance of the co-disposal waste package configurations consisting of both DOE SNF and HLW canisters.

The methodology described in the Disposal Criticality Analysis Methodology Topical Report (YMP/TR-004Q) shall be used to meet 10 CFR Part 63 postclosure criticality requirements to demonstrate that the total probability of criticality for all HLW canisters shall not cause the total probability of criticality for all waste forms to exceed one chance in 10,000 over the first 10,000 years after permanent closure of the repository.

4.8.12 HLW Canister Surface Contamination

The Producer shall inspect the canistered waste form and remove visible waste glass from the exterior surface of the canister prior to shipment.

4.8.13 Thermal Output in Canisters Containing HLW

Total heat generation rate for canisters containing HLW shall not exceed 1500 watts (5120 BTU/hr) per canister (Arenaz 2006) at the year of shipment.

5.3 NAVAL SNF

For naval SNF, the technical information needs are identified in the document Scope of the Geologic Disposal Technical Information Package for Naval SNF Canisters, Revision 2 S5G Only, (NNPP 2006) and Section V.A of the 2000 Memorandum of Agreement between NNPP and RW (Bowman and Itkin 2000). Similar technical information is required for other naval fuels.

5.4 HLW

This section presents the technical information needs concerning High Level Waste.

5.4.1 Prior to the Start of Production

A. Prior to the start of production of canistered waste forms, the waste producer shall provide all of the documentation (current revision, either as hard copy or as electronic media) required under the Memorandum of Agreement (DOE 2007a). This shall include the EM Waste Acceptance Product Specifications, WCP, Waste Form Qualification Report, and any supporting documentation required by these documents.

B. Information provided shall include the following:

(1) The chemical composition and crystalline phase projections for the vitrified HLW. Information on the chemical composition shall include identification of the oxides of elements present in concentrations greater than 0.5 percent by weight (of glass) and an estimate of the uncertainty of these concentrations for vitrified HLW.

(2) Estimates of the total facility inventory and individual canister inventory of radionuclides (in Curies) that have half-lives longer than 10 years and that are or will be present in concentrations greater than 0.05 percent of the total radioactive inventory. The estimates shall be indexed to the years 2010 and 3110. The Producer shall also report the estimate of the uncertainty in the radionuclide inventories.

(3) The Time-Temperature-Transformation diagrams for the vitrified HLW and identification of temperature limits (if any) necessary to preserve the properties of the vitrified HLW.

(4) Identification of the method to be used to ensure consistency of production batches, and any other information necessary to establish post-closure performance of the waste forms (e.g. identification of organic compounds that may be present and estimated quantities).

(5) Canister material.

(6) Canister dimensions (at the time of acceptance).

(7) Canister lifting and handling arrangements.

(8) Canister labeling conventions.

(9) Information required to assess the canister drop performance during preclosure and to assess repository postclosure performance including information regarding particulates, pyrophorics, combustibles, explosives, or other relevant factors that all may come into play in a Category II event sequence. This is likely to be a detailed list much of which has not yet been determined. This information need will be developed more fully in a future revision of the WASRD.

(10) Information required to assess canister criticality, both pre- and postclosure. This list of information includes, but is not limited to, the following general categories: quantities (number of canisters, amount/canister), waste form dimensions (goes to geometry and concentration of fissile material), quantities of fissile materials present by isotope, materials of construction of canisters and any internal components (goes to influences on chemistry during the postclosure period) and waste form degradation and dissolution characteristics (postclosure geometry and criticality). Information supplied in each category is expected to be as specific as possible. This list will be amplified as new issues arise.

(11) Estimated maximum gamma and neutron dose rates at the canister surface.

(12) Projected distribution of canister thermal outputs, including the maximum.

(13) Method used to assign individual canister Metric Ton Heavy Metal (MTHM) content for accounting against the repository 70,000 MTHM capacity limit as specified in Section 114d of the Nuclear Waste Policy Act of 1982 (as amended).

5.4.2 During Production

Waste producers shall report annually on the production of HLW waste forms, projections of remaining production, and any production trends which may influence the properties of canistered waste forms relative to the information provided in response to 5.4.1. Annual reports shall also identify non-conforming waste forms and the status of actions to address the non-conforming condition(s).

5.4.3 Prior to Delivery

Prior to delivery, waste producers shall provide all relevant production and storage records of canistered waste forms to be delivered, including any documentation of actions required to address non-conforming conditions. Included in the documentation to be provided is the following:

A. Identification (Label information) of the specific waste form(s) to be delivered.

B. Certification of compliance with WASRD requirements and that all actions required resolving non-conforming conditions have been completed. Completed and approved HLW Production Records in conjunction with relevant shipping and storage records may be used as proof of compliance certification.

C. Production Records and Storage and Shipping Records for individual canistered waste forms to be delivered. These Records along with required information in the WCP and Waste Form Qualification Report shall address product composition, product consistency, radionuclide inventory, sub-criticality, thermal output, gamma and neutron dose rates, post-production temperature history, presence of organic materials (compounds and amounts) and parameters important to canister drop performance. (JR EML on 19 Feb 07).

D. Metric Ton Heavy Metal (MTHM) assignment for each individual canister to be delivered.

5.4.4 At Delivery

A. At the time of delivery, waste producers shall provide a completed DOE/NRC Form-741, Nuclear Material Transaction Reports, traceable to the labels of individual canisters to be shipped. Waste producers shall also certify that canisters loaded into shipping casks are in compliance with the cask Certificate of Compliance.

B. EM shall provide, at the time of acceptance, signed documentation that verifies that each accepted waste form conforms to CRWMS acceptance criteria. EM shall transfer to the authorized RW representative the original or copy (either Hard Copy or Electronic Media) of the completed records package, for acceptance. Such documentation could include HLW Shipping and Storage Records and HLW Production Records.

7. PROJECTED INITIAL ACCEPTANCE CAPACITY AND OVERALL SCHEDULE

Table 7-1 provides an initial projection of the schedule for accepting Government Managed Nuclear Materials and commercial SNF. The estimated schedule shown for commercial SNF reflects the planning basis documented in Table 1 of the Civilian Radioactive Waste Management System Requirements Document (DOE 2006b, Section 3.2.1.D).

The NWPA requires that the NRC "...shall prohibit the emplacement in the first repository of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent fuel until such a time as a second repository is in operation." DOE plans to co-emplace DOE wastes and commercial SNF in a manner that ensures that repository thermal goals are met. When the emplacement limit is reached, emplacement will stop until a second repository is in operation or appropriate changes to the NWPA are enacted.

Table 7-1 identifies the total projected quantities of the various waste types expected to require geologic disposal and current plans for their acceptance by the CRWMS. The schedule is based on the following:

- Government-managed nuclear waste will be accepted by the CRWMS as early as Year 1 of operations.
- The 1995 EM plan (Lytle 1995; Dreyfus 1995) to include DOE SNF and naval SNF among the early DOE wastes to be delivered to the CRWMS.
- The December 1996 plan (62 FR 1095) by the Department of Navy (and DOE as cooperating agency) to use a naval canister system for loading, storing, transporting, and possibly disposing of naval SNF.
- The DOE plan (DOE 1999, page S.2) to immobilize approximately 13 metric tons of the surplus-weapons plutonium considered unsuitable for use in MOX fuel.
- The court-ordered agreement between DOE, the U.S. Navy, and the State of Idaho to remove the entire inventory of DOE SNF and naval SNF out of Idaho by January 1, 2035 (Public Service 1995) and that naval SNF shall be among the early shipments to the repository (paragraph D.1.e of the court order).
- Final receipt rates for naval SNF are to be negotiated to be consistent with the Memorandum of Agreement between RW and NNPP (Bowman, F.L. and Itkin, I. 2000).

The rates in this schedule are targets only and do not create any binding legal obligation on the Department of Energy.

Table 7.1: Descriptions of Wastes to be Sent to Repository

Waste Type	Inventory	Description of Waste Form
CSNF	**63,000 MTHM**	Approx. 221,000 BWR and PWR assemblies from commercial nuclear power generation, to be received at Yucca Mountain as Transport-Aging-Disposal canisters, dual-purpose canisters, or uncanistered, intact SNF assemblies. Approx. 1,700 MOX assemblies from conversion of 34 MT of surplus plutonium are included, but may require further testing/characterization. Also includes some commercial-origin DOE SNF for which fees have already been paid.
CHLW		275 canisters of vitrified HLW resulting from the commercial reprocessing of 640 MTHM of SNF. The HLW is owned by New York State and stored at the West Valley Demonstration Project. This HLW is characteristically identical to the HLW at Savannah River. There is currently no acceptance agreement between DOE and New York for this HLW.
DOE HLW	**4,667 MTHM**	Up to 9,334 canisters, either 10- or 15-foot long from reprocessing activities at Hanford, Savannah River, and Idaho National Laboratory. The reference HLW is a vitrified borosilicate glass with a range of waste loadings. (DOE uses a conversion of 0.5 MTHM per canister of DOE HLW to establish the basis to meet the NWPA statutory limit.) Only qualitative information is available to addresses approximately 870 canisters of a vitrified plutonium waste form (not part of the 4,667 MTHM inventory unless qualified for disposal) pending selection of the final waste form composition. The reference vitrified plutonium waste form includes a 10-foot canister of HLW containing up to 28 small cans containing lanthanide borosilicate (LaBS) glass incorporating the approximately 13 MT of surplus plutonium. An additional 100 canisters of HLW glass would also be generated due to the displacement of HLW from Pu.
DOE SNF	**2,333 MTHM**	Spent nuclear fuel from various non-commercial sources, such as weapons production, research and testing, and naval nuclear propulsion. DOE SNF is divided into 34 analytical groups based on fuel properties, cladding integrity, enrichment, etc. DOE SNF would be placed into disposable canisters at its current storage sites in Savannah River, Hanford, and Idaho National Laboratory. The canisters could be either a standardized canister (10-foot x 18", 10-foot x 24", 15-foot x 18", or 15-foot x 24"), multicanister overpacks, or naval spent fuel canisters (long or short). It is estimated that a range of 2,500 to 5,000 canisters will be produced. EM's current estimate is for approximately 3,500 canisters.

The inventories and allocation are consistent with CRWMS technical requirements baseline documents (e.g. CRWMS Requirements Document, MGR System Requirements Document, and Waste Acceptance System Requirements Document). Note that EM and RW agreed, for planning purposes, on a split of 1/3 of the 10% allocation of defense inventory to be for DOE SNF and 2/3 to be for HLW. This split can be readjusted upon joint agreement between EM and RW.

The following number is for OCRWM Records Management purposes only and should not be used when ordering this publication

Accession No.:

This publication was produced by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management (OCRWM)

For further information, contact:

U.S. Department of Energy
Yucca Mountain Site
Characterization Office
P.O. Box 30307
North Las Vegas, Nevada
89036-0307

Or call:

1-800-967-3477

DOE/EIS-0391

Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington

Volume 1
Chapters 1–12

U.S. Department of Energy

October 2009

Attachment 5

4.1.13.11 Alternative 6C: All Vitrification with Separations; Landfill Closure 4–211
4.1.14 Waste Management 4–212
4.1.14.1 Alternative 1: No Action 4–219
4.1.14.2 Alternative 2A: Existing WTP Vitrification; No Closure 4–221
4.1.14.3 Alternative 2B: Expanded WTP Vitrification; Landfill Closure 4–223
4.1.14.4 Alternative 3A: Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure 4–226
4.1.14.5 Alternative 3B: Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure 4–229
4.1.14.6 Alternative 3C: Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure 4–232
4.1.14.7 Alternative 4: Existing WTP Vitrification with Supplemental Treatment Technologies; Selective Clean Closure/Landfill Closure 4–235
4.1.14.8 Alternative 5: Expanded WTP Vitrification with Supplemental Treatment Technologies; Landfill Closure 4–238
4.1.14.9 Alternative 6A: All Vitrification/No Separations; Clean Closure 4–241
4.1.14.10 Alternative 6B: All Vitrification with Separations; Clean Closure 4–245
4.1.14.11 Alternative 6C: All Vitrification with Separations; Landfill Closure 4–249
4.1.15 Industrial Safety 4–252
4.1.15.1 Alternative 1: No Action 4–254
4.1.15.2 Alternative 2A: Existing WTP Vitrification; No Closure 4–254
4.1.15.3 Alternative 2B: Expanded WTP Vitrification; Landfill Closure 4–255
4.1.15.4 Alternative 3A: Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure 4–255
4.1.15.5 Alternative 3B: Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure 4–255
4.1.15.6 Alternative 3C: Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure 4–255
4.1.15.7 Alternative 4: Existing WTP Vitrification with Supplemental Treatment Technologies; Selective Clean Closure/Landfill Closure 4–255
4.1.15.8 Alternative 5: Expanded WTP Vitrification with Supplemental Treatment Technologies; Landfill Closure 4–255
4.1.15.9 Alternative 6A: All Vitrification/No Separations; Clean Closure 4–255
4.1.15.10 Alternative 6B: All Vitrification with Separations; Clean Closure 4–256
4.1.15.11 Alternative 6C: All Vitrification with Separations; Landfill Closure 4–256
4.2 Fast Flux Test Facility Decommissioning Alternatives 4–256
4.2.1 Land Resources 4–257
4.2.1.1 Alternative 1: No Action 4–257
4.2.1.2 Alternative 2: Entombment 4–259
4.2.1.3 Alternative 3: Removal 4–261
4.2.2 Infrastructure 4–263
4.2.2.1 Alternative 1: No Action 4–264
4.2.2.2 Alternative 2: Entombment 4–265

4.1.14.2.5 Secondary Waste

4.1.14.2.5.1 Mixed Transuranic Waste

As shown in Table 4–85, the estimated volume of mixed TRU waste would be less than the waste volume assumed under both Waste Management Alternative 2, Disposal Group 2, and Waste Management Alternative 3, Disposal Group 2; therefore, this volume should not impact existing TRU waste treatment and storage facilities and would be within the capacity allocated to Hanford for disposal at WIPP (DOE 1997:S-10).

4.1.14.2.5.2 Low-Level and Mixed Low-Level Radioactive Wastes

As shown in Table 4–85, Tank Closure Alternative 2A accounts for the disposal of 34,331 cubic meters (44,905 cubic yards) of LLW and 39,254 cubic meters (51,344 cubic yards) of MLLW that would be generated by the tank closure program. LLW and MLLW would be disposed of in an IDF. The amount of LLW and MLLW generated under this Tank Closure alternative is consistent with that accounted for under Waste Management Alternative 2, Disposal Group 2, and Waste Management Alternative 3, Disposal Group 2. Therefore, no long-term storage capacity would be needed; the impacts of treating and disposing of this waste in an IDF(s) are evaluated under Waste Management Alternative 2, Disposal Group 2, and Waste Management Alternative 3, Disposal Group 2.

4.1.14.2.5.3 Hazardous Waste

As shown in Table 4–85, a total of 79,203 cubic meters (103,598 cubic yards) of hazardous waste would be generated during construction and operations. For two peak years (2092–2093), hazardous waste would be generated at 31,380 cubic meters (41,045 cubic yards) per year.

4.1.14.2.5.4 Nonhazardous Waste

As shown in Table 4–85, the estimated volume of nonhazardous waste would be 2,647 cubic meters (3,462 cubic yards). This waste would be sent for offsite disposal in a local landfill. This additional waste load would have only a minor impact on the handling and accumulation of nonhazardous solid waste at Hanford.

4.1.14.2.5.5 Liquid Process Waste

As shown in Table 4–85, the estimated volume of low-level radioactive liquid process waste would be 9,691 liters (2,560 gallons). This waste would be treated on site.

4.1.14.3 Alternative 2B: Expanded WTP Vitrification; Landfill Closure

4.1.14.3.1 Waste Inventories

Table 4–86 presents the estimated waste volumes generated under Alternative 2B. Under this Tank Closure alternative, closure activities would include the removal of ancillary equipment and the top 4.6 meters (15 feet) of soil from two tank farms. This tank closure waste would be disposed of in the new RPPDF.

4.1.14.3.2 High-Level Radioactive Waste

As shown in Table 4–86, 14,220 cubic meters (18,600 cubic yards) of IHLW canisters and 400 cubic meters (523 cubic yards) of cesium and strontium canisters would be generated. DOE expects that the IHLW canisters would be stored on site.

DOE/EIS-0391

Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington

Reader's Guide

U.S. Department of Energy

October 2009

Table of Contents

READER'S GUIDE 1
Introduction 1
Proposed Actions 1
Scope 1
Alternatives 3
Tank Closure 3
Tank Closure Alternative 1: No Action 3
Tank Closure Alternative 2: Implement the *Tank Waste Remediation System EIS* Record of Decision with Modifications 4
Tank Closure Alternative 2A: Existing WTP Vitrification; No Closure 4
Tank Closure Alternative 2B: Expanded WTP Vitrification; Landfill Closure 5
Tank Closure Alternative 3: Existing WTP Vitrification with Supplemental Treatment Technology; Landfill Closure 5
Tank Closure Alternative 3A: Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure 6
Tank Closure Alternative 3B: Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure 7
Tank Closure Alternative 3C: Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure 7
Tank Closure Alternative 4: Existing WTP Vitrification with Supplemental Treatment Technologies; Selective Clean Closure/Landfill Closure 8
Tank Closure Alternative 5: Expanded WTP Vitrification with Supplemental Treatment Technologies; Landfill Closure 9
Tank Closure Alternative 6: All Waste as Vitrified HLW 10
Tank Closure Alternative 6A: All Vitrification/No Separations; Clean Closure (Base and Option Cases) 11
Tank Closure Alternative 6B: All Vitrification with Separations; Clean Closure (Base and Option Cases) 11
Tank Closure Alternative 6C: All Vitrification with Separations; Landfill Closure (Base and Option Cases) 12
FFTF Decommissioning 13
FFTF Decommissioning Alternative 1: No Action 13
FFTF Decommissioning Alternative 2: Entombment 15
FFTF Decommissioning Alternative 3: Removal 16
Waste Management 17
Waste Management Alternative 1: No Action 17
Waste Management Alternative 2: Disposal in IDF, 200-East Area Only 17
Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas 18
Roadmaps to the Alternatives 19
Organization of the *Draft TC & WM EIS* 37
Availability of the *Draft TC & WM EIS* 39

List of Figures

Figure 1. Simplified Process Flow Diagram 2

List of Tables

Table 1. Comparison of Tank Closure Alternatives 14
Table 2. Comparison of FFTF Decommissioning Alternatives 17
Table 3. Comparison of Waste Management Alternatives 18
Table 4. Roadmap to the Tank Closure Alternatives 20
Table 5. Roadmap to the FFTF Decommissioning Alternatives 31
Table 6. Roadmap to the Waste Management Alternatives 34

Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington

READER'S GUIDE

INTRODUCTION

This Reader's Guide serves as an introduction and guide to the contents of the U.S. Department of Energy's (DOE's) *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* to highlight the key features of the reasonable alternatives and to help readers review the technical analyses presented in this environmental impact statement (EIS). Included here are descriptions of the proposed actions; the scope of this EIS; the alternatives evaluated; and the organization of this EIS itself. Readers are encouraged to use this guide to assist them in navigating through the complex information presented in this *TC & WM EIS*.

PROPOSED ACTIONS

The Hanford Site (Hanford), located in southeastern Washington State, has a waste inventory of about 206 million liters (54.5 million gallons) of mixed radioactive and chemically hazardous waste resulting from defense production activities conducted during the Cold War years. This waste is stored in 177 large and 61 smaller underground storage tanks and is a major potential risk to public health and the environment. DOE proposes to reduce this risk by updating its waste storage methodology and retrieving, treating, and disposing of key elements of this waste inventory. This EIS addresses the potential environmental impacts for three sets of proposed actions at Hanford: tank closure, Fast Flux Test Facility (FFTF) decommissioning, and waste management.

Figure 1 is a simplified process flow diagram displaying the general flow of waste from the single-shell tanks (SSTs) and double-shell tanks (DSTs) through the proposed treatment, interim storage, and disposal options. For the reader's ease, the flow diagram does not reflect a single alternative or set of alternatives; instead, the diagram displays all the options that were analyzed under the 17 proposed alternatives (11 for tank closure, 3 for FFTF decommissioning, and 3 for waste management). A distinction between current and proposed facilities is also made in Figure 1 to assist the reader in understanding which capabilities currently exist and which proposed additional capabilities were analyzed.

SCOPE

The scope of this *TC & WM EIS* includes analyses of the potential environmental impacts and relative cost consequences of proposed actions and reasonable alternatives for accomplishing the proposed actions. These analyses focused on three key elements:

1. Revising and updating the analyses of the August 1996 *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (*TWRS EIS*), as well as subsequent supplement analyses, which addressed retrieval, treatment, and disposal of the tank waste, by also evaluating the impacts of different scenarios for final closure of Hanford's SST system.

2. Evaluating the potential environmental impacts of proposed activities to decommission FFTF, a nuclear test reactor, and associated auxiliary facilities at Hanford, including management of the waste generated by the decommissioning process (such as remote-handled special components [RH-SCs]) and disposition of Hanford's inventory of radioactively contaminated bulk sodium from FFTF and other onsite facilities.

Retrieval: Waste from the tanks would not be retrieved.

Treatment: No vitrification or treatment capacity would be built after 2008. Ongoing WTP construction would be terminated, and the WTP site would be isolated pending some future use, if any. No immobilized low-activity waste (ILAW) or immobilized high-level radioactive waste (IHLW) would be produced.

Disposal: The waste in the SST and DST systems would remain in the tank farms indefinitely.

Closure: Tank closure would not be addressed under this alternative. DOE would maintain security and management of the site for a 100-year administrative control period. During this period, DOE would continue to store and conduct routine monitoring of the waste in the SSTs, DSTs, and miscellaneous underground storage tanks.

Tank Closure Alternative 2: Implement the *Tank Waste Remediation System EIS* Record of Decision with Modifications

Tank Closure Alternative 2 would implement the decisions made in the Record of Decision for the *TWRS EIS* and considered in three supplement analyses completed through 2001. Under this alternative, all waste retrieved from the tanks would be vitrified, resulting in either an ILAW or IHLW glass product.

Tank Closure Alternative 2 consists of two subalternatives: (1) Tank Closure Alternative 2A: Existing WTP Vitrification; No Closure and (2) Tank Closure Alternative 2B: Expanded WTP Vitrification; Landfill Closure, as described below.

Tank Closure Alternative 2A: Existing WTP Vitrification; No Closure

Storage: DOE would continue current waste management operations using existing tank storage facilities. Because all of the DSTs will exceed their 40-year design life during the approximate 80-year period of waste retrieval, they would be replaced in a phased manner through 2054.

Retrieval: Using currently available liquid-based waste retrieval and leak detection systems, waste would be retrieved to the minimum goal of the Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement (TPA), i.e., residual waste would not exceed 10.2 cubic meters (360 cubic feet) for the 100-series tanks or 0.85 cubic meters (30 cubic feet) for the smaller 200-series tanks, corresponding to 99 percent retrieval. This approach would be the same under Tank Closure Alternative 2B.

Treatment: The existing WTP configuration (two high-level radioactive waste [HLW] melters and two low-activity waste [LAW] melters) would operate at a theoretical maximum capacity (TMC) of 6 metric tons of glass IHLW per day and 30 metric tons of glass ILAW per day. Treatment would start in 2018, and both HLW and LAW treatment would end in 2093. All of the waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur. The WTP would need to be replaced after 60 years due to design-life constraints. No supplemental or transuranic (TRU) waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Disposal: LAW immobilized via the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented. This approach would be the same under Tank Closure Alternative 2B.

Closure: Tank closure would not be addressed under this alternative. For analysis purposes, administrative control of the tank farms would cease following a 100-year period ending in 2193.

Tank Closure Alternative 2B: Expanded WTP Vitrification; Landfill Closure

Storage: DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new waste receiver facilities (WRFs), which are below-grade lag storage and minimal waste treatment facilities, would be constructed.

Retrieval: Using currently available liquid-based waste retrieval and leak detection systems, waste would be retrieved to the TPA minimum goal, i.e., residual waste would not exceed 10.2 cubic meters (360 cubic feet) for the 100-series tanks or 0.85 cubic meters (30 cubic feet) for the smaller 200-series tanks, corresponding to 99 percent retrieval. This approach would be the same under Tank Closure Alternative 2A.

Treatment: The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of four LAW melters) to provide a vitrification TMC of 6 metric tons of glass IHLW per day and 90 metric tons of glass ILAW per day. Treatment would start in 2018 and end in approximately 2040 (for HLW) and 2043 (for LAW). All of the waste streams routed to the WTP would be pretreated, including technetium-99 removal from the LAW stream. No facilities would need to be replaced. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Disposal: LAW immobilized via the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented. This approach would be the same under Tank Closure Alternative 2A.

Closure: As operations are completed, the SST system at Hanford would be closed as a Resource Conservation and Recovery Act (RCRA) hazardous waste landfill unit under Section 173-303 of the *Washington Administrative Code* (WAC 173-303), "Dangerous Waste Regulations," and DOE Order 435.1, *Radioactive Waste Management*, as applicable, or it would be decommissioned under DOE Order 430.1B, *Real Property Asset Management*. The tanks and ancillary equipment would be filled with grout to immobilize the residual waste, prevent future tank subsidence, and discourage intruder access. Soil would be removed down to 4.6 meters (15 feet) at the BX and SX tank farms and replaced with clean soil from onsite sources. The removed contaminated soils and ancillary equipment would be disposed of on site in the River Protection Project Disposal Facility (RPPDF), a new facility similar to an IDF. The closed tank systems and six sets of adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. Postclosure care would continue for 100 years.

Tank Closure Alternative 3: Existing WTP Vitrification with Supplemental Treatment Technology; Landfill Closure

This alternative consists of three subalternatives: (1) Tank Closure Alternative 3A: Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure, (2) Tank Closure Alternative 3B: Existing WTP Vitrification with Nonthermal Supplemental Treatment (Cast Stone); Landfill Closure, and (3) Tank Closure Alternative 3C: Existing WTP Vitrification with Thermal Supplemental Treatment (Steam Reforming); Landfill Closure. These subalternatives would involve the use of either thermal or nonthermal treatment technologies to supplement the WTP treatment processes. TRU tank waste would be packaged and interim-stored pending shipment to the Waste Isolation Pilot Plant (WIPP) for disposal.

The 90 percent retrieval level would be equal to residual tank waste of no more than 102 cubic meters (3,600 cubic feet) for the 100-series tanks or 8.5 cubic meters (300 cubic feet) for the smaller 200-series tanks.

Treatment: The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of one LAW melter) to provide a vitrification TMC of 6 metric tons of glass IHLW per day and 45 metric tons of glass ILAW per day. All waste streams routed to the WTP would be pretreated, although technetium-99 removal would not occur as part of WTP pretreatment. Treatment would start in 2018 and end in approximately 2034. This alternative considers implementation of a sulfate removal technology following WTP pretreatment that would potentially reduce the amount of glass produced in the WTP by increasing the waste loading in the ILAW glass. WTP capacity would be supplemented with additional waste treatment capacity to immobilize a portion of the LAW. Supplemental treatment of the LAW would occur in both the 200-East and 200-West Areas and consist of a combination of cast stone treatment in the 200-East Area and bulk vitrification treatment in the 200-West Area. The waste stream feed for the 200-East Area Cast Stone Facility would be pretreated in the WTP, excluding technetium-99 removal. In the 200-West Area, the waste feed would be pretreated in a new Solid-Liquid Separations Facility. A separate portion of the tank waste (approximately 11.8 million liters [3.1 million gallons]) would be designated as mixed TRU waste and packaged for disposal at WIPP. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Disposal: LAW immobilized both via the WTP and external to the WTP would be disposed of on site in an IDF. IHLW would be stored on site until disposition decisions are made and implemented. Mixed TRU waste would be packaged and stored on site in a new storage facility, pending disposal at WIPP.

Closure: As operations are completed, the SST system would be closed as an RCRA hazardous waste landfill unit under WAC 173-303, "Dangerous Waste Regulations," and DOE Order 435.1, *Radioactive Waste Management*, or it would be decommissioned under DOE Order 430.1B, *Real Property Asset Management*. The tanks and ancillary equipment would be filled with grout to immobilize the residual waste, prevent long-term degradation of the tanks, and discourage intruder access. The tank systems (tanks, ancillary equipment, and soils) and the six sets of adjacent cribs and trenches (ditches) would be closed in place and covered with the Hanford barrier (a barrier with performance characteristics that exceed RCRA requirements for disposal of hazardous waste). To support this schedule, SST system ancillary equipment outside the boundaries of the surface barriers would not be removed or decontaminated. Postclosure care would continue for 100 years.

Tank Closure Alternative 6: All Waste as Vitrified HLW[2]

This alternative consists of three subalternatives: (1) Alternative 6A: All Vitrification/No Separations; Clean Closure (Base and Option Cases), (2) Alternative 6B: All Vitrification with Separations; Clean Closure (Base and Option Cases), and (3) Alternative 6C: All Vitrification with Separations; Landfill Closure. These alternatives evaluate an all-vitrification case wherein all vitrified waste would be managed as HLW.

[2] Alternatives 6A, 6B, and 6C of this EIS evaluate management of tank waste as HLW combined with different closure scenarios. The purpose of Alternative 6A is to evaluate the bounding case for no-separation scenarios. The DOE Manual 435.1-1, "*Radioactive Waste Management Manual,*" waste incidental to reprocessing evaluation determination process is not required for treatment of the waste under these alternatives.

Tank Closure Alternative 6A: All Vitrification/No Separations; Clean Closure (Base and Option Cases)

Storage: DOE would continue current waste management operations using existing tank storage facilities that would be modified as needed to support SST waste retrieval and treatment. New DSTs would be required after the existing DSTs reach the end of their design life.

Retrieval: Using currently available liquid-based retrieval and leak detection systems and a final chemical wash step, waste would be retrieved to a volume corresponding to 99.9 percent retrieval, equal to residual tank waste of no more than 1 cubic meter (36 cubic feet) for the 100-series tanks or 0.08 cubic meters (3 cubic feet) for the smaller 200-series tanks. This approach would be the same under Tank Closure Alternative 6B.

Treatment: The existing WTP configuration would be modified to process all waste as HLW through expanded HLW vitrification capacity. This new WTP configuration (five HLW melters and no LAW melters) would provide a total vitrification TMC of 15 metric tons of glass IHLW per day. Treatment would start in 2018 and end in approximately 2163, requiring two WTP replacement facilities due to design-life constraints. There would be no pretreatment, LAW treatment, or technetium-99 removal. No supplemental or TRU waste treatment is proposed. The cesium and strontium capsules would be retrieved from the WESF, de-encapsulated, and treated in the WTP.

Disposal: IHLW canisters would be stored on site until disposition decisions are made and implemented. Replacement of the canister storage facilities would be required after a 60-year design life. The HLW debris from clean closure would be managed as HLW and stored on site.

Closure: Clean closure of all twelve 200-East and 200-West Area SST farms following deactivation would involve removal of all tanks, associated ancillary equipment, and contaminated soil to a depth of 3 meters (10 feet) directly beneath the tank base. These materials would be packaged as HLW for onsite storage in shielded boxes. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. The new PPF would process the highly contaminated deep soil to render it acceptable for onsite disposal. The liquid waste stream from the PPF soil washing would be thermally treated in the PPF and disposed of on site in an IDF. The washed soils would be disposed of in the RPPDF. Clean closure of the SST system would preclude the need for postclosure care. The six sets of adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier (Base Case). Optional clean closure of these cribs and trenches (ditches) would occur under the Option Case. This approach would be the same under Tank Closure Alternative 6B.

Tank Closure Alternative 6B: All Vitrification with Separations; Clean Closure (Base and Option Cases)

Storage: DOE would continue current waste management operations using existing tank storage facilities. No new DSTs would be required, but four new WRFs would be constructed. This approach would be the same under Tank Closure Alternative 6C.

Retrieval: Using currently available liquid-based retrieval and leak detection systems and a final chemical wash step, waste would be retrieved to a volume corresponding to 99.9 percent retrieval, equal to residual tank waste of no more than 1 cubic meter (36 cubic feet) for the 100-series tanks or 0.08 cubic meters (3 cubic feet) for the smaller 200-series tanks. This approach would be the same under Tank Closure Alternative 6A.

Treatment: The existing WTP configuration (two HLW melters and two LAW melters) would be supplemented with expanded LAW vitrification capacity (an addition of four LAW melters) to provide a

Table 4. Roadmap to the Tank Closure Alternatives *(continued)*

TANK CLOSURE ALTERNATIVE 2B: Expanded WTP Vitrification; Landfill Closure									
STORAGE		**RETRIEVAL**		**TREATMENT**		**DISPOSAL**		**CLOSURE**	
Key Features • 4 waste receiver facilities • No new double-shell tanks		*Key Features* • 99 percent tank waste retrieval • Liquid-based retrieval technologies • Current leak detection technology • Retrieval leakage rate = 15,120 liters (4,000 gallons) per single-shell tank		*Key Features* • Waste treatment: 2018–2043 • 6 MTG/day (2 HLW melters) × 90 MTG/day (6 LAW melters) • Tc-99 removal • No sulfate removal • No tank-derived TRU waste treatment		*Key Features* • ILAW disposal on site • IHLW storage includes CSB + 4 additional vaults		*Key Features* • Landfill closure (modified RCRA Subtitle C barrier) • Upper 4.6 meters (15 feet) of soil in BX and SX tank farms and ancillary equipment removed • 100-year postclosure care	
Potential Issues • Construction of 4 waste receiver facilities		*Potential Issues* • Retrieval leakage rate = 15,120 liters (4,000 gallons) per single-shell tank		*Potential Issues* • Construction of expanded WTP		*Potential Issues* • ILAW disposal on site • No waste acceptance criteria for HLW melters (stored indefinitely)		*Potential Issues* • Landfill closure of all single-shell tank farms with 1 percent residual waste and adjacent cribs and trenches (ditches) • Benefit of removing upper 4.6 meters (15 feet) of soil in BX and SX tank farms	
Description • 2.2.1 • 2.2.2.1 • 2.5.2.2.2 • D.1 • E.1	*Impacts* • 4.1.1.3 LR • 4.1.4.3 AQ • 4.1.10.3 NO • 4.1.11.3 FA	*Description* • 2.2.2.1 • 2.5.2.2.2 • D.1 • E.1	*Impacts* • 4.1.4.3 AQ • 4.1.6.3 WR • 4.1.9.3 S • 4.1.10.3 NO • 4.1.11.3 FA • 5.1.1.3 GW • 5.1.2.3 HH • 5.1.3.3 LER	*Description* • 2.2.2.2 • 2.5.2.2.2 • D.1 • E.1	*Impacts* • 4.1.1.3 LR • 4.1.4.3 AQ • 4.1.6.3 WR • 4.1.7.3 ER • 4.1.9.3 S • 4.1.10.3 NO • 4.1.11.3 FA • 4.1.14.3 WM • 5.1.1.3 GW • 5.1.2.3 HH • 5.1.3.3 LER	*Description* • 2.2.2.3 • 2.5.2.2.2 • D.1 • E.1	*Impacts* • 4.1.1.3 LR • 4.1.4.3 AQ • 4.1.6.3 WR • 4.1.7.3 ER • 4.1.11.3 FA • 4.1.12.3 T • 4.1.14.3 WM • 5.1.1.3 GW • 5.1.2.3 HH • 5.1.3.3 LER	*Description* • 2.2.2.4 • 2.5.2.2.2 • E.1	*Impacts* • 4.1.4.3 AQ • 4.1.6.3 WR • 4.1.10.3 NO • 4.1.14.3 WM • 5.1.1.3 GW • 5.1.2.3 HH • 5.1.3.3 LER

Note: "Key Features" include alternative configurations, treatment dates, and assumptions. "Potential Issues" include topics that may be environmental impact drivers or are expected to be of interest to readers. "Description" identifies EIS Chapter 2 and Appendix D and E sections that further describe the Key Features, including the technologies evaluated. Chapter 2 provides an overview of the alternatives, while Appendix E provides more-detailed information. "Impacts" identify EIS Chapter 4 and 5 sections that describe the impacts of the Key Features and/or Potential Issues.

Key: AQ=Air Quality; CSB=Canister Storage Building; EIS=environmental impact statement; ER=Ecological Resources; FA=Facility Accidents; GW=Groundwater; HH=Human Health; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; LER=Long-Term Ecological Risk; LR=Land Resources; MTG=metric tons of glass; NO=Normal Operations; RCRA=Resource Conservation and Recovery Act; S=Socioeconomics; T=Transportation; Tc-99=technetium-99; TRU=transuranic; WM=Waste Management; WR=Water Resources; WTP=Waste Treatment Plant.

Table 4. Roadmap to the Tank Closure Alternatives *(continued)*

<table>
<tr><th colspan="10">TANK CLOSURE ALTERNATIVE 3A:
Existing WTP Vitrification with Thermal Supplemental Treatment (Bulk Vitrification); Landfill Closure</th></tr>
<tr><th colspan="2">STORAGE</th><th colspan="2">RETRIEVAL</th><th colspan="2">TREATMENT</th><th colspan="2">DISPOSAL</th><th colspan="2">CLOSURE</th></tr>
<tr>
<td colspan="2">Key Features
• 4 waste receiver facilities
• No new double-shell tanks</td>
<td colspan="2">Key Features
• 99 percent tank waste retrieval
• Liquid-based retrieval technologies
• Current leak detection technology
• Retrieval leakage rate = 15,120 liters (4,000 gallons) per single-shell tank</td>
<td colspan="2">Key Features
• Waste treatment: 2018–2040
• 6 MTG/day (2 HLW melters) × 30 MTG/day (2 LAW melters)
• Supplemental treatment (bulk vitrification)
• No Tc-99 removal
• No sulfate removal
• Tank-derived TRU waste treatment</td>
<td colspan="2">Key Features
• ILAW disposal on site
• IHLW storage includes CSB + 4 additional vaults</td>
<td colspan="2">Key Features
• Landfill closure (modified RCRA Subtitle C barrier)
• Upper 4.6 meters (15 feet) of soil in BX and SX tank farms and ancillary equipment removed
• 100-year postclosure care</td>
</tr>
<tr>
<td colspan="2">Potential Issues
• Construction of 4 waste receiver facilities</td>
<td colspan="2">Potential Issues
• Retrieval leakage rate = 15,120 liters (4,000 gallons) per single-shell tank</td>
<td colspan="2">Potential Issues
• Construction in 200-East and 200-West Areas
• Addition of bulk vitrification supplemental treatment capacity</td>
<td colspan="2">Potential Issues
• ILAW disposal on site
• Tc-99 in ILAW and bulk vitrification
• No waste acceptance criteria for HLW melters (stored indefinitely)
• Tank-derived TRU waste disposal at WIPP</td>
<td colspan="2">Potential Issues
• Landfill closure of all single-shell tank farms with 1 percent residual waste and adjacent cribs and trenches (ditches)
• Benefit of removing upper 4.6 meters (15 feet) of soil in BX and SX tank farms</td>
</tr>
<tr>
<td>Description
• 2.2.1
• 2.2.2.1
• 2.5.2.3.1
• D.1
• E.1</td>
<td>Impacts
• 4.1.1.4 LR
• 4.1.4.4 AQ
• 4.1.10.4 NO
• 4.1.11.4 FA</td>
<td>Description
• 2.2.2.1
• 2.5.2.3.1
• D.1
• E.1</td>
<td>Impacts
• 4.1.4.4 AQ
• 4.1.6.4 WR
• 4.1.9.4 S
• 4.1.10.4 NO
• 4.1.11.4 FA
• 5.1.1.4 GW
• 5.1.2.4 HH
• 5.1.3.4 LER</td>
<td>Description
• 2.2.2.2
• 2.5.2.3.1
• D.1
• E.1</td>
<td>Impacts
• 4.1.1.4 LR
• 4.1.4.4 AQ
• 4.1.6.4 WR
• 4.1.7.4 ER
• 4.1.9.4 S
• 4.1.10.4 NO
• 4.1.11.4 FA
• 4.11.14.4 WM
• 5.1.1.4 GW
• 5.1.2.4 HH
• 5.1.3.4 LER</td>
<td>Description
• 2.2.2.3
• 2.5.2.3.1
• D.1
• E.1</td>
<td>Impacts
• 4.1.1.4 LR
• 4.1.4.4 AQ
• 4.1.6.4 WR
• 4.1.7.4 ER
• 4.1.11.4 FA
• 4.1.12.4 T
• 4.1.14.4 WM
• 5.1.1.4 GW
• 5.1.2.4 HH
• 5.1.3.4 LER</td>
<td>Description
• 2.2.2.4
• 2.5.2.3.1
• E.1</td>
<td>Impacts
• 4.1.4.4 AQ
• 4.1.6.4 WR
• 4.1.10.4 NO
• 4.1.14.4 WM
• 5.1.1.4 GW
• 5.1.2.4 HH
• 5.1.3.4 LER</td>
</tr>
</table>

Note: "Key Features" include alternative configurations, treatment dates, and assumptions. "Potential Issues" include topics that may be environmental impact drivers or are expected to be of interest to readers. "Description" identifies EIS Chapter 2 and Appendix D and E sections that further describe the Key Features, including the technologies evaluated. Chapter 2 provides an overview of the alternatives, while Appendix E provides more-detailed information. "Impacts" identify EIS Chapter 4 and 5 sections that describe the impacts of the Key Features and/or Potential Issues.

Key: AQ=Air Quality; CSB=Canister Storage Building; EIS=environmental impact statement; ER=Ecological Resources; FA=Facility Accidents; GW=Groundwater; HH=Human Health; HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; ILAW=immobilized low-activity waste; LAW=low-activity waste; LER=Long-Term Ecological Risk; LR=Land Resources; MTG=metric tons of glass; NO=Normal Operations; RCRA=Resource Conservation and Recovery Act; S=Socioeconomics; T=Transportation; Tc-99=technetium-99; TRU=transuranic; WIPP=Waste Isolation Pilot Plant; WM=Waste Management; WR=Water Resources; WTP=Waste Treatment Plant.

DOE/EIS-0391

Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington

Summary

U.S. Department of Energy

October 2009

Table of Contents

List of Figures .... S-iii
List of Tables .... S-iv
List of Abbreviations and Acronyms .... S-v
Measurement Units .... S-vii
Conversions .... S-viii

Summary S–1
S.1 Introduction S–1
S.1.1 History of the Hanford Site S–2
S.1.2 NEPA and Program Activities Leading Up to This TC & WM EIS S–3
S.1.2.1 Tank Waste Remediation Program S–4
S.1.2.2 Fast Flux Test Facility S–6
S.1.2.3 Hanford Solid Waste Program S–8
S.1.3 Purpose and Need for Agency Action S–9
S.1.3.1 Decisions to Be Made S–10
S.1.3.2 Decisions Not to Be Made S–11
S.1.4 Public Participation S–13
S.1.4.1 Public Meetings and Issues Identified During the *TC & WM EIS* Scoping Process S–14
S.1.4.2 Public Meetings and Issues Identified During the "Tank Closure EIS" Scoping Process S–15
S.1.4.3 Public Meetings and Issues Identified During the "FFTF Decommissioning EIS" Scoping Process S–18
S.2 Development of the Alternatives S–20
S.2.1 Tank Closure Alternatives S–21
S.2.1.1 Tank Waste Storage S–22
S.2.1.2 Tank Waste Retrieval S–23
S.2.1.3 Tank Waste Treatment S–23
S.2.1.4 Tank Waste Disposal S–25
S.2.1.5 Tank Farm Closure S–26
S.2.2 FFTF Decommissioning Alternatives S–28
S.2.2.1 Facility Disposition S–28
S.2.2.2 Disposition of Remote-Handled Special Components S–28
S.2.2.3 Disposition of Bulk Sodium S–28
S.2.3 Waste Management Alternatives S–29
S.2.3.1 Storage S–29
S.2.3.2 Disposal S–30
S.2.3.3 Closure S–30
S.3 Overview of Facilities and Technologies S–31
S.3.1 Tank Closure S–32
S.3.1.1 Tank Waste Storage S–32
S.3.1.2 Tank Waste Retrieval S–33
S.3.1.3 Tank Waste Transfer S–36
S.3.1.4 Tank Waste Treatment S–36
S.3.1.5 Interfacing Facilities – Tank Waste Storage, Retrieval, and Treatment S–39
S.3.1.6 Tank Waste Disposal S–39
S.3.1.7 Tank Farm Closure S–39

- Placing the remaining plant systems in a radiologically and industrially safe condition for long-term surveillance and maintenance
- Removal and packaging of the four RH-SCs for storage in the 400 Area

- **Disposition of the Cesium and Strontium Capsules.** Treatment of the cesium and strontium capsules, which are currently stored at the Waste Encapsulation and Storage Facility (WESF), is evaluated in this EIS based on the existing TPA milestone; however, the decision on final disposition of the cesium and strontium capsules will be determined at a later date subject to appropriate NEPA review.

- **HLW Transportation and Disposition.** The scope of this *TC & WM EIS* does not include making a decision on the ultimate disposition of HLW and any transportation related to such disposition. The *TWRS EIS* ROD to treat the Hanford tank waste has not changed. Funding for the Yucca Mountain facility has been eliminated in the Administration's fiscal year 2010 budget request. Notwithstanding the decision to terminate the Yucca Mountain program, which was the development of a geologic repository for the disposal of HLW and SNF, DOE remains committed to meeting its obligations to manage and ultimately dispose of HLW and SNF. The Administration intends to convene a blue ribbon commission to evaluate alternative approaches for meeting these obligations. Decisions reached through this process will need to be addressed at a later date subject to appropriate NEPA review.

S.1.4 Public Participation

Scoping is a process in which the public, regulators, and other interested parties provide comments directly to a Federal Agency on the scope of an EIS. This process is initiated by publication of the NOI in the *Federal Register*. The NOI to prepare this *TC & WM EIS* (71 FR 5655) was published on February 2, 2006, and initiated a 30-day scoping period that ended March 6, 2006. The NOI identified a set of preliminary alternatives available for public comment. A later notice (71 FR 8569) extended the scoping period to April 10, 2006. In the NOI, DOE requested comment on the proposed scope for the new *TC & WM EIS*. Public comments were submitted in a number of ways, including standard mail, electronic mail, fax, voicemail, and oral or written comments presented at formal public meetings. As stated in the NOI for this *TC & WM EIS*, DOE also considered earlier comments submitted in response to the 2003 NOI for the "Tank Closure EIS" (68 FR 1052) and the 2004 NOI for the "FFTF Decommissioning EIS" (69 FR 50176). Section S.1.4.1 discusses the *TC & WM EIS* scoping process and the comments received. Sections S.1.4.2 and S.1.4.3 similarly discuss the "Tank Closure EIS" and "FFTF Decommissioning EIS" scoping processes and comments, respectively. Information collected from the NEPA scoping process was used to modify the scope of this *TC & WM EIS*, as appropriate.

Ongoing dialogue with the public will continue as this Draft *TC & WM EIS* undergoes public review and comment (see Figure S–1). A 140-day comment period will begin when the EPA publishes a Notice of Availability in the *Federal Register*. Public hearings will be held during this comment period.

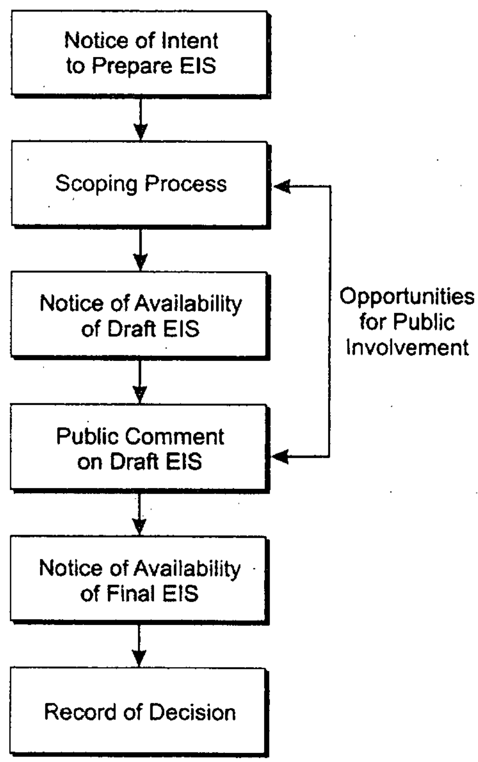


Figure S–1. National Environmental Policy Act (NEPA) Process

Recommendation by the Secretary of Energy Regarding the Suitability of the Yucca Mountain Site for a Repository Under the Nuclear Waste Policy Act of 1982

February 2002

Exhibit 2

1. Introduction *1*

2. Background *3*

2.1. History of the Yucca Mountain Project and the Nuclear Waste Policy Act **3**

2.2. The Nuclear Waste Policy Act and the Responsibilities of the Department of Energy and the Secretary **5**

3. Decision *6*

3.1. The Recommendation **6**

3.2. What This Recommendation Means, and What It Does Not Mean **6**

4. Decision Determination Methodology and the Decision-Making Process *7*

5. Decision Criteria *8*

5.1. Scientific and Technical Suitability **9**

5.2. National Interest Considerations **10**

6. Is Yucca Mountain Scientifically and Technically Suitable for Development of a Repository? *12*

6.1. Framework for Suitability Determination **12**

6.1.1. General Outline 12

6.1.2. Radiation Protection Standards 13

6.1.3. Underlying Hard Science 16

7. Results of Suitability Evaluations and Conclusions *18*

7.1. Results of Pre-Closure Evaluations **18**

7.2. Results of Post-Closure Evaluations **20**

8. The National Interest *26*

8.1. Nuclear Science and the National Interest **26**

8.2. Energy Security **27**

8.3. National Security **28**

8.3.1. Powering the Navy Nuclear Fleet 28

8.3.2. Allowing the Nation to Decommission Its Surplus Nuclear Weapons and Support Nuclear Non-Proliferation Efforts 28

8.4. Protecting the Environment **29**

8.5. Facilitating Continuation of Research, Medical, and Humanitarian Programs **30**

8.6. Assisting Anti-Terrorism at Home **30**

8.7. Summary **31**

9. None of the Arguments Against Yucca Mountain Withstands Analysis *31*

9.1. Assertion 1: The Citizens of Nevada Were Denied an Adequate Opportunity to Be Heard 32

9.2. Assertion 2: The Project Has Received Inadequate Study 33

9.3. Assertion 3: The Rules Were Changed in the Middle of the Game 33

9.4. Assertion 4: The Process Tramples States' Rights 37

9.5. Assertion 5: Transportation of Nuclear Materials is Disruptive and Dangerous 38

9.6. Assertion 6: Transportation of Wastes to the Site Will Have a Dramatically Negative Economic Impact on Las Vegas 39

9.7. Assertion 7: It is Premature for DOE to Make a Site Recommendation for Various Reasons 43

9.7.1. The General Accounting Office has concluded that it is premature for DOE to make a site recommendation now 43

9.7.2. DOE is not ready to make a site recommendation now because DOE and NRC have agreed on 293 technical items that need to be completed before DOE files a license application 44

9.7.3. It is premature for DOE to make a recommendation now because DOE cannot complete this additional work until 2006. The NWPA requires DOE to file a license application within 90 days of the approval of site designation 45

10. Conclusion *45*

1. Introduction

For more than half a century, since nuclear science helped us win World War II and ring in the Atomic Age, scientists have known that the Nation would need a secure, permanent facility in which to dispose of radioactive wastes. Twenty years ago, when Congress adopted the Nuclear Waste Policy Act of 1982 (NWPA or "the Act"), it recognized the overwhelming consensus in the scientific community that the best option for such a facility would be a deep underground repository. Fifteen years ago, Congress directed the Secretary of Energy to investigate and recommend to the President whether such a repository could be located safely at Yucca Mountain, Nevada. Since then, our country has spent billions of dollars and millions of hours of research endeavoring to answer this question. I have carefully reviewed the product of this study. In my judgment, it constitutes sound science and shows that a safe repository can be sited there. I also believe that compelling national interests counsel in favor of proceeding with this project. Accordingly, consistent with my responsibilities under the NWPA, today I am recommending that Yucca Mountain be developed as the site for an underground repository for spent fuel and other radioactive wastes.[1]

The first consideration in my decision was whether the Yucca Mountain site will safeguard the health and safety of the people, in Nevada and across the country, and will be effective in containing at minimum risk the material it is designed to hold. Substantial evidence shows that it will. Yucca Mountain is far and away the most thoroughly researched site of its kind in the world. It is a geologically stable site, in a closed groundwater basin, isolated on thousands of acres of Federal land, and farther from any metropolitan area than the great majority of less secure, temporary nuclear waste storage sites that exist in the country today.

This point bears emphasis. We are not confronting a hypothetical problem. We have a staggering amount of radioactive waste in this country – nearly 100,000,000 gallons of high-level nuclear waste and more than 40,000 metric tons of spent nuclear fuel with more created every day. Our choice is not between, on the one hand, a disposal site with costs and risks held to a minimum, and, on the other, a magic disposal system with no costs or risks at all. Instead, the real choice is between a single secure site, deep under the ground at Yucca Mountain, or making do with what we have now or some variant of it – 131 aging surface sites, scattered across 39 states. Every one of those sites was built on the assumption that it would be temporary. As time goes by, every one is closer to the limit of its safe life span. And every one is at least a potential security risk – safe for today, but a question mark in decades to come.

The Yucca Mountain facility is important to achieving a number of our national goals. It will promote our energy security, our national security, and safety in our homeland. It will help strengthen our economy and help us clean up the environment.

The benefits of nuclear power are with us every day. Twenty percent of our country's electricity comes from nuclear energy. To put it another way, the "average" home operates on nuclear-generated electricity for almost five hours a day. A government with a complacent, kick-the-

[1] For purposes of this Recommendation, the terms "radioactive waste" and "waste" are used to cover high-level radioactive waste and spent nuclear fuel, as those terms are used in the Nuclear Waste Policy Act.

can-down-the-road nuclear waste disposal policy will sooner or later have to ask its citizens which five hours of electricity they would care to do without.

Regions that produce steel, automobiles, and durable goods rely in particular on nuclear power, which reduces the air pollution associated with fossil fuels – greenhouse gases, solid particulate matter, smog, and acid rain. But environmental concerns extend further. Most commercial spent fuel storage facilities are near large populations centers; in fact, more than 161 million Americans live within 75 miles of these facilities. These storage sites also tend to be near rivers, lakes, and seacoasts. Should a radioactive release occur from one of these older, less robust facilities, it could contaminate any of 20 major waterways, including the Mississippi River. Over 30 million Americans are served by these potentially at-risk water sources.

Our national security interests are likewise at stake. Forty percent of our warships, including many of the most strategic vessels in our Navy, are powered by nuclear fuel, which eventually becomes spent fuel. At the same time, the end of the Cold War has brought the welcome challenge to our Nation of disposing of surplus weapons-grade plutonium as part of the process of decommissioning our nuclear weapons. Regardless of whether this material is turned into reactor fuel or otherwise treated, an underground repository is an indispensable component in any plan for its complete disposition. An affirmative decision on Yucca Mountain is also likely to affect other nations' weapons decommissioning, since their willingness to proceed will depend on being satisfied that we are doing so. Moving forward with the repository will contribute to our global efforts to stem the proliferation of nuclear weapons in other ways, since it will encourage nations with weaker controls over their own materials to follow a similar path of permanent, underground disposal, thereby making it more difficult for these materials to fall into the wrong hands. By moving forward with Yucca Mountain, we will show leadership, set out a roadmap, and encourage other nations to follow it.

There will be those who say the problem of nuclear waste disposal generally, and Yucca Mountain in particular, needs more study. In fact, both issues have been studied for more than twice the amount of time it took to plan and complete the moon landing. My Recommendation today is consistent with the conclusion of the National Research Council of the National Academy of Sciences – a conclusion reached, not last week or last month, but 12 years ago. The Council noted "a worldwide scientific consensus that deep geological disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste."[2] Likewise, a broad spectrum of experts agrees that we now have enough information, including more than 20 years of researching Yucca Mountain specifically, to support a conclusion that such a repository can be safely located there.[3]

Nonetheless, should this site designation ultimately become effective, considerable additional study lies ahead. Before an ounce of spent fuel or radioactive waste could be sent to Yucca

---

[2] *Rethinking High-Level Radioactive Waste Disposal: A Position Statement of the Board on Radioactive Waste Management*, Washington, D.C., National Academy Press, 1990.

[3] Letter and attached report, Charles G. Groat, Director, U.S. Geologic Survey, to Robert G. Card, October 4, 2001 (hereafter *USGS Letter & Report*); Letter and attached report, Hans Riotte, NEA-IAEA Joint Secretariat, to Lake H. Barrett, November 2, 2001 (hereafter *NEA-IAEA Letter & Report*); Letter, Charles V. Shank, Director, Lawrence Berkeley National Laboratory, to Spencer Abraham, September 6, 200 (hereafter *Lawrence Berkeley National Laboratory Letter*).

Mountain, indeed even before construction of the permanent facilities for emplacement of waste could begin there, the Department of Energy (DOE or "the Department") will be required to submit an application to the independent Nuclear Regulatory Commission (NRC). There, DOE would be required to make its case through a formal review process that will include public hearings and is expected to last at least three years. Only after that, if the license were granted, could construction begin. The DOE would also have to obtain an additional operating license, supported by evidence that public health and safety will be preserved, before any waste could actually be received.

In short, even if the Yucca Mountain Recommendation were accepted today, an estimated minimum of eight more years lies ahead before the site would become operational.

We have seen decades of study, and properly so for a decision of this importance, one with significant consequences for so many of our citizens. As necessary, many more years of study will be undertaken. But it is past time to stop sacrificing that which is forward-looking and prudent on the altar of a *status quo* we know ultimately will fail us. The *status quo* is not the best we can do for our energy future, our national security, our economy, our environment, and safety – and we are less safe every day as the clock runs down on dozens of older, temporary sites.

I recommend the deep underground site at Yucca Mountain, Nevada, for development as our Nation's first permanent facility for disposing of high-level nuclear waste.

2. Background

2.1. History of the Yucca Mountain Project and the Nuclear Waste Policy Act

The need for a secure facility in which to dispose of radioactive wastes has been known in this country at least since World War II. As early as 1957, a National Academy of Sciences report to the Atomic Energy Commission suggested burying radioactive waste in geologic formations. Beginning in the 1970s, the United States and other countries evaluated many options for the safe and permanent disposal of radioactive waste, including deep seabed disposal, remote island siting, dry cask storage, disposal in the polar ice sheets, transmutation, and rocketing waste into orbit around the sun. After analyzing these options, disposal in a mined geologic repository emerged as the preferred long-term environmental solution for the management of these wastes.[4] Congress recognized this consensus 20 years ago when it passed the Nuclear Waste Policy Act of 1982.

In the Act, Congress created a Federal obligation to accept civilian spent nuclear fuel and dispose of it in a geologic facility. Congress also designated the agencies responsible for implementing this policy and specified their roles. The Department of Energy must characterize, site, design, build, and manage a Federal waste repository. The Environmental Protection Agency (EPA) must set the public health standards for it. The Nuclear Regulatory Commission must license its construction, operation, and closure.

---

[4] *Final Environmental Impact Statement for Management of Commercially Generated Radioactive Waste*, DOE/EIS-0046, 1980.

The Department of Energy began studying Yucca Mountain almost a quarter century ago. Even before Congress adopted the NWPA, the Department had begun national site screening research as part of the National Waste Terminal Storage program, which included examination of Federal sites that had previously been used for defense-related activities and were already potentially contaminated. Yucca Mountain was one such location, on and adjacent to the Nevada Test Site, which was then under consideration. Work began on the Yucca Mountain site in 1978. When the NWPA was passed, the Department was studying more than 25 sites around the country as potential repositories. The Act provided for the siting and development of two; Yucca Mountain was one of nine sites under consideration for the first repository program.

Following the provisions of the Act and the Department's siting Guidelines,[5] the Department prepared draft environmental assessments for the nine sites. Final environmental assessments were prepared for five of these, including Yucca Mountain. In 1986, the Department compared and ranked the sites under consideration for characterization. It did this by using a multi-attribute methodology – an accepted, formal scientific method used to help decision makers compare, on an equivalent basis, the many components that make up a complex decision. When all the components of the ranking decision were considered together, taking account of both pre-closure and post-closure concerns, Yucca Mountain was the top-ranked site.[6] The Department examined a variety of ways of combining the components of the ranking scheme; this only confirmed the conclusion that Yucca Mountain came out in first place. The EPA also looked at the performance of a repository in unsaturated tuff. The EPA noted that in its modeling in support of development of the standards, unsaturated tuff was one of the two geologic media that appeared most capable of limiting releases of radionuclides in a manner that keeps expected doses to individuals low.[7]

In 1986, Secretary of Energy Herrington found three sites to be suitable for site characterization, and recommended the three, including Yucca Mountain, to President Reagan for detailed site characterization.[8] The Secretary also made a preliminary finding, based on Guidelines that did not require site characterization, that the three sites were suitable for development as repositories.[9]

The next year, Congress amended the NWPA, and selected Yucca Mountain as the single site to be characterized. It simultaneously directed the Department to cease activities at all other potential sites. Although it has been suggested that Congress's decision was made for purely political reasons, the record described above reveals that the Yucca Mountain site consistently ranked at or near the top of the sites evaluated well before Congress's action.

---

[5] The Guidelines then in force were promulgated at 10 CFR part 960, General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, 1984.

[6] *Recommendation by the Secretary of Energy of Candidate Sites for Site Characterization for the First Radioactive Waste Repository,* DOE/S-0048, May 1986.

[7] Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, Final Rule, 40 CFR Part 191, December 20, 1993.

[8] Letter, John S. Herrington, Secretary of Energy, to President Ronald Reagan, May 27, 1986, with attached report, *Recommendation by the Secretary of Energy of Candidate Sites for Site Characterization for the First Radioactive Waste Repository*, DOE/S-0048, May 1986.

[9] *Ibid.*

As previously noted, the National Research Council of the National Academy of Sciences concluded in 1990 (and reiterated last year) that there is "a worldwide scientific consensus that deep geological disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste."[10] Today, many national and international scientific experts and nuclear waste management professionals agree with DOE that there exists sufficient information to support a national decision on designation of the Yucca Mountain site.[11]

2.2. The Nuclear Waste Policy Act and the Responsibilities of the Department of Energy and the Secretary

Congress assigned to the Secretary of Energy the primary responsibility for implementing the national policy of developing a deep underground repository. The Secretary must determine whether to initiate the next step laid out in the NWPA – a recommendation to designate Yucca Mountain as the site for development as a permanent disposal facility. The criteria for this determination are described more fully in section 5. Briefly, I first must determine whether Yucca Mountain is in fact technically and scientifically suitable to be a repository. A favorable suitability determination is indispensable for a positive recommendation of the site to the President. Under additional criteria I have adopted above and beyond the statutory requirements, I have also sought to determine whether, when other relevant considerations are taken into account, recommending it is in the overall national interest and, if so, whether there are countervailing arguments so strong that I should nonetheless decline to make the Recommendation.

The Act contemplates several important stages in evaluating the site before a Secretarial recommendation is in order. It directs the Secretary to develop a site characterization plan, one that will help guide test programs for the collection of data to be used in evaluating the site. It directs the Secretary to conduct such characterization studies as may be necessary to evaluate the site's suitability. And it directs the Secretary to hold hearings in the vicinity of the prospective site to inform the residents and receive their comments. It is at the completion of these stages that the Act directs the Secretary, if he finds the site suitable, to determine whether to recommend it to the President for development as a permanent repository..

If the Secretary recommends to the President that Yucca Mountain be developed, he must include with the Recommendation, and make available to the public, a comprehensive statement of the basis for his determination.[12] If at any time the Secretary determines that Yucca Mountain is not a suitable site, he must report to Congress within six months his recommendations for further action to assure safe, permanent disposal of spent nuclear fuel and high-level radioactive waste.

---

[10] *Rethinking High-Level Radioactive Waste Disposal: A Position Statement of the Board on Radioactive Waste Management*, Washington, D.C., National Academy Press, 1990. And: *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges*, Board on Radioactive Waste Management, Washington, D.C., National Academy Press, 2001.

[11] *USGS Letter & Report, supra; NEA-IAEA Letter & Report, supra; Lawrence Berkeley National Laboratory Letter, supra.*

[12] This document together with accompanying materials comprises the recommendation and the comprehensive statement. The accompanying materials are described in footnote 26.

Following a Recommendation by the Secretary, the President may recommend the Yucca Mountain site to Congress "if... [he] considers [it] qualified for application for a construction authorization...."[13] If the President submits a recommendation to Congress, he must also submit a copy of the statement setting forth the basis for the Secretary's Recommendation.

A Presidential recommendation takes effect 60 days after submission unless Nevada forwards a notice of disapproval to the Congress. If Nevada submits such a notice, Congress has a limited time during which it may nevertheless give effect to the President's recommendation by passing, under expedited procedures, a joint resolution of siting approval. If the President's recommendation takes effect, the Act directs the Secretary to submit to the NRC a construction license application.

The NWPA by its terms contemplated that the entire process of siting, licensing, and constructing a repository would have been completed more than four years ago, by January 31, 1998. Accordingly, it required the Department to enter into contracts to begin accepting waste for disposal by that date.

3. Decision

3.1. The Recommendation

After over 20 years of research and billions of dollars of carefully planned and reviewed scientific field work, the Department has found that a repository at Yucca Mountain brings together the location, natural barriers, and design elements most likely to protect the health and safety of the public, including those Americans living in the immediate vicinity, now and long into the future. It is therefore suitable, within the meaning of the NWPA, for development as a permanent nuclear waste and spent fuel repository.

After reviewing the extensive, indeed unprecedented, analysis the Department has undertaken, and in discharging the responsibilities made incumbent on the Secretary under the Act, I am recommending to the President that Yucca Mountain be developed as the Nation's first permanent, deep underground repository for high-level radioactive waste. A decision to develop Yucca Mountain will be a critical step forward in addressing our Nation's energy future, our national defense, our safety at home, and protection for our economy and environment.

3.2. What This Recommendation Means, and What It Does Not Mean

Even after so many years of research, this Recommendation is a preliminary step. It does no more than start the formal safety evaluation process. Before a license is granted, much less before repository construction or waste emplacement may begin, many steps and many years still lie ahead. The DOE must submit an application for a construction license; defend it through formal review, including public hearings; and receive authorization from the NRC, which has the statutory responsibility to ensure that any repository built at Yucca Mountain meets stringent

[13] NWPA section 114(a)(2)(A).

tests of health and safety. The NRC licensing process is expected to take a minimum of three years. Opposing viewpoints will have every opportunity to be heard. If the NRC grants this first license, it will only authorize initial construction. The DOE would then have to seek and obtain a second operating license from the NRC before any wastes could be received. The process altogether is expected to take a minimum of eight years.

The DOE would also be subject to NRC oversight as a condition of the operating license. Construction, licensing, and operation of the repository would also be subject to ongoing Congressional oversight.

At some future point, the repository is expected to close. EPA and NRC regulations require monitoring after the DOE receives a license amendment authorizing the closure, which would be from 50 to about 300 years after waste emplacement begins, or possibly longer.
The repository would also be designed, however, to be able to adapt to methods future generations might develop to manage high-level radioactive waste. Thus, even after completion of waste emplacement, the waste could be retrieved to take advantage of its economic value or usefulness to as yet undeveloped technologies.

Permanently closing the repository would require sealing all shafts, ramps, exploratory boreholes, and other underground openings connected to the surface. Such sealing would discourage human intrusion and prevent water from entering through these openings. DOE's site stewardship would include maintaining control of the area, monitoring and testing, and implementing security measures against vandalism and theft. In addition, a network of permanent monuments and markers would be erected around the site to alert future generations to the presence and nature of the buried waste.[14] Detailed public records held in multiple places would identify the location and layout of the repository and the nature and potential hazard of the waste it contains. The Federal Government would maintain control of the site for the indefinite future. Active security systems would prevent deliberate or inadvertent human intrusion and any other human activity that could adversely affect the performance of the repository.

4. Decision Determination Methodology and the Decision-Making Process

I have considered many kinds of information in making my determination today. I have put on a hard hat, gone down into the Mountain, and spoken with many of the scientists and engineers working there. Of course my decision-making included a great deal more than that. I have also personally reviewed detailed summaries of the science and research undertaken by the Yucca Mountain Project since 1978. I relied upon review materials, program evaluations, and face-to-face briefings given by many individuals familiar with the Project, such as the acting program manager and program senior staff.

My consideration included: (a) the general background of the program, including the relevant legislative history; (b) the types, sources, and amounts of radioactive waste that would be disposed of at the site and their risk; (c) the extent of Federal responsibilities; (d) the criteria for a

[14] During characterization of the Yucca Mountain site, Nye County began to develop its Early Warning Monitoring program and boreholes. These boreholes not only provide information about water movement in the area of the site, but also can serve as monitoring points should a repository be built at Yucca Mountain.

suitability decision, including the NWPA's provisions bearing on the basis for the Secretary's consideration; the regulatory structure, its substance, history, and issues; DOE's Yucca Mountain Suitability Guidelines promulgated under the NWPA;[15] the NRC licensing regulations,[16] and EPA radiation protection standards[17] as referenced in the Suitability Guidelines; (e) assessments of repository performance, including technical data and descriptions of how those data were gathered and evaluated; assessments of the effectiveness of natural and engineered barriers in meeting applicable radiation protection standards, and adjustments for uncertainties associated with each of these; (f) the Yucca Mountain Site Suitability Evaluation; (g) the views of members of the public, including those expressed at hearings and through written comments; (h) environmental, socioeconomic, and transportation issues; (i) program oversight history, technical issues, and responses, including the role and views of the NRC, the Nuclear Waste Technical Review Board, the General Accounting Office, the Inspector General, and the State of Nevada; and the role and views of the National Laboratories, the United States Geological Survey, and peer reviews; and (j) public policy impact.

I also requested an external review of program briefing materials. It was conducted by Dr. Chris Whipple, a member of the National Academy of Engineering and an experienced independent peer reviewer of programs for both the Waste Isolation Pilot Plant and the Yucca Mountain Project. Dr. Whipple previously had led a peer review team that critically analyzed Total System Performance Assessment (TSPA) work of the Yucca Mountain Project.

I also reviewed the comment summary documents from both the Environmental Impact Statement (EIS) and NWPA Section 114 site recommendation hearing process in order fully to take into account public views concerning a possible recommendation of the Yucca Mountain site. This review enabled me to evaluate scientific and research results in the context of both strongly held local concerns and issues of national importance. I took particular note of comments and concerns raised by the Governor of Nevada, governors of other states, state agencies, Native American tribes, and members of the public at large.

5. Decision Criteria

My charge to make a recommendation to the President on this matter stems from the Nuclear Waste Policy Act of 1982. That statute directs the Secretary of Energy to determine "whether to recommend to the President that he approve [the Yucca Mountain] site for development of a repository."[18] The NWPA establishes certain guideposts along the way to making this determination, but it also gives the Secretary significant responsibility for deciding what the relevant considerations are to be.

Pursuant to that responsibility, I concluded that I should use three criteria in determining whether to recommend approval of the Yucca Mountain Project. First, is Yucca Mountain a scientifically

---

[15] 10 CFR Part 963, Yucca Mountain Site Suitability Guidelines, November 14, 2001.
[16] 10 CFR Part 63, Disposal of High-Level Radioactive Waste in a Geologic Repository at Yucca Mountain, Nevada, November 2, 2001.
[17] 40 CFR Part 197, Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada, June 13, 2001.
[18] NWPA section 114(a)(1).

and technically suitable site for a repository, *i.e.*, a site that promises a reasonable expectation of public health and safety for disposal of spent nuclear fuel and high-level radioactive waste for the next 10,000 years? Second, are there compelling national interests that favor proceeding with the decision to site a repository there? And third, are there countervailing considerations that outweigh those interests?

The first of these criteria is expressly contemplated by the NWPA, although the NWPA also confers considerable discretion and responsibility on the Secretary in defining how to determine scientific and technical suitability and in making a judgment on the question. The two other criteria are not specified by the NWPA, but I am convinced that they are appropriate checks on a pure suitability-based decision.

5.1. Scientific and Technical Suitability

Under the NWPA, the first step in a Secretarial determination regarding Yucca Mountain is deciding whether it is scientifically and technically suitable as a repository site. Although the NWPA does not state explicitly that this is the initial step, the language and structure of the Act strongly suggest that this is so. Most significantly, section 114(a)(1) of the NWPA states that the Secretary's recommendation is to be made at the conclusion of site characterization.[19] Section 113, in turn, makes clear that the function of site characterization is to provide enough site-specific information to allow a decision on Yucca Mountain's scientific suitability.[20]

As to what a determination of site suitability entails, the only real guidance the Act provides is that in several places it equates a favorable suitability judgment with a judgment that a repository could (1) be built at that site and (2) receive a construction authorization from the NRC.[21] This suggests that a determination that the site is suitable entails a judgment on my part that a repository at Yucca Mountain would likely be licensable by the NRC.

Beyond that, the NWPA largely leaves the question to the Secretary of Energy by charging him with establishing "criteria to be used to determine the suitability of ... candidate site[s] for the location of a repository."[22] On November 14, 2001, following NRC's concurrence, the Department issued its final version of these criteria in a rule entitled, "Yucca Mountain Site Suitability Guidelines." I shall describe these in detail in the next section of this Recommendation, but outline them here. In brief, DOE's Guidelines envision that I may find the Yucca Mountain site suitable if I conclude that a repository constructed there is "likely" to meet

---

[19] Ibid.

[20] This is apparent from two related provisions of section 113: section 113(c)(1), which states that, "The Secretary may conduct at the Yucca Mountain site only such site characterization activities as the Secretary considers necessary to provide the data required for evaluation of the suitability of such site for an application to be submitted to the Commission for a construction authorization for a repository at such site" (as well as for NEPA purposes); and its companion provision, section 113(c)(3), which states that, "If the Secretary at any time determines the Yucca Mountain site to be unsuitable for development as a repository, the Secretary shall ... terminate all site characterization activities [there]."

[21] NWPA section 112(b)(1)(D)(ii); NWPA section 113(c)(1); NWPA section 113(c)(3).

[22] NWPA section 113(b)(1)(A)(iv). That section contemplates that these criteria are to be included in the first instance in the site characterization plan for each site and thereafter may be modified using the procedures of section 112(a).

extremely stringent radiation protection standards designed to protect public health and safety.[23] The EPA originally established these standards.[24] They are now also set out in NRC licensing rules.[25]

The EPA and NRC adopted the standards so as to assure that while the repository is receiving nuclear materials, any radiation doses to workers and members of the public in the vicinity of the site would be at safe levels, and that after the repository is sealed, radiation doses to those in the vicinity would be at safe levels for 10,000 years. These radiation protection levels are identical to those with which the DOE will have to demonstrate compliance to the satisfaction of the NRC in order to obtain a license to build the repository.

Using the Department's suitability Guidelines, I have concluded that Yucca Mountain is in fact suitable for a repository. The reasons for this conclusion are set out in section 7 of this Recommendation. However, I want to pause to make one thing clear at the outset. If for any reason I found that the site were not suitable or licensable, then, irrespective of any other consideration, I would not recommend it. Specifically, however much as I might believe that proceeding toward a repository would advance the national interest in other ways, those additional considerations could not properly influence, and have not influenced, my determination of suitability.

5.2. National Interest Considerations

Beyond scientific suitability, the NWPA is virtually silent on what other standard or standards the Secretary should apply in making a recommendation. It does direct me to consider certain matters. It requires that I consider the record of hearings conducted in the vicinity of Yucca Mountain, the site characterization record, and various other information I am directed to transmit to the President with my Recommendation.[26] The Act does not, however, specify how I

---

[23] 10 CFR part 963.
[24] 40 CFR part 197.
[25] 10 CFR part 63.
[26] The statutorily required information is set out in Section 114(a)(1) of the NWPA, which states:
Together with any recommendation of a site under this paragraph, the Secretary shall make available to the public, and submit to the President, a comprehensive statement of the basis of such recommendation, including the following:
(A) a description of the proposed repository, including preliminary engineering specifications for the facility;
(B) a description of the waste form or packaging proposed for use at such repository, and an explanation of the relationship between such waste form or packaging and the geologic medium of such site;
(C) a discussion of data, obtained in site characterization activities, relating to the safety of such site;
(D) a final environmental impact statement prepared for the Yucca Mountain site pursuant to subsection (f) and the National Environmental Policy Act of 1969 [42 U.S.C. 4321 et seq.], together with comments made concerning such environmental impact statement by the Secretary of the Interior, the Council on Environmental Quality, the Administrator, and the Commission, except that the Secretary shall not be required in any such environmental impact statement to consider the need for a repository, the alternatives to geological disposal, or alternative sites to the Yucca Mountain site;
(E) preliminary comments of the Commission concerning the extent to which the at-depth site characterization analysis and the waste form proposal for such site seem to be sufficient for inclusion in any application to be submitted by the Secretary for licensing of such site as a repository;
(F) the views and comments of the Governor and legislature of any State, or the governing body of any affected Indian tribe, as determined by the Secretary, together with the response of the Secretary to such views;

am to consider these various items or what standard I am to use in weighing them. And finally among the items it directs me to take into account is, "such other information as the Secretary considers appropriate."

The approach taken in the Act led me to conclude that, after completing the first step of reaching a judgment as to the scientific suitability of Yucca Mountain, if I concluded the site was scientifically suitable, I should also address a second matter: whether it is in the overall national interest to build a repository there. In considering that issue, I have addressed two further questions: are there compelling national interests favoring development of the site, and if so, are there countervailing considerations weighty enough to overcome the arguments for proceeding with development? Sections 8 and 9 of this Recommendation set forth my conclusions on these questions.

In my view, the statute's silence on the factors that go into the recommendation process makes it at a minimum ambiguous on whether I should conduct any inquiry beyond the question of scientific suitability. In light of that ambiguity, I have elected to construe the statute as allowing me, if I make a favorable suitability determination based on science, also to consider whether development of a repository at Yucca Mountain is in the national interest. For several reasons, I believe this is the better way to interpret the NWPA. First, given the significance of a siting

---

(G) such other information as the Secretary considers appropriate; and
(H) any impact report submitted under section 116(c)(2)(B) [42 U.S.C. 10136(c)(2)(B)] by the State of Nevada.
This material is attached to this Recommendation, as follows:

- The description of the repository called for by section 114(a)(1)(A) is contained in Chapter 2 of the Yucca Mountain Science and Engineering Report (YMS&ER), Revision 1.
- The material relating to the waste form called for by section 114(a)(1)(B) is contained in Chapters 3 and 4 of the YMS&ER, Revision 1.
- The discussion of site characterization data called for by section 114(a)(1)(C) is contained in Chapter 4 of the YMS&ER, Revision 1.
- The EIS-related material called for by section 114(a)(1)(D) is contained in the *Final Environmental Impact Statement (EIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, along with letters received from the Secretary of the Interior, the Chair of the Council on Environmental Quality, the Administrator of the Environmental Protection Agency, and the Chairman of the Nuclear Regulatory Commission (NRC), transmitting their respective comments on the final EIS.
- The information called for by section 114(a)(1)(E) is contained in a letter from NRC Chairman Meserve to Under Secretary Card, dated November 13, 2001.
- The information called for by section 114(a)(1)(F) is contained in Section 2 of two separate reports, the *Comment Summary Document* and the *Supplemental Comment Summary Document*, and in a separate document providing responses to comments from the Governor of Nevada sent to the Department after the public comment periods on a possible site recommendation closed.
- Section 114(a)(1)(G) provides for the inclusion of other information as the Secretary considers appropriate. The report, *Yucca Mountain Site Suitability Evaluation* (DOE/RW-0549, February 2002), has been included as other information. This report provides an evaluation of the suitability of the Yucca Mountain site against Departmental Guidelines setting forth the criteria and methodology to be used in determining the suitability of the Yucca Mountain site, pursuant to section 113(b)(1)(A)(iv). In addition, impact reports submitted by the various Nevada counties have been included as other information to be forwarded to the President. In transmitting these reports to the President, the Department is neither deciding on, nor endorsing, any specific impact assistance requested by the governmental entities in those reports.
- The State of Nevada submitted an impact report pursuant to section 114(a)(1)(H). In transmitting this report to the President, the Department is likewise neither deciding on, nor endorsing this report.

decision and the nature of the officers involved, one would expect that even if a Cabinet Secretary were to find a site technically suitable for a repository, he should be able to take broader considerations into account in determining what recommendation to make to the President. A pure suitability-based decision risks taking insufficient heed of the views of the people, particularly in Nevada but in other parts of the country as well. Second, it is difficult to envision a Cabinet Secretary's making a recommendation without taking into account these broader considerations. Finally, it is plain that any conclusion on whether to recommend this site is likely to be reviewed by Congress. Since that review will inevitably focus on broader questions than the scientific and technical suitability of the site, it seems useful in the first instance for the Executive Branch to factor such considerations into its recommendation as well. I note, however, that if my interpretation of the statute in this regard is incorrect, and Congress has made a finding of suitability the sole determinant of whether to recommend Yucca Mountain, my Recommendation would be the same.

6. *Is Yucca Mountain Scientifically and Technically Suitable for Development of a Repository?*

The Department of Energy has spent over two decades and billions of dollars on carefully planned and reviewed scientific fieldwork designed to help determine whether Yucca Mountain is a suitable site for a repository. The results of that work are summarized in the *Yucca Mountain Science and Engineering Report, Revision 1*, and evaluated in the Yucca Mountain Site Suitability Evaluation (YMSSE), which concludes, as set out in 10 CFR part 963, that Yucca Mountain is "likely" to meet the applicable radiation standards and thus to protect the health and safety of the public, including those living in the immediate vicinity now and thousands of years from now. I have carefully studied that evaluation and much of the material underlying it, and I believe it to be correct.

6.1. Framework for Suitability Determination

6.1.1. General Outline

The general outline of the analytic framework I have used to evaluate the scientific suitability of the site is set out in the Department's Yucca Mountain Site Suitability Guidelines, found at 10 CFR part 963.

The framework has three key features. First, the Guidelines divide the suitability inquiry into sub-inquiries concerning a "pre-closure" safety evaluation and a "post-closure" performance evaluation. The "pre-closure" evaluation involves assessing whether a repository at the site is likely to be able to operate safely while it is open and receiving wastes. The "post-closure" evaluation involves assessing whether the repository is likely to continue to isolate the materials for 10,000 years after it has been sealed, so as to prevent harmful releases of radionuclides.

Second, the Guidelines set out a method and criteria for conducting the pre-closure safety evaluation. The method is essentially the same as that used to evaluate the safety of other proposed nuclear facilities; it is not particularly novel and should be recognized by those familiar with safety assessments of existing facilities. This is because, while it is open and receiving nuclear materials, a repository at Yucca Mountain will not be very different, in terms of its functions and the activities expected to take place there, from many other modern facilities built to handle such materials. A pre-closure evaluation to assess the probable safety of such a facility entails considering its design, the nature of the substances it handles, and the kinds of activities and external events that might occur while it is receiving waste. It then uses known data to forecast the level of radioactivity to which workers and members of the public would be likely to be exposed as a result.

Third, the Guidelines set out a method and criteria for evaluating the post-closure performance of the repository. This is the most challenging aspect of evaluating Yucca Mountain's suitability, since it entails assessing the ability of the repository to isolate radioactive materials far into the future. The scientific consensus is, and the Guidelines specify, that this should be done using a "Total System Performance Assessment." This approach, which is similar to other efforts to forecast the behavior of complex systems over long periods of time, takes information derived from a multitude of experiments and known facts. It feeds that information into a series of models. These in turn are used to develop one overarching model of how well a repository at Yucca Mountain would be likely to perform in preventing the escape of radioactivity and radioactive materials. The model can then be used to forecast the levels of radioactivity to which people near the repository might be exposed 10,000 years or more after the repository is sealed.[27]

6.1.2. Radiation Protection Standards

A key question to be answered, as part of any suitability determination is, "What level of radiation exposure is acceptable?"

---

[27] The selection of the 10,000-year compliance period for the individual-protection standard involves both technical and policy considerations. EPA weighed both during the rulemaking for 40 CFR Part 197. EPA considered policy and technical factors, as well as the experience of other EPA and international programs. First, EPA evaluated the policies for managing risks from the disposal of both long lived, hazardous, nonradioactive materials and radioactive materials. Second, EPA evaluated consistency with both 40 CFR Part 191 and the issue of consistent time periods for the protection of groundwater resources and public health. Third, EPA considered the issue of uncertainty in predicting dose over the very long periods contemplated in the alternative of peak dose within the period of geologic stability. Finally, EPA reviewed the feasibility of implementing the alternative of peak risk within the period of geologic stability.

As a result of these considerations, EPA established a 10,000-year compliance period with a quantitative limit and a requirement to calculate the peak dose, using performance assessments, if the peak dose occurs after 10,000 years. Under this approach, DOE must make the performance assessment results for the post-10,000-year period part of the public record by including them in the EIS for Yucca Mountain.

The relevance of a 10,000-year compliance period can also be understood by examining hazard indices that compare the potential risk of released radionuclides to other risks. One such analysis, presented in the *Final Environmental Impact Statement for the Management of Commercially Generated Radioactive Waste*, DOE/EIS-0046F, examined the relative amounts of water required to bring the concentration of a substance to allowable drinking water standards. The relative hazard for spent fuel compared to the toxicity of the ore used to produce the reactor fuel at one year after removal of the spent fuel from the reactor is about the same hazard as a rich mercury ore. The hazard index is about the same as average mercury ores at about 80 years. By 200 years the hazard index is about the same as average lead ore; by 1,000 years it is comparable to a silver ore. The relative hazard index is about the same as the uranium ore that it came from at 10,000 years. This is not to suggest that the wastes from spent fuel are not toxic. However, it is suggested that where concern for the toxicity of the ore bodies is not great, the spent fuel should cause no greater concern, particularly if placed within multiple engineered barriers in geologic formations, at least as, if not more, remote from the biosphere than these common ores.

DOE's Site Suitability Guidelines use as their benchmark the levels the NRC has specified for purposes of deciding whether to license a repository at Yucca Mountain. The NRC, in turn, established these levels on the basis of radiation protection standards set by the EPA. The standards generally require that during pre-closure, the repository facilities, operations, and controls restrict radiation doses to less than 15 millirem a year[28] to a member of the public in its vicinity.[29] During post-closure, they generally require that the maximum radiation dose allowed to someone living in the vicinity of Yucca Mountain be no more than 15 millirem per year, and no more than four millirem per year from certain radionuclides in the groundwater.[30]

This level of radiation exposure is comparable to, or less than, ordinary variations in natural background radiation that people typically experience each year. It is also less than radiation levels to which Americans are exposed in the course of their everyday lives – in other words, radiation "doses" to which people generally give no thought at all.

To understand this, it is important to remember that radiation is part of the natural world and that we are exposed to it all the time. Every day we encounter radiation from space in the form of cosmic rays. Every day we are also exposed to terrestrial radiation, emitted from naturally radioactive substances in the earth's surface.

In addition to natural background radiation from these sources, people are exposed to radiation from other everyday sources. These include X-rays and other medical procedures, and consumer goods (*e.g.*, television sets and smoke detectors).

Americans, on average, receive an annual radiation exposure of 360 millirem from their surroundings. The 15 millirem dose the EPA standard set as the acceptable annual exposure from the repository is thus slightly over four percent of what we receive every year right now.

---

[28]Risk to human beings from radiation is due to its ionizing effects. Radionuclides found in nature, commercial products, and nuclear waste emit ionizing radiation. The forms of ionizing radiation differ in their penetrating power or energy and in the manner in which they affect human tissue. Some ionizing radiation, known as alpha radiation, can be stopped by a sheet of paper, but may be very harmful if inhaled, ingested or otherwise admitted into the body. Long-lived radioactive elements, with atomic numbers higher than 92, such as plutonium, emit alpha radiation. Other ionizing radiation, known as beta radiation, can penetrate the skin and can cause serious effects if emitted from an inhaled or ingested radionuclide. The ionizing radiation with the greatest penetrating power is gamma radiation; it can penetrate and damage critical organs in the body. Fission products can emit both gamma and beta radiation depending on the radionuclides present. In high-level nuclear waste, beta and gamma radiation emitters, such as cesium and strontium, present the greatest hazard for the first 300 to 1,000 years, by which time they have decayed. After that time, the alpha-emitting radionuclides present the greatest hazard.
Radiation doses can be correlated to potential biologic effects and are measured in a unit called a rem. Doses are often expressed in terms of thousandths of a rem, or millirem (mrem); the internationally used unit is the Sievert (S), which is equivalent to 100 rem.

[29] The NRC regulations also require that the annual dose to workers there be less than 5 rem. See 10 CFR part 63, referencing 10 CFR part 20. This is the general standard for occupational exposure that applies in numerous other settings, such as operating nuclear facilities.

[30] During both pre- and post-closure, the NRC licensing rules, 10 CFR part 63, also contain a number of more particularized standards for specific situations. These are referenced in the results tables contained in the following sections. Pursuant to EPA's groundwater standard, 40 CFR part 197, they also contain concentration limits on certain kinds of radionuclides that may be present in the water, whether or not their presence is attributable to a potential repository. These are also referenced in the results tables.

Moreover, background radiation varies from one location to another due to many natural and man-made factors. At higher elevations, the atmosphere provides less protection from cosmic rays, so background radiation is higher. In the United States, this variation can be 50 or more millirem. Thus, if the repository generates radiation doses set as the benchmark in the Guidelines, the incremental radiation dose a person living in the vicinity of Yucca Mountain would receive from it would be about the same level of increase in radiation exposure as a person would experience as a result of moving from Philadelphia to Denver.

Ordinary air travel is another example. Flying at typical cross-country altitudes results in increased exposure of about one-half millirem per hour. If the Yucca Mountain repository generates radiation at the 15 millirem benchmark, it would increase the exposure of those living near it to about the same extent as if they took three round trip flights between the East Coast and Las Vegas.

Rocks and soil also affect natural background radiation, particularly if the rocks are igneous or the soils derived from igneous rock, which can contain radioactive potassium, thorium, or uranium. In these cases, the variation in the background radiation is frequently in the tens of millirem or higher. Wood contains virtually no naturally occurring radioactive substances that contribute to radiation exposures, but bricks and concrete made from crushed rock and soils often do. Living or working in structures made from these materials can also result in tens of millirem of increased exposure to radiation. Thus, if the repository generates radiation at the levels in the Guidelines' benchmark, it is likely to result in less additional exposure to a person living in its vicinity than if he moved from a wood house to a brick house.

Finally, it is noteworthy that the radiation protection standards referenced by the Guidelines are based on those selected by the NRC for licensing the repository. They in turn relied on the EPA rule establishing these as the appropriate standards for the site. The NRC and EPA acted pursuant to specific directives in the NWPA, in which Congress first assigned to the EPA the responsibility to set these standards, and later in the Energy Policy Act of 1992, which directed the EPA to act in conjunction with the National Academy of Sciences and develop a standard specifically for Yucca Mountain. The EPA carefully considered the question of how to do so. The 15 millirem per year standard is the same it has applied to the Waste Isolation Pilot Plant in New Mexico.[31] And it is well within the National Academy of Sciences-recommended range, a range developed in part by referring to guidelines from national and international advisory bodies and regulations in other developed countries.[32]

For all these reasons, there is every cause to believe that a repository that can meet the 15 millirem radiation protection standard will be fully protective of the health and safety of residents living in the vicinity of the repository.[33]

---

[31] 40 CFR part 191.

[32] *Technical Bases for Yucca Mountain Standards,* National Academy of Sciences, National Research Council, 1995.

[33] As noted above, the EPA, in 40 CFR part 197, also established groundwater protection standards in the Yucca Mountain rule; these are compatible with drinking water standards applied elsewhere in the United States, and apply maximum contaminant levels, as well as a 4 mrem/yr dose standard.

6.1.3. Underlying Hard Science

As explained in section 6.1.1, the Guidelines contemplate the use of models and analyses to project whether the repository will meet the 15 millirem dose standard.[34] To have confidence in the model results, however, it is important to understand the kind of science that went into constructing them.

For over 20 years, scientists have been investigating every aspect of the natural processes – past, present and future – that could affect the ability of a repository beneath Yucca Mountain to isolate radionuclides emitted from nuclear materials emplaced there. They have been conducting equally searching investigations into the processes that would allow them to understand the behavior of the engineered barriers – principally the waste "packages" (more nearly akin to vaults) – that are expected to contribute to successful waste isolation. These investigations have run the gamut, from mapping the geological features of the site, to studying the repository rock, to investigating whether and how water moves through the Mountain. To give just a few examples:

<u>At the surface of the repository:</u>

- Yucca Mountain scientists have mapped geologic structures, including rock units, faults, fractures, and volcanic features. To do this, they have excavated more than 200 pits and trenches to remove alluvial material or weathered rock to be able to observe surface and near-surface features directly, as well as to understand what events and processes have occurred or might occur at the Mountain.

- They have drilled more than 450 surface boreholes and collected over 75,000 feet of geologic core samples and some 18,000 geologic and water samples. They used the information obtained to identify rock and other formations beneath the surface, monitor infiltration of moisture, measure the depth of the water table and properties of the hydrologic system, observe the rate at which water moves from the surface into subsurface rock, and determine air and water movement properties above the water table.

- They have conducted aquifer testing at sets of wells to determine the transport and other properties of the saturated zone below Yucca Mountain. These tests included injecting easily identified groundwater tracers in one well, which were then detected in another; this helped scientists understand how fast water moves.

- They have conducted tectonic field studies to evaluate extensions of the earth's crust and the probability of seismic events near Yucca Mountain.

---

[34] As well, of course, as the other radiation protection standards such as the groundwater standard.

Underground:

The Department's scientists have conducted a massive project to probe the area under the Mountain's surface where the repository will be built.

- They constructed a five mile-long main underground tunnel, the Exploratory Studies Facility, to provide access to the specific rock type that would be used for the repository. This main tunnel is adjacent to the proposed repository block, about 800 feet underground. After completing the main tunnel, they excavated a second tunnel, 1.6-miles long and 16.5 feet in diameter. This tunnel, referred to as the Cross-Drift tunnel, runs about 45 feet above and across the repository block.

- They then mapped the geologic features such as faults, fractures, stratigraphic units, mineral compositions, etc., exposed by the underground openings in the tunnels.

- They collected rock samples to determine geotechnical properties.

- They conducted a drift-scale thermal test to observe the effects of heat on the hydrologic, mechanical, and chemical properties of the rock, and chemical properties of the water and gas liberated as a result of heating. The four yearlong heating cycle of the drift-scale test was the largest known heater test in history, heating some seven million cubic feet of rock over its ambient temperature. This test also included samples of engineered materials to determine corrosion resistance in simulated repository conditions.

In various laboratory-based studies:

Yucca Mountain scientists have supplemented with laboratory work the surface and underground tests previously described.

- They have tested mechanical, chemical, and hydrologic properties of rock samples in support of repository design and development of natural process models.

- They have tested radionuclides to determine solubility and colloid formation that affect their transport if released.

- They have tested over 13,000 engineered material samples to determine their corrosion resistance in a variety of environments.

- They have determined the chemical properties of water samples and the effects of heat on the behavior and properties of water in the host rock.

The findings from these numerous studies were used to develop computer simulations that describe the natural features, events, and processes that exist at Yucca Mountain or that could be changed as the result of waste disposal. The descriptions in turn were used to develop the models discussed in the next section to project the likely radiation doses from the repository.

7. Results of Suitability Evaluations and Conclusions

As explained above, the Guidelines contemplate that the Secretary will evaluate the suitability of the Yucca Mountain site for a repository on two separate bases.

The Guidelines first contemplate that I will determine whether the site is suitable for a repository during the entire pre-closure or operational period, assumed to be from 50 to 300 years after emplacement of nuclear materials begins. To answer this question, the Guidelines ask me to determine whether, while it is operating, the repository is likely to result in annual radiation doses to people in the vicinity and those working there that will fall below the dosage levels set in the radiation protection standards.[35] The Guidelines contemplate that I will use a pre-closure safety evaluation to guide my response.[36]

Second, the Guidelines contemplate that I will determine whether the repository is suitable – in other words, may reasonably be expected to be safe – after it has been sealed. To answer that question, the Guidelines ask me to determine whether it is likely that the repository will continue to isolate radionuclides for 10,000 years after it is sealed, so that an individual living 18 kilometers (11 miles) from the repository is not exposed to annual radiation doses above those set in the radiation protection standards.[37] The Guidelines contemplate that I will use a Total System Performance Assessment to guide my response to this question.[38]

The Department has completed both the Pre-Closure Safety Evaluation and TSPA called for by the Guidelines. These project that a repository at Yucca Mountain will result in radioactive doses well below the applicable radiation protection standards. As I explain below, I have reviewed these projections and the bases for them, and I believe them to be well founded. I also believe both the Pre-Closure Safety Evaluation and the Total System Performance Assessment have properly considered the criteria set out in the Guidelines for each period. Using these evaluations as set out in the Guidelines,[39] I believe it is likely that a repository at Yucca Mountain will result in radiation doses below the radiation protection standards for both periods. Accordingly, I believe Yucca Mountain is suitable for the development of a repository.

7.1. Results of Pre-Closure Evaluations

As explained in section 6.1.1, the Pre-Closure Safety Evaluation method I have employed is commonly used to assess the likely performance of planned or prospective nuclear facilities. Essentially what it involves is evaluating whether the contemplated facility is designed to prevent or mitigate the effects of possible accidents. The facility will be considered safe if its design is likely to result in radioactive releases below those set in the radiation protection standards.

---

[35] 10 CFR part 963.
[36] Ibid.
[37] Ibid.
[38] Ibid.
[39] Ibid.

The Department has conducted such a Pre-Closure Safety Evaluation, which is summarized in the *Yucca Mountain Science and Engineering Report, Revision 1*.[40] In conducting this evaluation, the Department considered descriptions of how the site will be laid out, the surface facilities, and the underground facilities and their operations. It also considered a series of potential hazards, including, for example, seismic activity, flooding, and severe winds, and their consequences. Finally, it considered preliminary descriptions of how components of the facilities' design would prevent or mitigate the effects of accidents.

The Pre-Closure Safety Evaluation concluded that the preliminary design would prevent or dramatically mitigate the effects of accidents, and that the repository would therefore not result in radioactive releases that would lead to exposure levels above those set by the radiation protection standards. It considered the pre-closure criteria of 10 CFR 963.14 in reaching this conclusion. In particular, it found that the preliminary design has the ability to contain and limit releases of radioactive materials; the ability to implement control and emergency systems to limit exposures to radiation; the ability to maintain a system and components that perform their intended safety functions; and the ability to preserve the option to retrieve wastes during the pre-closure period. The annual doses of radiation to which the Pre-Closure Safety Evaluation projected individuals in the vicinity of the repository and workers would be exposed are set out in the following table. These doses fall well below the levels that the radiation protection standards establish.

I have carefully reviewed the Pre-Closure Safety Evaluation and find its conclusions persuasive. I am therefore convinced that a repository can be built at Yucca Mountain that will operate safely without harming those in the repository's vicinity during the pre-closure period. Finally, I would note that although many aspects of this project are controversial, there is no controversy of which I am aware concerning this aspect of the Department's conclusions. This stands to reason. The kinds of activities that would take place at the repository during the pre-closure period – essentially, the management and handling of nuclear materials including packaging and emplacement in the repository – are similar to the kinds of activities that at present go on every day, and have gone on for years, at temporary storage sites around the country. These activities are conducted safely at those sites, and no one has advanced a plausible reason why they could not be conducted equally if not more safely during pre-closure operations at a new, state-of-the-art facility at Yucca Mountain.

That is not an insignificant point, since the pre-closure period will last at least 50 years after the start of emplacement, which will begin at the earliest eight years from today. Moreover, the Department's Pre-Closure Safety Evaluation also assumed a possible alternative pre-closure period of 300 years from the beginning of emplacement, and its conclusions remained unchanged. Thus, the Department's conclusion that the repository can operate safely for the next 300 years – or for about three generations longer than the United States has existed – has not been seriously questioned.

[40] *Yucca Mountain Science and Engineering Report, Revision 1.*

Table 1. Summary Pre-Closure Dose Performance Criteria and Evaluation Results[41]

Standard	Limits	Results
	Public Exposures[a]	
Pre-closure standard: 10 CFR 63.204, referenced in 10 CFR 963.2; Pre-Closure Performance Objective for normal operations and Category 1 event sequences per 10 CFR 63.111(a)(2), referenced in 10 CFR 963.2	15 mrem/yr[b]	0.06 mrem/yr[b]
Constraint specified for air emissions of radioactive material to the environment (not a dose limitation): 10 CFR 20.1101 (d)[c]	10 mrem/yr[b,d]	0.06 mrem/yr[b]
Dose limits for individual member of the public for normal operations and Category 1 event sequences: 10 CFR 20.1301[c]	100 mrem/yr[b,d]	0.06 mrem/yr[b]
	2 mrem/hr in any unrestricted area from external sources	<<2 mrem/hr
Pre-Closure Performance Objective for any Category 2 event sequence: 10 CFR 63.111(b)(2), referenced in 10 CFR 963.2	5 rem[b]	0.02 rem[b]
	50 rem organ or tissue dose (other than the lens of the eye)	0.10 rem
	15 rem lens of the eye dose	0.06 rem
	50 rem skin dose	0.04 rem
	Workers' Exposures	
Occupational Dose Limits for Adults from normal operational emissions and Category 1 event sequences: 10 CFR 20.1201[e]	5 rem/yr[b]	0.01 rem/yr[b]
	50 rem/yr organ or tissue dose (other than the lens of the eye)	0.10 rem/yr
	15 rem/yr lens of the eye dose	0.15 rem/yr
	50 rem/yr skin dose	0.13 rem/yr
Routine Occupational Dose Limits for Adults: 10 CFR 20.1201[e]	5 rem/yr[b]	0.06 to 0.79 rem/yr[b]

NOTES:
[a] Results for public exposures are calculated at the site boundary.
[b] Total effective dose equivalent.
[c] 10 CFR 63.111(a)(1), which is referenced in 10 CFR 963.2, would require repository operations area to meet the requirements of 10 CFR part 20.
[d] 10 CFR 20.1301(a)(1), which is cross-referenced through 10 CFR 963.2; dose limit to extent applicable.
[e] 10 CFR 63.111(b)(1), which referenced in 10 CFR 963.2, would require repository design objectives for Category 1 and normal operations to meet 10 CFR 63.111(a)(1) requirements (10 CFR part 20).

7.2. Results of Post-Closure Evaluations

The most challenging aspect of evaluating Yucca Mountain is assessing the likely post-closure performance of a repository 10,000 years into the future. As previously explained, the Department's Guidelines contemplate that this will be done using a Total System Performance Assessment. That assessment involves using data compiled from scientific investigation into the natural processes that affect the site, the behavior of the waste, and the behavior of the

[41] *Yucca Mountain Site Suitability Evaluation.*

engineered barriers such as the waste packages; developing models from these data; then developing a single model of how, as a whole, a repository at Yucca Mountain is likely to behave during the post-closure period. The model is then used to project radiation doses to which people in the vicinity of the Mountain are likely to be exposed as a result of the repository. Finally, the assessment compares the projected doses with the radiation protection standards to determine whether the repository is likely to comply with them.

The challenge, obviously, is that this involves making a prediction a very long time into the future concerning the behavior of a very complex system. To place 10,000 years into perspective, consider that the Roman Empire flourished nearly 2,000 years ago. The pyramids were built as long as 5,000 years ago, and plants were domesticated some 10,000 years ago. Accordingly, as the NRC explained, "Proof that the geologic repository will conform with the objectives for post-closure performance is not to be had in the ordinary sense of the word because of the uncertainties inherent in the understanding of the evolution of the geologic setting, biosphere, and engineered barrier system"[42] over 10,000 years. The judgment that the NRC envisions making is therefore not a certainty that the repository will conform to the standard, certainty being unattainable in this or virtually any other important matter where choices must be made. Rather, as it goes on to explain, "For such long-term performance, what is required is reasonable expectation, making allowance for the time period, hazards, and uncertainties involved, that the outcome will conform with the objectives for post-closure performance for the geologic repository."[43] The Nuclear Waste Technical Review Board recently summarized much the same thought (emphasis added): "Eliminating all uncertainty associated with estimates of repository performance would never be possible at <u>any</u> repository site."[44]

These views, in turn, inform my understanding of the judgment I am expected to make at this stage of the proceeding in evaluating the likely post-closure performance of a repository at Yucca Mountain. To conclude that it is suitable for post-closure, I do not need to know that we have answered all questions about the way each aspect of the repository will behave 10,000 years from now; that would be an impossible task. Rather, what I need to decide is whether, using the TSPA results, and fully bearing in mind the inevitable uncertainties connected with such an enterprise, I can responsibly conclude that we know enough to warrant a predictive judgment on my part that, during the post-closure period, a repository at Yucca Mountain is likely to meet the radiation protection standards.

I believe I can. Essentially, the reason for this is the system of multiple and redundant safeguards that will be created by the combination of the site's natural barriers and the engineered ones we will add. Even given many uncertainties, this calculated redundancy makes it likely that very little, if any, radiation will find its way to the accessible environment.

---

[42] Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada, Final Rule, 66 Fed. Reg. 55731, 55804, November 2, 2001.
[43] Ibid.
[44] Nuclear Waste Technical Review Board Letter Report from all Board members to Speaker Hastert, Senator Byrd, and Secretary Abraham, January 24, 2002.

Before I describe in broad terms how the TSPA results and the criteria used in the regulations lead to this conclusion, I would like to give an illustration of how this works. The illustration draws on the TSPA analyses, but also explains what these analyses mean in the real world.

An Example

The most studied issue relating to Yucca Mountain, and the single most pressing concern many have felt about the post-closure phase of a repository there, is whether there might be a way for radionuclides from the emplaced nuclear materials to contaminate the water supply. This is not a problem unique to Yucca Mountain. Rather, besides disruptive events discussed later, water is the primary mechanism to transport radionuclides to people and is also the most likely mechanism for radionuclides to escape from the storage facilities we have now.

In the case of Yucca Mountain, the concern has been that rainwater seeping into the Mountain might contact disposal casks and carry radionuclides down to the water table in sufficient amounts to endanger sources of groundwater. In my judgment, when one considers everything we have learned about the multiple natural and engineered barriers that lie at the core of the Department's planning for this Project, this concern turns out to have virtually no realistic foundation.

Yucca Mountain is in the middle of a desert. Like any desert, it has an arid climate, receiving less than eight inches of rain in an average year. Most of that runs off the Mountain or evaporates. Only about five percent, less than four-tenths of an inch per year, ever reaches repository depth.

In order to reach the tunnels where the waste casks would be housed, this water must travel through about 800 feet of densely welded and bedded tuffs,[45] a trip that will typically require more than 1,000 years. The amount of water that eventually reaches the repository level at any point in time is very small, so small that capillary forces tend to retain it in small pores and fractures in the rock. It is noteworthy that all our observations so far indicate that <u>no</u> water actually drips into the tunnels at this level and <u>all</u> of the water is retained within the rock.

In spite of this finding, our TSPA ran calculations based on the assumption that water does drip into the tunnels. At that point, even just to reach radionuclides in the waste, the water would still have to breach the engineered barriers. These include waste packages composed of an outer barrier of highly corrosion-resistant alloy and a thick inner barrier of high quality stainless steel.

[45]Yucca Mountain consists of alternating layers of welded and nonwelded volcanic material known as welded and non-welded tuff: welded tuff at the surface, welded tuff at the level of the repository, and an intervening layer of nonwelded tuffs. These nonwelded units contain few fractures; thus, they delay the downward flow of moisture into the welded tuff layer below, where the repository would be located. At the repository level, water in small fractures has a tendency to remain in the fractures rather than flow into larger openings, such as tunnels. Thus, the small amount of water traveling through small fractures near any emplacement tunnel would tend to flow around the tunnel, rather than seeping, forming a drip, and falling onto the drip shields below. Non-welded tuffs below the repository also provide a significant barrier to radionuclide transport. Deposits of minerals in the fractures demonstrate that for the last several million years the repository host rock has been under unsaturated conditions, even when higher precipitation, owing to the continent's overall glacial conditions, prevailed at the Mountain's surface.

The waste package is designed to prevent contact between the waste pellets and water that might seep into the tunnels unexpectedly, and thus to prevent release of radionuclides.[46] In addition, anchored above each waste package is a titanium drip shield that provides yet more protection against seepage. But even assuming the water defeats both the titanium shield and the metal waste package, the waste form itself is a barrier to the release of radionuclides. Specifically, the spent fuel is in the form of ceramic pellets, resistant to degradation and covered with a corrosion-resistant metal cladding.

Nevertheless, DOE scientists ran a set of calculations assuming that water penetrated the titanium shield and made small holes in three waste packages, due to manufacturing defects (even though the manufacturing process will be tightly controlled). The scientists further assumed that the water dissolves some of the ceramic waste. Even so, the analyses showed that only small quantities of radionuclides would diffuse and escape from the solid waste form. In order to reach the water table from the repository, the water, now assumed to be carrying radionuclides, must travel another 800 feet through layers of rock, some of which are nearly impenetrable. During this trip, many of the radionuclides are adsorbed by the rock because of its chemical properties.

The result of all this is instructive. Even under these adverse conditions, all assumed in the teeth of a high probability that not one of them will come to pass, the amount of radionuclides reaching the water table is so low that annual doses to people who could drink the water are well below the applicable radiation standards, and less than a millionth of the annual dose people receive from natural background radiation. Extrapolating from these calculations shows that even if <u>all</u> of the waste packages were breached in the fashion I have described above, the resulting contribution to annual dose would still be below the radiation safety standards, and less than one percent of the natural background.[47]

<u>Total System Performance More Generally</u>

It is important to understand that there is nothing unique about the kind of planning illustrated in the water seepage scenario described above. Rather, the scenario is characteristic of the studies DOE has undertaken and the solutions it has devised: deliberately pessimistic assumptions incorporated sometimes to the point of extravagance, met with multiple redundancies to assure safety. For example, one of our scenarios for Nevada postulates the return of ice ages, and examines Yucca Mountain assuming that it would receive about twice as much rain as it does today with four times as much infiltration into the Mountain.

As in the example above, the Department evaluated physical and historical information used to develop models of repository components, and then employed those models to forecast how the repository would perform in the post-closure period. These results are described at length in the

[46] These engineered barriers will protect the waste under a wide range of conditions. For example, the barriers are protected by their underground location from the daily variations in temperature and moisture that occur above ground. As a result, the Mountain provides favorable conditions for the performance of these barriers. Indeed, the battery of tests we have conducted suggests that the waste packages are extremely resistant to corrosion.

[47] *Yucca Mountain Science and Engineering Report, Revision 1.*

TPSA analyses and summarized in Chapter 4 of the *Yucca Mountain Science and Engineering Report.*[48]

The Department used the suitability criteria set forth in 10 CFR 963.17 in the TSPA analyses. It carefully evaluated and modeled the behavior of characteristics of the site, such as its geologic, hydrologic, geophysical, and geochemical properties. Likewise it evaluated what are called unsaturated zone flow characteristics, such as precipitation entering the Mountain and water movement through the pores of the rock – in other words, natural processes which affect the amount of water entering the unsaturated zone above the repository and potentially coming in contact with wastes inside. DOE also evaluated and modeled near-field environment characteristics, such as effects of heat from the waste on waterflow through the site, the temperature and humidity at the engineered barriers, and chemical reactions and products that could result from water contacting the engineered barriers.

The Department carefully studied and modeled the characteristics of the engineered barriers as they aged. DOE emphasized specifically those processes important to determining waste package lifetimes and the potential for corroding the package. It examined waste form degradation characteristics, including potential corrosion or break-down of the cladding on the spent fuel pellets and the ability of individual radionuclides to resist dissolving in water that might penetrate breached waste packages. It examined ways in which radionuclides could begin to move outward once the engineered barrier system has been degraded – for example, whether colloidal particles might form and whether radionuclides could adhere to these particles as they were assumed to wash through the remaining barriers. Finally, the Department evaluated and modeled saturated and unsaturated zone flow characteristics, such as how water with dissolved radionuclides or colloidal particles might move through the unsaturated zone below the repository, how heat from the waste would affect waterflow through the site, and how water with dissolved radionuclides would move in the saturated zone 800 feet beneath the repository (assuming it could reach that depth).

Consistent with 10 CFR 963.17, the Department also evaluated the lifestyle and habits of individuals who potentially could be exposed to radioactive material at a future time, based, as would be required by NRC licensing regulations,[49] on representative current conditions. Currently, there are about 3,500 people who live in Amargosa Valley, the closest town to Yucca Mountain. They consume ground or surface water from the immediate area through direct extraction or by eating plants that have grown in the soil. The Department therefore assumed that the "reasonably maximally exposed individual" – that is, the hypothetical person envisioned to test whether the repository is likely to meet required radiation protection standards – likewise would drink water and eat agricultural products grown with water from the area, and built that assumption into its models.

Using the models described above, as well as a host of others it generated taking account of other relevant features, events and processes that could affect the repository's performance, the Department developed a representative simulation of the behavior of the proposed Yucca Mountain site. It then considered thousands of possibilities about what might happen there. For

[48] Ibid.
[49] 10 CFR part 63.

example, it considered the possibility that waste packages might be manufactured defectively. It considered the possibility that the climate would change. It considered earthquakes. Our studies show that earthquakes probably will occur at Yucca Mountain sometime in the future. Because the occurrence of earthquakes is difficult to predict, our models conservatively treat earthquakes by assuming that they will occur over the next 10,000 years.

Essentially, if the Department believed that there was close to a 1 in 10,000 per year probability of some potentially adverse occurrence in the course of the 10,000 year post-closure period (which comes to a probability close to one during the entire period) the Department considered that possibility, unless it concluded the occurrence would not affect the repository's performance. It then used the simulation model to calculate what the resulting dose would be based on each such possibility. Finally, it used the mean peak values of the results of these calculations to project the resulting dose.

The Department then proceeded to consider the impact of disruptive events, such as volcanism, with a lower probability of occurrence, on the order of one in 10,000 over the entire 10,000 year period (meaning roughly a one in a 100 million per year of occurring during that time). This led it to analyze, for example, the effects that a volcano might have on the repository's waste containment capabilities. Scientists started with a careful analysis of the entire geologic setting of Yucca Mountain. Then, with substantial data on regional volcanoes, they used computer modeling to understand each volcanic center's controlling structures. Experts then estimated the likelihood of magma intruding into one of the repository's emplacement tunnels. The DOE estimates the likelihood of such an event's occurring during the first 10,000 years after repository closure to be one chance in about 70 million per year, or one chance in 7,000 over the entire period.

Including volcanoes in its analyses, the TSPA results still indicate that the site meets the EPA standards.[50] What the calculations showed is that the projected, probability-weighted maximum mean annual dose to an individual from the repository for the next 10,000 years is one-tenth of a millirem. That is less than one-fifth of the dose an individual gets from a one-hour airplane flight. And it is less than one one-hundredth of the dose that DOE's Guidelines, using the EPA standards, specify as acceptable for assessing suitability.

Finally, in a separate assessment, analysts studied a hypothetical scenario under which people inadvertently intruded into the repository while drilling for water. The Guidelines' radiation protection standards, based on EPA and NRC rules, specify that as part of its Total System Performance Assessment, DOE should determine when a human-caused penetration of a waste package could first occur via drilling, assuming the drillers were using current technology and practices and did not recognize that they had hit anything unusual. If such an intrusion could occur within 10,000 years, the 15 millirem dose limit would apply.

DOE's analyses, however, indicate that unrecognized contact through drilling would not happen within 10,000 years. Under conditions that DOE believes can realistically be expected to exist at

---

[50] The results produced under volcanic scenarios are weighted by probability under the NRC method specified for how to treat low probability events. 10 CFR Part 63.

the repository, the waste packages are extremely corrosion-resistant for tens of thousands of years. Even under pessimistic assumptions, the earliest time DOE could even devise a scenario under which a waste package would be unnoticeable to a driller is approximately 30,000 years. Before then, the waste package structure would be readily apparent to a driller who hit it.

Table 2 presents the summary results of the Total System Performance Assessment analyses and how they compare to the radiation protection standards.[51]

In Summary

Using the methods and criteria set out in DOE's Yucca Mountain Site Suitability Guidelines, I am convinced that the Yucca Mountain site is scientifically suitable – in a word, safe – for development of a repository. Specifically, on the basis of the safety evaluation DOE has conducted pursuant to 10 CFR 963.13, it is my judgment that a repository at the site is likely to meet applicable radiation protection standards for the pre-closure period. And on the basis of the Total System Performance Assessment DOE has conducted pursuant to 10 CFR 963.16, it is my judgment that a repository at the site is likely to meet applicable radiation protection standards for the post-closure period as well. Additionally, I have evaluated the pre-closure suitability criteria of 10 CFR 963.14 and the post-closure suitability criteria of 10 CFR 963.17, and am convinced that the safety evaluations were done under the stringent standards required. Accordingly, I find the Yucca Mountain site suitable for development of a repository.

8. The National Interest

Having determined that the site is scientifically suitable, I now turn to the remaining factors I outlined above as bearing on my Recommendation. Are there compelling national interests favoring going forward with a repository at Yucca Mountain? If so, are there countervailing considerations of sufficient weight to overcome those interests? In this section I set out my conclusions on the first question. In section 9 I set out my views on the second.

8.1. Nuclear Science and the National Interest

Our country depends in many ways on the benefits of nuclear science: in the generation of twenty percent of the Nation's electricity; in the operation of many of the Navy's most strategic vessels; in the maintenance of the Nation's nuclear weapons arsenal; and in numerous research and development projects, both medical and scientific. All these activities produce radioactive wastes that have been accumulating since the mid-1940s. They are currently scattered among 131 sites in 39 states, residing in temporary surface storage facilities and awaiting final disposal. In exchange for the many benefits of nuclear power, we assume the cost of managing its byproducts in a responsible, safe, and secure fashion. And there is a near-universal consensus that a deep geologic facility is the only scientifically credible, long-term solution to a problem that will only grow more difficult the longer it is ignored.

---

[51] *Yucca Mountain Site Suitability Evaluation.*

Table 2. Summary Post-Closure Dose and Activity Concentration Limits and Evaluation Results

Standard	Limits	Results[c]
Individual protection standard: 10 CFR 63.311, referenced in 10 CFR 963.2	15 mrem/yr TEDE	0.1 mrem/yr[a] (HTOM) 0.1 mrem/yr[a] (LTOM)
Human intrusion standard: 10 CFR 63.321, referenced in 10 CFR 963.2	15 mrem/yr TEDE	NA[b]
Groundwater protection standard: 10 CFR 63.331, referenced in 10 CFR 963.2	5 pCi/L combined radium-226 and radium-228, including natural background	1.04 pCi/L[c] (HTOM) 1.04 pCi/L[c] (LTOM)
	15 pCi/L gross alpha activity (including radium-226 but excluding radon and uranium), including natural background	1.1 pCi/L[c,d] (HTOM) 1.1 pCi/L[c,d] (LTOM)
	4 mrem/yr to the whole body or any organ from combined beta-and photon-emitting radionuclides	.000023 mrem/yr (HTOM) .000013mrem/yr (LTOM)

NOTES: [a] Probability-weighted peak mean dose equivalent for the nominal and disruptive scenarios, which include igneous activity; results are based on an average annual water demand of approximately 2,000 acre-ft; the mean dose for groundwater-pathway-dominated scenarios would be reduced by approximately one-third by using 3,000 acre-ft.

[b] Human-intrusion-related releases are not expected during the period of regulatory compliance; the DOE has determined that the earliest time after disposal that the waste package would degrade sufficiently that a human intrusion could occur without recognition by the driller is at least 30,000 years, so the dose limits do not apply for purposes of the site suitability evaluation.

[c] These values represent measured natural background radiation concentrations; calculated activity concentrations from repository releases are well below minimum detection levels, background radiation concentrations, and regulatory limits.

[d] Gross alpha background concentrations are 0.4 pCi/L $\pm$ 0.7 (for maximum of 1.1 pCi/L).

[e] Peak value of the mean probability-weighted results within the regulatory timeframe.

TEDE= total effective dose equivalent; HTOM= higher temperature operating mode; LTOM= lower-temperature operating mode; NA= not applicable. Source: Williams 2001a, Section 6, Tables 6-1, 6-2, 6-3, and 6-4.

8.2. Energy Security

Roughly 20 percent of our country's electricity is generated from nuclear power. This means that, on average, each home, farm, factory, and business in America runs on nuclear fuel for a little less than five hours a day.

A balanced energy policy – one that makes use of multiple sources of energy, rather than becoming dependent entirely on generating electricity from a single source, such as natural gas – is important to economic growth. Our vulnerability to shortages and price spikes rises in direct proportion to our failure to maintain diverse sources of power. To assure that we will continue to have reliable and affordable sources of energy, we need to preserve our access to nuclear power.

Yet the Federal government's failure to meet its obligation to dispose of spent nuclear fuel under the NWPA – as it has been supposed to do starting in 1998 – is placing our access to this source of energy in jeopardy. Nuclear power plants have been storing their spent fuel on site, but many are running out of space to do so. Unless a better solution is found, a growing number of these plants will not be able to find additional storage space and will be forced to shut down prematurely. Nor are we likely to see any new plants built.

Already we are facing a growing imbalance between our projected energy needs and our projected supplies. The loss of existing electric generating capacity that we will experience if nuclear plants start going off-line would significantly exacerbate this problem, leading to price spikes and increased electricity rates as relatively cheap power is taken off the market. A permanent repository for spent nuclear fuel is essential to our continuing to count on nuclear energy to help us meet our energy demands.

8.3. National Security

8.3.1. Powering the Navy Nuclear Fleet

A strong Navy is a vital part of national security. Many of the most strategically important vessels in our fleet, including submarines and aircraft carriers, are nuclear powered. They have played a major role in every significant military action in which the United States has been involved for some 40 years, including our current operations in Afghanistan. They are also essential to our nuclear deterrent. In short, our nuclear-powered Navy is indispensable to our status as a world power.

For the nuclear Navy to function, nuclear ships must be refueled periodically and the spent fuel removed. The spent fuel must go someplace. Currently, as part of a consent decree entered into between the State of Idaho and the Federal Government, this material goes to temporary surface storage facilities at the Idaho National Environmental and Engineering Laboratory. But this cannot continue indefinitely, and indeed the agreement specifies that the spent fuel must be removed. Failure to establish a permanent disposition pathway is not only irresponsible, but could also create serious future uncertainties potentially affecting the continued capability of our Naval operations.

8.3.2. Allowing the Nation to Decommission Its Surplus Nuclear Weapons and Support Nuclear Non-Proliferation Efforts

A decision now on the Yucca Mountain repository is also important in several ways to our efforts to prevent the proliferation of nuclear weapons. First, the end of the Cold War has brought the welcome challenge to our country of disposing of surplus weapons-grade plutonium as part of the process of decommissioning weapons we no longer need. Current plans call for turning the plutonium into "mixed-oxide" or "MOX" fuel. But creating MOX fuel as well as burning the fuel in a nuclear reactor will generate spent nuclear fuel, and other byproducts which themselves will require somewhere to go. A geological repository is critical to completing disposal of these materials. Such complete disposal is important if we are to expect other nations to decommission their own weapons, which they are unlikely to do unless persuaded that we are truly decommissioning our own.

A repository is important to non-proliferation for other reasons as well. Unauthorized removal of nuclear materials from a repository will be difficult even in the absence of strong institutional controls. Therefore, in countries that lack such controls, and even in our own, a safe repository is essential in preventing these materials from falling into the hands of rogue nations. By permanently disposing of nuclear weapons materials in a facility of this kind, the United States would encourage other nations to do the same.

8.4. Protecting the Environment

An underground repository at Yucca Mountain is important to our efforts to protect our environment and achieve sustainable growth in two ways. First, it will allow us to dispose of the radioactive waste that has been building up in our country for over fifty years in a safe and environmentally sound manner. Second, it will facilitate continued use and potential expansion of nuclear power, one of the few sources of electricity currently available to us that emits no carbon dioxide or other greenhouse gases.

As to the first point: While the Federal government has long promised that it would assume responsibility for nuclear waste, it has yet to start implementing an environmentally sound approach for disposing of this material. It is past time for us to do so. The production of nuclear weapons at the end of the Second World War and for many years thereafter has resulted in a legacy of high-level radioactive waste and spent fuel, currently located in Tennessee, Colorado, South Carolina, New Mexico, New York, Washington, and Idaho. Among these wastes, approximately 100,000,000 gallons of high-level liquid waste are stored in, and in some instances have leaked from, temporary holding tanks. In addition to this high-level radioactive waste, about 2,100 metric tons of solid, unreprocessed fuel from a plutonium-production reactor are stored at the Hanford Nuclear Reservation, with another 400 metric tons stored at other DOE sites.

In addition, under the NWPA, the Federal government is also responsible for disposing of spent commercial fuel, a program that was to have begun in 1998, four years ago. More than 161 million Americans, well more than half the population, reside within 75 miles of a major nuclear facility – and, thus, within 75 miles of that facility's aging and temporary capacity for storing this material. Moreover, because nuclear reactors require abundant water for cooling, on-site storage tends to be located near rivers, lakes, and seacoasts. Ten <u>closed</u> facilities, such as Big Rock Point, on the banks of Lake Michigan, also house spent fuel and incur significant annual costs without providing any ongoing benefit. Over the long-term, without active management and monitoring, degrading surface storage facilities may pose a risk to any of 20 major U.S. lakes and waterways, including the Mississippi River. Millions of Americans are served by municipal water systems with intakes along these waterways. In recent letters, Governors Bob Taft of Ohio[52] and John Engler of Michigan[53] raised concerns about the advisability of long-term storage of spent fuel in temporary systems so close to major bodies of water. The scientific consensus is that disposal of this material in a deep underground repository is not merely the safe answer and the right answer for protecting our environment but the <u>only</u> answer that has any degree of realism.

[52] Letter, Governor Bob Taft to Secretary Spencer Abraham, July 30, 2001.
[53] Letter, Governor John Engler to Secretary Spencer Abraham, September 5, 2001.

In addition, nuclear power is one of only a few sources of power available to us now in a potentially plentiful and economical manner that could drastically reduce air pollution and greenhouse gas emissions caused by the generation of electricity. It produces no controlled air pollutants, such as sulfur and particulates, or greenhouse gases. Therefore, it can help keep our air clean, avoid generation of ground-level ozone, and prevent acid rain. A repository at Yucca Mountain is indispensable to the maintenance and potential expansion of the use of this environmentally efficient source of energy.

8.5. Facilitating Continuation of Research, Medical, and Humanitarian Programs

The Department has provided fuel for use in research reactors in domestic and foreign universities and laboratories. Research reactors provide a wide range of benefits including the production of radioisotopes for medical use – *e.g.*, in body-scan imaging and the treatment of cancer. To limit the risk to the public, and to support nuclear non-proliferation objectives, these laboratories are required to return the DOE-origin spent fuel from domestic research reactors and from foreign research reactors. These spent fuels are temporarily stored at Savannah River, South Carolina, and at the Idaho National Engineering and Environmental Laboratory while awaiting disposal in a permanent repository.

Again, we can either implement a permanent solution – Yucca Mountain – or risk eroding our capacity to conduct this kind of research. The chances of a person becoming sick from the nuclear materials to be stored at the Yucca Mountain site are, as shown above, all but non-existent. Responsible critics must balance that against the chance of a person becoming sick as a result of the research that may not be undertaken, remaining sick for want of the drug that may not be found, or dying for lack of the cure that may not be developed – all because the nuclear fuel-dependent science that could produce these things was never done, our country having run out of places to dispose of the waste.

8.6. Assisting Anti-Terrorism at Home

As I have noted previously, spent fuel and other high level radioactive waste is presently stored at temporary storage facilities at 131 locations in 39 states. Ten of these are at shutdown reactor sites for which security would not otherwise be required. Moreover, many reactors are approaching their storage capacity and are likely to seek some form of off-site storage, thereby creating potential new targets.

Storage by reactor-owners was intended to be a temporary arrangement. The design of the storage facilities reflects that fact. They tend to be less secured than the reactors themselves, and the structures surrounding the fuel stored in aboveground containers are also less robust.

These storage facilities should be able to withstand current threats. But as the determination and sophistication of terrorists increases, that may well change. That means we will have to choose one of two courses. We can continue to endeavor to secure each of these sites, many of which, as noted above, are close to major metropolitan areas and waterways. Or we can consolidate this fuel in one remote, secure, arid underground location and continue to develop state-of-the-art security arrangements to protect it there.

To me the choice is clear. The proposed geologic repository in the desert at Yucca Mountain offers unique features that make it far easier to secure against terrorist threats. These include: 1) disposal 800 feet below ground; 2) remote location; 3) restricted access afforded by Federal land ownership of the Nevada Test Site; 4) proximity to Nellis Air Force Range; 5) restricted airspace above the site; 6) far from any major waterways. The design and operation of a geologic repository, including surface operations, can also incorporate from the beginning appropriate features to protect against a terrorist threat and can be changed, if necessary, to respond to future changes in the terrorist threat.

An operational repository will also be an important signal to other nuclear countries, none of which have opened a repository. Inadequately protected nuclear waste in any country is a potential danger to us, and we can't expect them to site a facility if we, with more resources, won't. A fresh look at nuclear material security should involve new concepts such as those inherent in a geologic repository, and should set the standard for the manner in which the international community manages its own nuclear materials.

To understand Yucca Mountain's relative advantage in frustrating potential terrorist attacks compared to the *status quo*, one need only ask the following: If nuclear materials were already emplaced there, would anyone even suggest that we should spread them to 131 sites in 39 states, at locations typically closer to major cities and waterways than Yucca Mountain is, as a means of <u>discouraging</u> a terrorist attack?

8.7. Summary

In short, there are important reasons to move forward with a repository at Yucca Mountain. Doing so will advance our energy security by helping us to maintain diverse sources of energy supply. It will advance our national security by helping to provide operational certainty to our nuclear Navy and by facilitating the decomissioning of nuclear weapons and the secure disposition of nuclear materials. It will help us clean up our environment by allowing us to close the nuclear fuel cycle and giving us greater access to a form of energy that does not emit greenhouse gases. And it will help us in our efforts to secure ourselves against terrorist threats by allowing us to remove nuclear materials from scattered above-ground locations to a single, secure underground facility. Given the site's scientific and technical suitability, I find that compelling national interests counsel in favor of taking the next step toward siting a repository at Yucca Mountain.

9. None of the Arguments Against Yucca Mountain Withstands Analysis

As explained above, after months of study based on research unique in its scope and depth, I have concluded that the Yucca Mountain site is fully suitable under the most cautious standards that reasonably might be applied. I have also concluded that it serves the national interest in numerous important ways. The final question I shall examine is whether the arguments against its designation not rise to a level that outweighs the case for going forward. I believe they do not, as I shall explain. I do so by briefly describing these principle arguments made by opponents of the Project, and then responding to them.

9.1. Assertion 1: The Citizens of Nevada Were Denied an Adequate Opportunity to Be Heard

Critics have claimed that the decision-making process under the NWPA was unfair because it allowed insufficient opportunity for public input, particularly from the citizens of Nevada. That is not so. There was ample opportunity for public discussion and debate; the Department in fact went well beyond the Act's requirements in providing notice and the opportunity to be heard.

My predecessors and I invited and encouraged public, governmental, and tribal participation at all levels. The Department also made numerous Yucca Mountain documents available to the public. These included several specifically prepared to inform any who might be interested of the technical information and analyses that I would have before me as I considered the suitability of the site. There was no statutory requirement for producing these documents; I considered it important to make them available, and thus to provide a timely sharing of information that would form the basis of my consideration and, ultimately, decision.

To assist in discharging part of the Secretarial responsibilities created by the Act, the Department conducted official public meetings before starting the Environmental Impact Statement. Subsequently, the Department held a total of 24 public hearings on the draft and the supplemental draft Environmental Impact Statements. With the release of the *Yucca Mountain Science and Engineering Report* in May 2001, the DOE opened a public comment period lasting approximately six months; the period continued through the release of the *Preliminary Site Suitability Evaluation* in July 2001 and closed on October 19, 2001. After publishing DOE's final rule, "Yucca Mountain Site Suitability Guidelines," on November 14, 2001, I announced an additional 30-day supplemental comment period with a closing date of December 14, 2001. During these combined public comment periods, the DOE held 66 additional public hearings across Nevada and in Inyo County, California, to receive comments on my consideration of a possible recommendation of the Yucca Mountain site. More than 17,000 comments were received.[54]

The lengths to which the Department went to solicit public comment can be seen in the details: from 1995 through 2001, there were 126 official hearings with a court reporter present. The Nevada cities where these hearings were held included: Amargosa Valley, Battle Mountain, Caliente, Carson City, Crescent Valley, Elko, Ely, Fallon, Gardnerville, Goldfield, Hawthorne, Las Vegas, Lovelock, Pahrump, Reno, Tonopah, Virginia City, Winnemucca, and Yerington. Elsewhere, meetings were held in Independence, Lone Pine, Sacramento, and San Bernardino in California; Washington, DC; Boise, ID; Chicago, IL; Denver, CO; Dallas/Ft. Worth, TX; Salt Lake City, UT; Baltimore, MD; Albany, NY; Atlanta, GA; Kansas City, MO.; Cleveland, OH; and St. Louis, MO.

There were 600 hours of public meetings for the 2001 hearings alone. All in all, there were a total of 528 comment days, or about a year and a half. Additionally, the science centers were

[54] *Comment Summary Document* and *Supplemental Comment Summary Document*, February 2002.

open for 340 hours (both with and without court reporter) to receive comments. Since 1991, there have been 2,062 tours of Yucca Mountain, and 49,073 visitors have been to the site.

In light of the extensive opportunities DOE has provided for public input, it is my judgment that the opportunities for hearing and consideration of comments were abundant and met any procedural measure of fairness.

9.2. Assertion 2: The Project Has Received Inadequate Study

Critics have said that there has been inadequate study to determine Yucca Mountain's suitability. To the contrary, and as I believe section 6 of this Recommendation makes clear at length, the characterization process at Yucca Mountain is unprecedented for any even remotely comparable undertaking. Indeed, Yucca Mountain studies have now been under way for nearly five times as long as it took to build the Hoover Dam and more than six times the entire duration of the Manhattan Project. Yucca Mountain is, by any measure, the most exhaustively studied project of its kind the world has ever known.

Beginning in 1978 and continuing to the present day, the Department has spent billions of dollars on characterization studies. There has been ongoing dialogue between the Department and the NRC over the goals, content and results of the test programs. As noted, there have been ample opportunities for public involvement. At this still early stage, and with many more years before the Yucca Mountain site could become operational, the request for yet more preliminary study, even before seeking a license from the NRC, is unsupportable. Additional study will be undertaken at stages to come as an appropriate part of the licensing process.

For these reasons, I have concluded that the current body of accumulated scientific and technical knowledge provides a more than adequate technical basis to designate the Yucca Mountain site, thereby beginning the licensing phase of the project. For convenience, a listing of the types of tests that have been performed is provided in Table 3.

9.3. Assertion 3: The Rules Were Changed in the Middle of the Game

The State of Nevada claims that at some point the Department concluded that Yucca Mountain was not suitable under earlier regulations, and then changed the rules to fit the site. That is not true. Even the most elementary knowledge of the history of the program shows this claim is baseless.

The Guidelines did change, but not in a way that disadvantaged critics from making their case, and certainly not to suit any pre-existing agenda at the Department. Rather, they were changed to conform to changes in the statutory and regulatory framework governing the siting process and in the scientific consensus regarding the best approach for assessing the likely performance of a repository over long periods of time.

Table 3: Types of Tests Performed to Collect Data for Site Characterization of Yucca Mountain [55]

Process Models	Types of Tests and Studies
Unsaturated Zone (the rocks above the water table containing little water that limit the amount of water that can contact waste packages)	Future climate studies
	Infiltration model studies
	Unsaturated zone flow model studies
	Seepage model studies
	Unsaturated zone transport studies
Near-Field Environment (moisture, temperature, and chemistry conditions surrounding and affecting the waste packages)	Drift scale test
	Single heater test
	Large block test
	Field tests on coupled processes
	Laboratory coupled processes tests
Engineered Barrier System (EBS) (man-made features comprising the repository that influence how radionuclides might move)	Cementicious materials tests
	EBS design tests
	In-drift gas composition tests
	In-drift water chemistry, precipitates and salts tests
	Microbial communities tests
	Radionuclide transport tests
	Drift degradation analysis tests
	Rock mass mechanical properties tests
Waste Package (metal container that the wastes would be placed in)	Waste package environment tests
	Materials selection studies
	General corrosion tests
	Localized corrosion tests
	Stress corrosion cracking tests
	Hydrogen-induced cracking tests
	Metallurgical stability/phases tests
	Manufacturing defects tests
	Filler material tests
	Welding tests
Waste Form (high-level wastes and spent fuel that are the source of radionuclides)	Radioisotope inventory study
	In-package chemistry tests
	Commercial spent nuclear fuel cladding degradation tests
	Defense spent nuclear fuel degradation tests
	High level waste glass degradation tests
	Dissolved radioisotope concentration tests
	Colloid radioisotope concentration tests
Saturated Zone (movement of water in rocks below the water table)	Saturated zone characterization studies
	Saturated zone flow studies
	Saturated zone transport studies

[55] Summary information about progress in testing is provided to the NRC twice each year. There are 23 Semiannual Progress Reports available, covering all testing for the Yucca Mountain site. These documents include references to numerous technical reports of the Program, which number in the thousands.

Table 3: Types of Tests Performed to Collect Data for Site Characterization of Yucca Mountain, continued

Integrated Site Model (computer models of the geology)	Geologic framework model studies
	Rock properties model studies
	Mineralogical model studies
Site Description (description of the repository)	Geologic mapping studies
	Fracture data collection studies
	Natural resources assessment studies
	Erosion studies
	Natural and man-made analog studies
Disruptive Events (unlikely disruptions to the repository)	Probability of igneous activity studies
	Characteristics of igneous activity studies
	Seismic hazards studies

The DOE's original siting Guidelines were promulgated in 1984. At the time, the Nuclear Waste Policy Act called on the Department to evaluate and characterize multiple sites and to recommend one or more among them. Also at the time, consistent with the scientific and regulatory consensus of the late 1970's, the Nuclear Regulatory Commission had in place regulations for licensing repositories that sought to protect against radioactive releases by focusing on the performance of individual subparts, or subsystems, that were part of the repository. Finally, the EPA had proposed rules for repositories that also focused on limiting the amount and type of radionuclides released from a repository. Consistent with this framework, DOE's Guidelines focused on making comparative judgments among sites and emphasized mechanisms for evaluating the performance of potential repository subsystems against the NRC subsystem performance requirements and the EPA release limits.

Starting in 1987, however, both the regulatory framework and scientific consensus began to change. To begin with, Congress changed the law governing evaluation and selection of a repository site. In 1987, it amended the Nuclear Waste Policy Act to eliminate any authority or responsibility on the part of the Department for comparing sites, directed the Department to cease all evaluation of any potential repository sites other than Yucca Mountain, and directed it to focus its efforts exclusively on determining whether or not to recommend the Yucca Mountain site. This change was important, as it eliminated a central purpose of the Guidelines – to compare and contrast multiple fully characterized sites for ultimate selection of one among several for recommendation.

Next, Congress reinforced its directive to focus on Yucca Mountain in section 801 of the Energy Policy Act of 1992. This provision also gave three new directives to EPA. First, it directed EPA, within 90 days of enactment, to contract with the National Academy of Sciences for a study regarding, among other topics, whether a specific kind of radiation protection standard for repositories would be protective of public health and safety. The question posed was whether standards prescribing a maximum annual effective dose individuals could receive from the repository – as opposed to the then-current standards EPA had in place focusing on releases –

would be reasonable standards for protecting health and safety at the Yucca Mountain site. Second, Congress directed EPA, consistent with the findings and recommendations of the Academy, to promulgate such standards no later than one year after completion of the Academy's study. Finally, it directed that such standards, when promulgated, would be the exclusive public health and safety standards applicable to the Yucca Mountain site. Section 801 also contained a directive to the NRC that, within a year after EPA's promulgation of the new standards, NRC modify its licensing criteria for repositories under the NWPA as necessary to be consistent with the EPA standards.

Pursuant to the section 801 directive, in 1995 the National Academy of Sciences published a report entitled "Technical Bases for Yucca Mountain Standards."[56] This report concluded that dose standards would be protective of public health and safety.[57] It also concluded that if EPA adopted this kind of standard, it would be appropriate for the NRC to revise its licensing rules, which currently focused on subsystem performance, to focus instead on the performance of the total repository system, including both its engineered and natural barriers. It noted that this would be a preferable approach because it was the performance of the entire repository, not the different subsystems, that was crucial, and that imposition of separate subsystem performance requirements might result in suboptimal performance of the repository as a whole.[58] Finally, National Academy of Sciences noted that its recommendations, if adopted, "*impl[ied] the development of regulatory and analytical approaches for Yucca Mountain that are different from those employed in the past*" whose promulgation would likely require more than the one-year timeframe specified in the Energy Policy Act of 1992.

Along with these changes in regulatory thinking, the scientific and technical understanding of repository performance at Yucca Mountain was advancing. The DOE's use of Total System Performance Assessment to evaluate repository performance became more sophisticated, and helped focus DOE's research work on those areas important to maximizing the safety of the repository and minimizing public exposure to radionuclide releases from the repository.

In 1999, the culmination of years of scientific and technical advancements and careful regulatory review resulted in EPA and NRC proposals for new regulations specific to a repository at Yucca Mountain based on state-of-the-art science and regulatory standards.[59] Since section 113(c) of the NWPA directed DOE to focus its site characterization activities on those necessary to evaluate the suitability of the site for a license application to the NRC, the proposed changes to the EPA and NRC rules in turn required DOE to propose modifications to its criteria and methodology for determining the suitability of the Yucca Mountain site. Accordingly, DOE proposed new state-of-the-art Yucca-Mountain-specific site suitability Guidelines consistent with NRC licensing regulations.[60] After EPA and NRC finalized their revisions,[61] DOE promptly

---

[56] *Technical Bases for Yucca Mountain Standards,* National Academy of Sciences, National Research Council, 1995.

[57] *Ibid.*

[58] *Ibid.*

[59] Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada, Proposed Rule, 64 Fed. Reg. 8640, February 22, 1999; Environmental Radiation Protection Standards for Yucca Mountain, Nevada, Proposed Rule, 64 Fed. Reg. 46975, August 27, 1999.

[60] General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, Yucca Mountain Site Suitability Guidelines, 64 Fed. Reg. 67054, November 30, 1999.

finalized its own.[62] For the reasons explained in the National Academy of Sciences study, the revised Guidelines' focus on the performance of the total repository system also makes them a better tool for protection of public safety than the old Guidelines, since the old subsystem approach might have resulted in a repository whose subsystems performed better in one or another respect but whose total performance in protecting human health was inferior.

In short, far from seeking to manipulate its siting Guidelines to fit the site, DOE had no choice but to amend its Guidelines to conform with the new regulatory framework established at Congress's direction by the National Academy of Sciences, the EPA, and the NRC. Moreover, this framework represents the culmination of a carefully considered set of regulatory decisions initiated at the direction of the Congress of the United States and completed nine years later, in which top scientists in the country have participated, and in which expert regulatory authorities, the NRC and the EPA, have played the leading role. These authorities likewise agree that the new regulatory framework, of which the Department's revised Guidelines are a necessary part, forms a coherent whole well designed to protect the health and safety of the public.

9.4. Assertion 4: The Process Tramples States' Rights

Some have argued that a Federal selection of siting disrespects states' rights. That is incorrect. Indeed, Nevada's interests have been accorded a place in Federal law to an extent seldom, if ever, seen before.

As provided by the NWPA, the State of Nevada has the right to veto any Presidential site recommendation. It may do so by submitting a notice of disapproval to Congress within 60 days of the President's action.

If Nevada submits a notice of disapproval, Congress has 90 calendar days of continuous session to override the notice by passing a resolution of siting designation. If it does not do so, the State's disapproval becomes effective.

The respect due Nevada has not stopped with grudging obedience to the statutory commands. Instead, as noted previously, the Department has held hearings over a range of dates and places well in excess of what reasonably could have been viewed as a statutory mandate. And I have taken full account of Governor Guinn's comment and those of Nevada's other elected officials who oppose this Project. Although they reflect a view I do not share, I will continue to accord them the highest degree of respect.

Finally, the Federal Government has appropriated more funds to Nevada to conduct its own Yucca Mountain studies than any other State has ever been given for any remotely similar purpose. Since the start of the Program in 1983, the State of Nevada has received over $78 million in oversight funding. Since 1989, when the affected units of local government requested

---

[61] Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada, Final Rule, 66 FR 32073, June 13, 2001; Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada; Final Rule, 66 FR 55732, November 2, 2001.

[62] General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, Yucca Mountain Site Suitability Guidelines, Final Rule, 66 Fed. Reg. 57303, November 14, 2001.

oversight funding, they have received over $67 million. In total, the State of Nevada and the affected units of local government have received over $145 million over that timeframe; with Nye County, home to Yucca Mountain, receiving over $22 million and Clark County, home to Las Vegas, receiving about $25 million. In addition, over the last 10 years, the State of Nevada and the affected units of local government have been given over $73 million to compensate for taxes they would have collected on the site characterization and the development and operation of a repository if they were legally authorized to tax activities of the Federal Government. Nye County has also conducted its own oversight drilling program since 1996, for which over that time Nye has received almost $21 million. Thus, the grand total that has been awarded to the state and its local governments simply on account of Yucca Mountain research has been nearly $240 million.

Given the extensive evidence that the state has been, and will be, accorded a degree of involvement and authority seldom if ever accorded under similar circumstances, it is my judgment that the assertion of an infringement on state's rights is incorrect.

9.5. Assertion 5: Transportation of Nuclear Materials is Disruptive and Dangerous

Critics have argued that transporting wastes to Yucca Mountain is simply too dangerous, given the amount involved and the distances that will need to be traversed, sometimes near population centers.

These concerns are not substantiated for three principal reasons. First, they take no account of the dangers of not transporting the wastes and leaving them to degrade and/or accumulate in their present, temporary facilities. Second, they pay no heed to the fact that, if the Yucca Mountain repository is not built, some wastes that would have been bound for that location will have to be transported elsewhere, meaning that our real choice is not between transporting or not transporting, but between transporting with as much planning and safety as possible, or transporting with such organization as the moment might invite. And third, they ignore the remarkable record of safe transportation of nuclear materials that our country has achieved over more than three decades.

The first point is not difficult to understand. The potential hazards of transporting wastes are made to appear menacing only by ignoring the potential hazards of leaving the material where it is – at 131 aging surface facilities in 39 states. Every ton of waste not transported for five or ten minutes near a town on the route to Yucca Mountain is a ton of waste left sitting in or near someone else's town – and not for five or ten minutes but indefinitely. Most of the wastes left where they are in or near dozens of towns (and cities) continue to accumulate day-by-day in temporary facilities not intended for long-term storage or disposal.

The second point is also fairly simple. Many of these older sites have reached or will soon reach pool storage limits. Over 40 are projected to need some form of dry storage by 2010. Additional facilities will therefore be required. There are real limits, however, to how many of these can realistically be expected to be built on site. Many utilities do not have the space available to build them, and are likely to face major regulatory hurdles in attempting to acquire it.

Therefore one way or another, unless all these reactors shut down, off-site storage facilities will need to be built, substantial amounts of waste will have to be transported there, and this will happen not in the distant future but quite soon. For example, today nuclear utilities and a Native American tribe in Utah are working toward construction of an "interim" storage facility on tribal land. Whether or not this effort ultimately succeeds, it is likely that some similar effort will. Thus, if we are merely to keep our present supply of nuclear energy, at some fast-approaching point there will be transportation of nuclear wastes. The only question is whether we will have (a) numerous supplemental storage sites springing up, with transportation to them arranged *ad hoc*, or (b) one permanent repository, with transportation to it arranged systematically and with years of advance planning. The second alternative is plainly preferable, making the Yucca Mountain plan superior on this ground alone.

Finally, transportation of nuclear waste is not remotely the risky venture Yucca's critics seek to make it out to be. Over the last 30 years, there have been over 2,700 shipments of spent nuclear fuel. Occasional traffic accidents have occurred, but there has not been one identifiable injury related to radiation exposure because of them. In addition, since 1975, or since the last stages of the war in Vietnam, national security shipments have traveled over 100 million miles – more than the distance from here to the sun – with no accidents causing a fatality or harmful release of radioactive material.[63]

Our safety record is comparable to that in Europe, where nuclear fuel has been transported extensively since 1966.[64] Over the last 25 years, more than 70,000 MTU (an amount roughly equal to what is expected to be shipped over the entire active life of the Yucca Mountain Project) has been shipped in approximately 20,000 casks. France and Britain average 650 shipments per year, even though the population density in each of those countries grossly exceeds that of the United States.

Even so, we need not, and should not, be content to rest upon the record of the past no matter how good. For transportation to Yucca Mountain, the Department of Transportation has established a process that DOE and the states must use for evaluating potential routes. Consistent with Federal regulations, the NRC would approve all routes and security plans and would certify transportation casks prior to shipment.

In short, for all these reasons, I have concluded that the stated concerns about transportation are ill-founded and should not stand in the way of taking the next step toward designation of the Yucca Mountain site.

9.6. Assertion 6: Transportation of Wastes to the Site Will Have a Dramatically Negative Economic Impact on Las Vegas

There have been repeated assertions that shipments of radioactive waste through the Las Vegas valley could have effects on the local, entertainment-based, economy. Such effects could include, for example, discouraging tourism and lowering property values. These assertions are

---

[63] *About the Transportation Safeguards System*, Office of Transportation Safeguards Fact Sheet.
[64] Presentation by Ronald Pope, Head of Transport Safety Unit for the Internal Atomic Energy Agency, at 13th International Symposium for Packing of Radioactive Materials 2001, Chicago, IL, September 2001.

largely unsupportable by any evidence and are addressed in the Final Environmental Impact Statement.

Much of what has been said in the preceding section applies here as well. The record speaks for itself. In addition to the history of safe shipment on interstate highways through relatively open spaces, five metric tons of spent nuclear fuel from 27 countries have, over the last 16 years, been transported without incident through Concord, California, and Charleston, South Carolina (the latter, like Las Vegas, a tourist destination). There is no reason to believe that a similar safe record will not be achieved in Nevada.

The truth of it is that many tourists coming to Las Vegas will be farther from nuclear sites when they get there than when they left home. All major nuclear power generation facilities in the United States are located near large metropolitan centers in order to minimize the amount of power lost during transmission. It is thus not surprising that more than 161 million Americans are closer to a commercial nuclear facility than anyone in Las Vegas is to Yucca Mountain, as shown in Table 4. Indeed there are few large metropolitan centers that do <u>not</u> have a major nuclear facility located within 75 miles.[65]

Table 4. U.S. Population in Contiguous United States Living Within Various Distances of Commercial Nuclear Facilities

State	Zone (miles from facilities)				
	0 - 25	*25 - 50*	*50 - 75*	*0 - 50*	*0 - 75*
AL	327,488	617,283	452,817	944,771	1,397,588
AR	91,993	159,544	859,399	251,537	1,110,936
AZ	25,803	1,550,878	1,608,816	1,576,682	3,185,497
CA	2,488,467	8,666,094	11,962,159	11,154,561	23,116,719
CO	*	*	*	*	*
CT	962,725	2,394,573	55,292	3,357,298	3,412,590
DC		153,634	418,425	153,634	572,059
DE	457,523	184,324	123,438	641,847	765,285
FL	1,135,427	2,865,538	3,550,098	4,000,965	7,551,063
GA	186,028	886,879	1,145,585	1,072,907	2,218,491
IA	512,517	566,867	474,723	1,079,384	1,554,107
ID	*	*	*	*	*
IL	2,068,321	7,970,381	835,971	10,038,701	10,874,673
IN	34,431	945,514	468,802	979,945	1,448,747
KS	19,797	161,268	686,554	181,065	867,619
KY					
LA	786,052	1,592,771	772,888	2,378,823	3,151,710
MA	740,668	4,346,548	1,275,039	5,087,217	6,362,255
MD	438,958	2,528,095	2,007,566	2,967,053	4,974,619

[65] It is noteworthy that Atlantic City has three reactor sites closer than 75 miles at the same time its tourism-based economy has been expanding. Yucca Mountain, by contrast, would be one of the few nuclear facilities in the country in a remote area with no metropolitan center within 75 miles.

Table 4. U.S. Population in Contiguous United States Living Within Various Distances of Commercial Nuclear Facilities, continued

ME	151,828	521,691	280,266	673,520	953,785
MI	898,433	3,815,786	2,491,128	4,714,219	7,205,346
MN	450,935	2,999,162	330,754	3,450,097	3,780,850
MO	72,929	393,186	952,824	466,115	1,418,939
MS	36,411	169,211	561,585	205,622	767,207
MT					
NC	1,864,567	2,265,107	2,577,799	4,129,674	6,747,239
ND					
NE	564,594	181,950	379,944	746,544	1,126,488
NH	278,528	649,119	188,301	927,646	1,115,947
NJ	795,512	5,628,139	2,023,890	6,423,650	8,447,540
NM	*	*	*	*	*
NV					
NY	1,866,267	9,017,732	5,435,801	10,883,999	16,319,800
OH	656,156	2,790,959	2,074,628	3,447,115	5,521,743
OK			5,479		5,479
OR	45,053	1,381,995	432,829	1,427,047	1,859,876
PA	3,206,819	6,437,719	1,564,624	9,644,538	11,209,162
RI	19,252	284,282	744,786	303,534	1,048,320
SC	705,470	1,760,435	747,457	2,465,906	3,213,363
SD			569		569
TN	532,368	456,157	927,261	988,525	1,915,786
TX	136,390	1,337,035	3,766,243	1,473,425	5,239,668
UT	*	*	*	*	*
VA	597,715	2,377,308	2,221,770	2,975,024	5,196,794
VT	54,257	43,739	77,319	97,996	175,315
WA	331,397	500,577	585,734	831,974	1,417,708
WI	542,083	2,065,518	1,646,584	2,607,601	4,254,185
WV	43,813	65,183	37,095	108,996	146,090
WY					
Grand Total	24,126,975	80,732,181	56,752,239	104,859,156	161,651,160
Proposed Repository at Yucca Mountain					
Population around Yucca Mountain	1,678	13,084	19,069	14,762	33,831

*State with no commercial facilities but with other nuclear facilities depending on a repository for waste disposition.

As shown in Table 5, 22 of the 30 most populous metropolitan areas in the United States have 36 operating nuclear reactors closer to them than a waste repository at Yucca Mountain would be to Las Vegas, some 90 miles distant.

Table 5. Top 30 Metropolitan Areas in Contiguous U.S. by Population - Distance to Nearest Commercial Power Reactor (does not include other nuclear facilities that are dependent on a high-level repository for waste disposition)

Rank	Area Name	Population 2000 Census (Note 1)	Major Population Centers	State	Nearest Commercial Nuclear Reactor	Distance (Miles) (Note 4)
1	New York—Northern New Jersey—Long Island, NY—NJ—CT—PA CMSA (Note 2)	21,199,865	New York	NY	INDIAN POINT	45.0
			Jersey City	NJ	INDIAN POINT	44.4
2	Los Angeles—Riverside—Orange County, CA CMSA	16,373,645	Los Angeles	CA	SAN ONOFRE	61.5
			Riverside	CA	SAN ONOFRE	41.2
3	Chicago—Gary—Kenosha, IL—IN—WI CMSA	9,157,540	Chicago	IL	ZION	44.9
			Rockford	IL	BYRON	17.7
4	Washington—Baltimore, DC—MD—VA—WV CMSA	7,608,070	Baltimore	MD	PEACH BOTTOM	43.0
			Washington D.C.	DC	CALVERT CLIFFS	51.2
5	San Francisco—Oakland—San Jose, CA CMSA	7,039,362	San Francisco	CA	RANCHO SECO	81.3
			Oakland	CA	RANCHO SECO	73.3
			San Jose	CA	RANCHO SECO	81.8
6	Philadelphia—Wilmington—Atlantic City, PA—NJ—DE—MD CMSA	6,188,463	Philadelphia	PA	LIMERICK	34.1
7	Boston—Worcester—Lawrence, MA—NH—ME—CT CMSA	5,819,100	Boston	MA	PILGRIM	45.2
			Worcester	MA	VERMONT YANKEE	60.3
8	Detroit—Ann Arbor—Flint, MI CMSA	5,456,428	Detroit	MI	FERMI	30.4
9	Dallas—Fort Worth, TX CMSA	5,221,801	Dallas	TX	COMANCHE PEAK	69.3
			Fort Worth	TX	COMANCHE PEAK	41.7
10	Houston—Galveston—Brazoria, TX CMSA	4,669,571	Houston	TX	SOUTH TEXAS PROJECT	82.7
11	Atlanta, GA MSA (Note 3)	4,112,198	Atlanta	GA	SEQUOYAH	121.7
12	Miami—Fort Lauderdale, FL CMSA	3,876,380	Fort Lauderdale	FL	TURKEY POINT	57.9
			Miami	FL	TURKEY POINT	29.6
13	Seattle—Tacoma—Bremerton, WA CMSA	3,554,760	Seattle	WA	TROJAN	111.4
			Tacoma	WA	TROJAN	86.4
14	Phoenix—Mesa, AZ MSA	3,251,876	Glendale	AZ	PALO VERDE	40.4
			Scottsdale	AZ	PALO VERDE	56.3
			Phoenix	AZ	PALO VERDE	45.8
			Tempe	AZ	PALO VERDE	55.2
			Mesa	AZ	PALO VERDE	60.2
			Chandler	AZ	PALO VERDE	59.4
15	Minneapolis—St. Paul, MN—WI MSA	2,968,806	Minneapolis	MN	MONTICELLO	39.1
			Saint Paul	MN	PRAIRIE ISLAND STATION	34.2
16	Cleveland—Akron, OH CMSA	2,945,831	Cleveland	OH	PERRY	39.3
			Akron	OH	PERRY	59.3
17	San Diego, CA MSA	2,813,833	San Diego	CA	SAN ONOFRE	50.7
18	St. Louis, MO—IL MSA	2,603,607	Saint Louis	MO	CALLAWAY	91.7
19	Denver—Boulder—Greeley, CO CMSA	2,581,506	Denver	CO	FORT CALHOUN	495.6
20	Tampa—St. Petersburg—Clearwater, FL MSA	2,395,997	Tampa	FL	CRYSTAL RIVER	81.9
21	Pittsburgh, PA MSA	2,358,695	Pittsburgh	PA	BEAVER VALLEY	29.6

Table 5. Top 30 Metropolitan Areas in Contiguous U.S. by Population - Distance to Nearest Commercial Power Reactor, continued

22	Portland—Salem, OR—WA CMSA	2,265,223	Portland	OR	TROJAN	37.2
23	Cincinnati—Hamilton, OH—KY—IN CMSA	1,979,202	Cincinnati	OH	DAVIS BESSE	206.8
24	Sacramento—Yolo, CA CMSA	1,796,857	Sacramento	CA	RANCHO SECO	26.1
25	Kansas City, MO—KS MSA	1,776,062	Kansas City	MO	WOLF CREEK	88.2
			Kansas City	KS	WOLF CREEK	87.0
26	Milwaukee—Racine, WI CMSA	1,689,572	Milwaukee	WI	ZION	44.2
27	Orlando, FL MSA	1,644,561	Orlando	FL	CRYSTAL RIVER	98.7
28	Indianapolis, IN MSA	1,607,486	Indianapolis	IN	CLINTON	156.5
29	San Antonio, TX MSA	1,592,383	San Antonio	TX	SOUTH TEXAS PROJECT	161.3
30	Norfolk—Virginia Beach—Newport News, VA—NC MSA	1,569,541	Newport News	VA	SURRY	23.2
			Virginia Beach	VA	SURRY	53.4
			Norfolk	VA	SURRY	37.3

Notes

1 Populations from 2000 Census data for Continental USA
2 CMSA means "Consolidated Metropolitan Statistical Area"
3 MSA means "Metropolitan Statistical Area"
4 Distances shown are relative to a central feature such as a city hall, county seat, or capitol building.

Many cities with strong tourism industries are located closer to existing storage facilities than Las Vegas would be to a repository at Yucca Mountain. Therefore, those who assert that a repository 90 miles from Las Vegas would have dramatically negative effects on local tourism have the burden of producing strong evidence to back up their claims. They have not done so. Thus, I know of no reason to believe that there is any compelling argument that the Las Vegas economy would be harmed by a repository at Yucca Mountain.

9.7. Assertion 7: It is Premature for DOE to Make a Site Recommendation for Various Reasons

9.7.1. The General Accounting Office has concluded that it is premature for DOE to make a site recommendation now

The GAO did make this statement in its draft report, *Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project*, which was prematurely released.[66] After receiving the Department's response, however, in the final version of this report, released in December 2001, GAO expressly acknowledged that "the Secretary has the discretion to make such a recommendation at this time." [67]

---

[66] *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project*, Unpublished Draft.
[67] *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project*, GAO-02-191, December 21, 2001.

9.7.2. DOE is not ready to make a site recommendation now because DOE and NRC have agreed on 293 technical items that need to be completed before DOE files a license application

The Nuclear Regulatory Commission provided a sufficiency letter to DOE on November 13, 2001, that concluded that existing and planned work, upon completion, would be sufficient to apply for a construction authorization. The agreed upon course of action by DOE and the NRC is intended to assist in the license application phase of the project, not site recommendation. In consultation with the Nuclear Regulatory Commission staff concerning *licensing*, DOE agreed it would obtain certain additional information relating to nine "key technical issues" to support license application. The DOE agreed to undertake 293 activities that would assist in resolution of these issues.

The NRC has *never* stated that this was work that DOE needed to complete before *site recommendation*. In fact, it went out of its way not to do so. The Commission is well aware that section 114(a)(1)(E) of the NWPA requires a Secretarial recommendation of Yucca Mountain to be accompanied by a letter from the Commission providing its preliminary comments on the sufficiency of the information the Department has assembled for a construction license application. Had it been of the view that site recommendation should not proceed, its preliminary views would have stated that this information is not sufficient and that the Commission has no confidence that it ever will be.

Instead, in its section 114(a)(1)(E) letter, the Commission said the opposite: "[T]he NRC believes that sufficient at-depth characterization analysis and waste form proposal information, although not available now, *will be available at the time of a potential license application such that development of an acceptable license application is achievable*" (emphasis added). It also listed the outstanding issues as "closed pending," meaning that the NRC staff has confidence that DOE's proposed approach, together with the agreement to provide additional information, acceptably addresses the issue so that no information beyond that provided or agreed to would likely be required for a license application.

The DOE has completed over one-third of the actions necessary to fulfill the 293 agreements and has submitted the results to the NRC for review. The NRC has documented 23 of these as "complete." The remaining work consists largely of documentation (improve technical positions and provide additional plans and procedures) and confirmation (enhance understanding with additional testing or analysis or additional corroboration of data or models).

As I explained earlier, the NWPA makes clear that site recommendation is an intermediate step. The filing of a construction license application is the step that comes after site recommendation is complete. It is entirely unsurprising that the Department would have to do additional work before taking that next step. But the fact that the next step will require additional work is no reason not to take this one.

9.7.3. It is premature for DOE to make a recommendation now because DOE cannot complete this additional work until 2006. The NWPA requires DOE to file a license application within 90 days of the approval of site designation

When Congress enacted the NWPA in 1982, it included in the Act a series of deadlines that represented its best judgment regarding how long various steps should take. These deadlines included the 90-day provision referenced above. They also included a requirement that DOE begin disposing of waste in 1998, in the expectation that a repository would by then have been built and licensed.

Obviously, the timeframes set in the Act have proven to be optimistic. That is no reason, however, for the Department not to honor what was plainly their central function: to move along as promptly and as responsibly as possible in the development of a repository. Accordingly, to read the 90-day provision at issue as a basis for proceeding more slowly stands the provision on its head.

Our current plans call for filing a license application at the end of 2004, not 2006. Assuming Congressional action on this question this year, that would mean that DOE could be two years late in filing the application. But any delay in site recommendation will only result in *further* delay in the filing of this application. For the reasons explained in section 7, I believe I have the information necessary to allow me to determine that the site is scientifically and technically suitable, and I have so determined. That being so, I am confident that I best honor the various deadlines set out in the Act, including the central 1998 deadline (already passed) specifying when the Department was to begin waste disposal, by proceeding with site recommendation as promptly as I can after reaching this conclusion.

10. Conclusion

As I explained at the outset of this document, the Nuclear Waste Policy Act vests responsibilities for deciding how this country will proceed with regard to nuclear waste in a number of different Federal and state actors. As Secretary of Energy, I am charged with making a specific determination: whether to recommend to the President that Yucca Mountain be developed as the site for a repository for spent fuel and high-level radioactive wastes. I have endeavored to discharge that responsibility conscientiously and to the best of my ability.

The first question I believe the law asks me to answer is whether the Yucca Mountain site is scientifically and technically suitable for development as a repository. The amount and quality of research the Department of Energy has invested into answering this question — done by top-flight people, much of it on the watch of my predecessors from both parties — is nothing short of staggering. After careful evaluation, I am convinced that the product of over 20 years, millions of hours, and four billion dollars of this research provides a sound scientific basis for concluding that the site can perform safely during both the pre- and post-closure periods, and that it is indeed scientifically and technically suitable for development as a repository.

Having resolved this fundamental question, I then turned to a second set of considerations: are there compelling national interests that warrant proceeding with this project? I am convinced that there are, and that a repository for nuclear waste at Yucca Mountain will advance, in important ways, our energy security, our national security, our environmental goals, and our security against terrorist attacks.

Finally, I examined the arguments that opponents of the project have advanced for why we should not proceed. I do not believe any of them is of sufficient weight to warrant following a different course.

Accordingly, I have determined to recommend to the President that he find Yucca Mountain qualified for application for a construction authorization before the Nuclear Regulatory Commission, and that he recommend it for development of a repository.

Department of Energy
Washington, DC 20585

FEB 17 2010

The Honorable Byron Dorgan
Chairman, Subcommittee on Energy
and Water Development
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

This letter is to notify you of the Department of Energy's (DOE) use of reprogramming authority, as provided in the Conference Report accompanying the Energy and Water Development and Related Agencies Appropriations Act, 2010 (Pub. L.No. 111-85). This authority is being exercised by DOE to reprogram a total of approximately $115,000,000 within the Office of Civilian Radioactive Waste Management. Within this, approximately $85,000,000 will be programmed within the Repository Program control point and approximately $30,000,000 within the Program Direction control point for Yucca Mountain Project and program office termination activities within the Nuclear Waste Disposal and Defense Nuclear Waste Disposal appropriations.

As stated in the President's Budget for Fiscal Year (FY) 2010, the Administration has determined that Yucca Mountain is not a workable option for the long-term management of used nuclear fuel and that we can develop a better solution to this challenge. As a result, we do not believe it would be prudent to continue to spend tens of millions of dollars on the license application. Accordingly, the Department will discontinue its application to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct a high-level waste geologic repository at Yucca Mountain. On Monday, February 1, 2010, the Department filed a motion with the NRC to stay all proceedings for 30 days. During this time, we will withdraw the application pursuant to NRC rules.

The Department intends to dedicate the remaining funds available in FY 2010 to bring the Yucca Mountain Project to an orderly close. Closeout activities include workforce transition actions for Federal and national laboratory employees; payoff and closure of the management and operating contractor's defined benefit pension plan; cancellation of contracts, including issuance of Worker Adjustment and Retraining Notification (WARN) Act notices for certain contractor employees; cancellation of leases for office space when vacated; preparation of the repository site for surveillance and maintenance pending remediation; and archiving of project and program documents and scientific material so that the lessons learned during this process are not lost. The Department intends to complete these activities by the end of FY 2010.

We continue to evaluate the scope, timing, and sequence of closeout actions based on ending licensing activities with the NRC. The Department is committed to keeping the Committees informed of our plans to make use of FY 2010 funds for closeout and termination activities.

Thank you for your continuing support of DOE's programs. If you have any questions, please have your staff contact Ms. Tara Hicks, Office of External Coordination, at (202) 586-7487.

Sincerely,

Steve Isakowitz
Chief Financial Officer

Enclosures

cc: The Honorable Robert F. Bennett
Ranking Member

Department of Energy
Washington, DC 20585

FEB 17 2010

The Honorable Peter J. Visclosky
Chairman, Subcommittee on Energy
and Water Development
Committee on Appropriations
United States House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

This letter is to notify you of the Department of Energy's (DOE) use of reprogramming authority, as provided in the Conference Report accompanying the Energy and Water Development and Related Agencies Appropriations Act, 2010 (Pub. L. No. 111-85). This authority is being exercised by DOE to reprogram a total of approximately $115,000,000 within the Office of Civilian Radioactive Waste Management. Within this, approximately $85,000,000 will be programmed within the Repository Program control point and approximately $30,000,000 within the Program Direction control point for Yucca Mountain Project and program office termination activities within the Nuclear Waste Disposal and Defense Nuclear Waste Disposal appropriations.

As stated in the President's Budget for Fiscal Year (FY) 2010, the Administration has determined that Yucca Mountain is not a workable option for the long-term management of used nuclear fuel and that we can develop a better solution to this challenge. As a result, we do not believe it would be prudent to continue to spend tens of millions of dollars on the license application. Accordingly, the Department will discontinue its application to the U.S. Nuclear Regulatory Commission (NRC) for a license to construct a high-level waste geologic repository at Yucca Mountain. On Monday, February 1, 2010, the Department filed a motion with the NRC to stay all proceedings for 30 days. During this time, we will withdraw the application pursuant to NRC rules.

The Department intends to dedicate the remaining funds available in FY 2010 to bring the Yucca Mountain Project to an orderly close. Closeout activities include workforce transition actions for Federal and national laboratory employees; payoff and closure of the management and operating contractor's defined benefit pension plan; cancellation of contracts, including issuance of Worker Adjustment and Retraining Notification (WARN) Act notices for certain contractor employees; cancellation of leases for office space when vacated; preparation of the repository site for surveillance and maintenance pending remediation; and archiving of project and program documents and scientific material so that the lessons learned during this process are not lost. The Department intends to complete these activities by the end of FY 2010.

We continue to evaluate the scope, timing, and sequence of closeout actions based on ending licensing activities with the NRC. The Department is committed to keeping the Committees informed of our plans to make use of FY 2010 funds for closeout and termination activities.

Thank you for your continuing support of DOE's programs. If you have any questions, please have your staff contact Ms. Tara Hicks, Office of External Coordination, at (202) 586-7487.

Sincerely,

Steve Isakowitz
Chief Financial Officer

Enclosures

cc: The Honorable Rodney P. Frelinghuysen
Ranking Member

Department of Energy
Office of Civilian Radioactive Waste Management
1551 Hillshire Drive
Las Vegas, NV 89134-6321

QA: N/A

FEB 0 8 2010

Mr. Tracy Taylor, State Engineer
Division of Water Resources
Department of Conservation and
Natural Resources
State of Nevada
901 South Stewart Street, Suite 2002
Carson City, NV 89701-5249

Subject: Withdrawal of Water Applications 77798 through 77913

Dear Mr. Taylor:

This letter responds to your letters November 10, 2009 and January 14, 2010 regarding the Department's intent to pursue the 116 applications to appropriate groundwater that were filed on January 20, 2009. In light of recent developments, the U.S. Department of Energy does not intend to pursue the 116 subject applications and requests that these applications be withdrawn.

If you have any questions, please contact me at (702) 794-1454.

Sincerely,

Ned B. Larson

Ned B. Larson
Federal Project Director
Nevada Rail Line Project

Exhibit 5

Department of Energy
Office of Civilian Radioactive Waste Management
1551 Hillshire Drive
Las Vegas, NV 89134-6321

QA: N/A
DOCKET NUMBER 63-001

FEB 2 6 2010

OVERNIGHT MAIL

ATTN: Document Control Desk
Michael F. Weber, Director
Office of Nuclear Material Safety and
Safeguards
U.S. Nuclear Regulatory Commission
EBB-2B2
11545 Rockville Pike
Rockville, MD 20852-2738

CESSATION OF PERFORMANCE CONFIRMATION ACTIVITIES AT THE YUCCA MOUNTAIN SITE

The purpose of this letter is to inform you that the U.S. Department of Energy has decided that certain Office of Civilian Radioactive Waste Management activities, including data collection and performance confirmation activities, at the Yucca Mountain site, will cease as of March 1, 2010. Specifically, the power and communications systems for all surface and subsurface work and data collection processes will be shut down.

The termination will be performed in a controlled manner and the large existing datasets collected over the course of site characterization and performance confirmation, including those for the performance confirmation activities of seismic monitoring, precipitation, and construction monitoring, will not be impacted, although further data acquisition is being stopped.

If you have any questions, please contact Jeffrey R. Williams at (202) 586-6850, or by email to jeff.williams@rw.doe.gov.

April V. Gil

William J. Boyle, Director
Regulatory Affairs Division
Office of Technical Management

OTM:AVG-0290

Exhibit 6

cc:
J. C. Chen, NRC, Rockville, MD
J. R. Davis, NRC, Rockville, MD
R. K. Johnson, NRC, Rockville, MD
A. S. Mohseni, NRC, Rockville, MD
J. D. Parrott, NRC, Las Vegas, NV
D. B. Spitzberg, NRC, Arlington, TX
N. K. Stablein, NRC, Rockville, MD
L. M. Willoughby, NRC, Las Vegas, NV
W. C. Patrick, CNWRA, San Antonio, TX
B. Sagar, CNWRA, San Antonio, TX
B. Street, CNWRA, San Antonio, TX
R. McCullum, NEI, Washington, DC
B. J. Garrick, NWTRB, Arlington, VA
B. Breslow, State of Nevada, Carson City, NV
A. Kalt, Churchill County, Fallon, NV
I. Navis, Clark County, Las Vegas, NV
E. Mueller, Esmeralda County, Goldfield, NV
R. Damele, Eureka County, Eureka, NV
A. Lembke, Inyo County, Independence, CA
C. Chapin, Lander County, Battle Mountain, NV
C. Simkins, Lincoln County, Pioche, NV
L. Mathias, Mineral County, Hawthorne, NV
D. Lacy, Nye County, Pahrump, NV
J. Kennedy, Timbisha Shoshone Tribe, Death Valley, CA
M. Simon, White Pine County, Ely, NV
B. Byron, California Energy Commission, Sacramento, CA

bcc:
D. K. Zabransky, DOE (RW-2) FORS
D. L. Barr, DOE (RW-5.2.2) NV
S. A. Bokhari, DOE (RW-5.2.3) FORS
W. J. Boyle, DOE (RW-5.2) NV
M. S. Crosland, DOE (GC-52) FORS
S. A. Davis, DOE (RW-2) FORS
L. J. Desell, DOE (RW-5.2.3) FORS
A. V. Gil, DOE (RW-5.2.2) NV
S. E. Gomberg, DOE (RW-5.2.3) FORS
T. C. Gunter, DOE (RW-5.2.1) NV
J. M. Gutierrez, DOE (GC-52) NV
P. G. Harrington, DOE (RW-5.3) NV
J. W. Hollrith, DOE (RW-7) NV
N. K. Hunemuller, DOE (RW-5.2.1) NV
D. W. Kane, DOE (RW-5.2.2) NV
C. J. Macaluso, DOE (RW-5.2.3) FORS
J. B. McRae, DOE (GC-52) FORS
J. C. Price, DOE (RW-5.2.2) NV
T. A. Shrader, DOE (RW-5.2) NV
E. T. Smistad, DOE (RW-5.1) NV
J. R. Summerson, DOE (RW-5.2) NV
J. R. Williams, DOE (RW-5.2.3) FORS
M. H. Williams, DOE (RW-1.2) NV
C. A. Zaccone, DOE (RW-5.2.2) NV
E. J. Bonano, SNL, Las Vegas, NV
R. Howard, SNL, Las Vegas, NV
S. P. Kuzio, SNL, North Bethesda, MD
J. A. McNeish, SNL, Las Vegas, NV
CMS Coordinator, USA RS, Las Vegas, NV
J. Donnell, USA RS, Las Vegas, NV
S. B. Thom, USA RS, Las Vegas, NV
D. P. Irwin, Hunton & Williams, Richmond, VA
J. M. Gutierrez, Morgan, Lewis & Bockius, LLP, Washington, DC
T. C. Poindexter, Morgan, Lewis & Bockius, LLP, Washington, DC
D. J. Silverman, Morgan, Lewis & Bockius, LLP, Washington, DC
D. Franklin, Naval Reactors, Las Vegas, NV
J. M. McKenzie, U.S. Department of the Navy, Washington, DC
OTM-RAD Records Coordinator, NV
OTM-RAD Library
Records Processing Center = "3"

Condition Report

Current Record Report

*** Condition Report is currently in this process step ***

CR Num	CR Level	CR Type	Step Entry Date	Step	Step Resp	Step Owner
14327	C	QARD	3/4/2010 2:17:13 PM	Plan CR		Bonano, Evaristo

Condition Information

CR Title: Impact to seismic data collection in Alcove 5 due to no access

Date Found: 02-Mar-10
Time Found: 3:41

CR Initiator: Boggs, Susan
CR Initiating Org: Sandia National Lab
Involve Initiator? Yes

Condition Description:
Contrary to TST-PRO-T-004 Rev 06 Section 5.2.11 the batteries in Alcove 5 for the seismic monitoring station were not changed out within the stipultated 4-6 week time frame despite a planned entry.

The underground entry that was scheduled for today, 3/3/2010 was cancelled yesterday by Site Management Division in an email to Ranch Control POD dated 3/2/1010 (email attached "Notice of Permanent Site Closure.pdf").

Contrary to the notification from DOE RAD OTM to the NRC dated Feb 26, 2010 referenced in the email (letter can be found attached to CR 14323), data collected over the course of site characterization and performance confirmation will be impacted as a result of site access denial. Seismic data at this station has not been retrieved since January.

As the resolution to Condition Report (CR) 12687 data at this site must be manually retrieved and powered by battery. This seismic monitoring station is the only station at repository depth and is commitment in the License Application.

The original planned entry was for February 17, 2010 at the 4 week interval. Without support for an underground access for maintenance and data retrieval, data will be lost and the intent to not impact data during performance confirmation as described in the letter from DOE to NRC dated Feb 26, 2010.

Supplemental Information:

Routing Notes:

Exhibit 7

CR Num	CR Level	CR Type	Step Entry Date	Step	Step Resp	Step Owner
14327	C	QARD	3/4/2010 2:17:13 PM	Plan CR		Bonano, Evaristo

03/03/10 Danika Miller - Significance Determination established at a Level C using criteria Performance Document Noncompliance.

Trend Only? No

Requirement Involved? Yes
Requirement: TST-PRO-T-004 REV 06

Business Process:
Business Process ID:

Condition Information

Assignment Information

Ownership Organization: Sandia National Lab
Responsible Organization: Sandia National Lab
Business Process Review Org:

Oversight Organization: OTM - Sci Division
Oversight Lead: Savage, Woody
QA Review Type: No QA Review Required
Quality Assurance Rep (QAR):

Assignment Information

Screening Information

CR Level: C
Date Submitted: 3/3/2010
Date Issued: 3/4/2010
CST / MRC Conclusions:
03/04/10 Danika Miller - Significance Determination established at a Level C using criteria Performance Document Noncompliance.

Screening Information

Review Information

NRC Reportability Review (e.g. Part 21 and 10CFR63.73b)

Potential NRC Reportable CR? No
Validated NRC Reportable CR?
NRC Reportable Discussion:

CR Num	CR Level	CR Type	Step Entry Date	Step	Step Resp	Step Owner
14327	C	QARD	3/4/2010 2:17:13 PM	Plan CR		Bonano, Evaristo

Self-Revealing Conditions

* Conditions identified outside of formal processes (such as Self Assessments) where the event/consequence occurred prior to entry of the condition into CAP

Self-Revealing condition? No

10CFR835 - Radiological Protection Program (RPP) Review

Potential RPP issue? No

Validated RPP issue?

RPP Category:

RPP Discussion:

10CFR851 - Worker Safety and Health Program (WSHP) Review

Potential WSHP issue? No

Validated WSHP issue?

WSHP Category:

WSHP Discussion:

Occurrence Reporting and Processing System (ORPS) Review

Potential ORPS issue? No

Validated ORPS issue?

ORPS Criteria:

ORPS Significance:

ORPS Report ID:

ORPS Discussion:

NTS Reportable conditions only

NTS Report ID:

CR Num	CR Level	CR Type	Step Entry Date	Step	Step Resp	Step Owner
14327	C	QARD	3/4/2010 2:17:13 PM	Plan CR		Bonano, Evaristo

Review Information

Evaluation Information

Immediate/Interim Action Taken?

Immediate/Interim Action Desc:

Previous Occurrence Review:

Extent of Condition:

Evaluation Information

Cause Analysis Information

Cause Analysis Type: N/A

Cause Analysis Results:

LL/GI Required?

Reason LL/GI Not Performed:

Cause Analysis Team Members

Team Member Name	Team Member Organization
< NO CAUSE ANALYSIS TEAM MEMBERS IDENTIFIED FOR THIS CONDITION REPORT >	

Cause Code(s):

A0B0C00 - Cause not applicable or required

Event Code(s):

9999 - Other

CR Num	CR Level	CR Type	Step Entry Date	Step	Step Resp	Step Owner
14327	C	QARD	3/4/2010 2:17:13 PM	Plan CR		Bonano, Evaristo

Cause Analysis Information

Plan Information

Plan Due Date: 4/3/2010

Plan Completed Date:

Original Est Comp Date:

Current Est Comp Date:

Date Completed:

Date Closed:

Actions Required?

Corrective Action Plan Summary:

Effectiveness Revw Required? **Effectiveness Revw Days**

Effectiveness Revw Criteria:

Action	Title
< NO CORRECTIVE ACTIONS CREATED FOR THIS CONDITION REPORT >	

Plan Information

Discussions Information

Discussed Plan with CR Initiator? **Discussion Results:**

Discussed Implementation with CR Initiator? **Discussion Results:**

Discussed Plan with Oversight? **Discussion Results:**

Discussed Implementation with Oversight? **Discussion Results:**

Discussions Information

Review Information

Condition Report

Current Record Report

CR Num	CR Level	CR Type	Step Entry Date	Step	Step Resp	Step Owner
14327	C	QARD	3/4/2010 2:17:13 PM	Plan CR		Bonano, Evaristo

Review Information

CR Step History

Rev #	EnteredStep	Entry Date	Step Owner	Step Resp	Exit Date	Exit To Status	User that hit 'GO'	Milestone on Exit	# of Days in Step
1	Initiate CR	3/3/2010	Bonano, Evaristo	Boggs, Susan	3/3/2010	Staff Review CR	Boggs, Susan		0
2	Staff Review CR	3/3/2010	Pesek, John	Miller, Danika	3/3/2010	CST Review CR	Miller, Danika		0
3	CST Review CR	3/3/2010	Pesek, John	Miller, Danika	3/4/2010	Plan CR	Miller, Danika	CR ISSUED 3/4/2010 2:17:13 PM	1
4	Plan CR	3/4/2010	Bonano, Evaristo						0 and counting

CR Step History

CR Attachments

Filename	Size	Date
CR-14327 Action.pdf	32 kb	
Notice of Permanent Site Closure.pdf	30 kb	

CR Attachments

Department of Energy
Washington, DC 20585

March 10, 2010

FROM: DAVID ZABRANSKY
CHIEF OPERATING OFFICER
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

TO:

SUBJECT: NOTICE OF EXPECTED SEPARATION

In accordance with the Deputy Secretary's memorandum of February 3, 2010, concerning the potential affect of the President's FY 2011 budget request eliminating funding for the Office of Civilian Radioactive Waste Management (RW), this notice of expected separation is being issued to all RW employees. While no determination has been made concerning your specific position, it is likely that your position will be eliminated due to a lack of funding. You will receive more specific information once a final determination has been made.

This notice entitles you to priority consideration for selection to vacant positions in the Department as outlined in the attached guidance. This program is an expansion of the provisions found in law, the Code of Federal Regulations and Departmental Orders. In order to receive consideration under this program, you must apply for vacant positions in the Department for which you are eligible and would like to be considered.

Please carefully read the guidance provided. If you have any questions, the points of contact designated for this program in the guidance will be happy to answer them.

Attachment

Sent on behalf of Bob Clark:.

Please read the attached LA Impact Screening which covers the initiation, revision, or cancellation of all future federal activities from now to Program termination. In accordance with LP-REG-020-OCRWM, it has been submitted to the RPC as a stand alone record. Should anyone have questions, please call me at 702-794-5583.

Exhibit 9

OCRWM	**Activity Screening** (for LA impacts)	QA: NA Page 1 of 2

Section 1 – Proposed Activity	
1. Identifying number/revision of proposed activity: N/A	Title: Any and all future activities, performed by the federal staff, through OCRWM Program termination
Description of proposed activity (include CR number if associated with a corrective action): Any and all future activites Given the recent events regarding DOE's motion to withdraw the LA and related Program termination efforts, will **any** future activities have an impact on the LA?	
2. List attachments (if any): N/A	
3. Preparer (name, organization, and signature): Kathryn S. Knapp, OOM Kathryn S Knapp	Date: 3-17-10
Section 2 – LA Impact Determination	
4. LA Impacted?	☒ No: proceed with proposed activity ☐ Yes: approval to proceed with proposed activity is required
5. Basis for LA Impact Determination: refer to Attachment 1	
6. LA section(s)/reference(s) reviewed: N/A	
7. LA section(s)/reference(s) impacted: N/A	
8. DOE LA Group Lead (name and signature): Robert W. Clark R.W. Clark	Date: 3/17/2010

Attachment 1

Activity Screening
(for LA impacts)

Block 5, Basis for LA Impact Determination:

On February 1, 2010, the President announced with the release of his FY2011 Budget that the OCRWM program would receive no future funding. It was stated that Yucca is no longer an option and that other options for dealing with the nation's SNF and HLW should instead be explored. Based on this decision by the Administration, activities associated with the termination of the OCRWM Program have begun. These include: DOE's motion to withdraw the License Application on March 3, 2010; Memorandum from the Deputy Secretary of Energy to Heads of Departmental Elements on March 5, 2010 regarding the Transition Assistance Program for Surplus OCRWM employees; and the March 10, notification by Dave Zabransky to all OCRWM employees indicating initiation of the 1st step in the Reduction in Force process. Also, DOE-OCRWM letters are being prepared which will formally provide direction to USA-RS and the Lead Lab regarding changes to their respective workscopes from that of activities associated with Program mission to that of activities associated with Program termination.

Given this Administration's desires and direction, particularly with respect to the motion to withdraw the LA, DOE-OCRWM, consistent with the aforementioned Program termination activities, will not be updating the LA any further. Consequently, no Program activities from this date forward can now possibly have any impact on an LA that will no longer be updated and is being withdrawn (from consideration by the regulator) by a Program that is being terminated.

Since this screening has determined that any and all future Program activities **will not** impact the LA, all future activities may now proceed without being screened for LA impact and all Program procedures associated with maintaining LA configuration management are no longer applicable.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA

STATE OF WASHINGTON, Petitioner, v. UNITED STATES DEPARTMENT OF ENERGY, DR. STEVEN CHU, Secretary of the U.S. Department of Energy, NUCLEAR REGULATORY COMMISSION, Respondents.	No. PETITIONER'S CERTIFICATE AS TO PARTIES, RULINGS, AND RELATED CASES

Parties

The parties to this case are Petitioner State of Washington (Washington); Respondents United States Department of Energy, Hon. Dr. Steven Chu, Secretary of Energy, and the United States Nuclear Regulatory Commission.

Rulings Under Review

Petitioner seeks review of the decision of the Respondents Department of Energy and Secretary Chu (hereafter, DOE) to irrevocably terminate Yucca Mountain, Nevada, from consideration as the site of a permanent repository for high-level radioactive nuclear waste and spent nuclear fuel. This decision became final on or about January 29, 2010.

Related Cases

This case was not previously before this Court or any other court. There are three similar cases pending before this Court: *Aiken County v. Chu et al.*, No. 10-1050 (D.C.Cir.), *South Carolina ex rel. McMaster v. Dep't of Energy*, No. 10-1069 (D.C. Cir.), and *Ferguson v. Obama et al.*, No 10-1052.

RESPECTFULLY SUBMITTED this 12th day of April, 2010.

ROBERT M. MCKENNA
Attorney General

TODD R. BOWERS, WSBA #25274
ANDREW A. FITZ, WSBA #22169
Senior Counsel
P.O. Box 40117
Olympia, WA 98504-0117
(360) 586-6770
Application for Admittance Pending

OF COUNSEL:

MICHAEL L. DUNNING
H. LEE OVERTON
JONATHAN C. THOMPSON
Assistant Attorneys General
State of Washington
Office of the Attorney General
PO Box 40117
Olympia, WA 98504-0117

CERTIFICATE OF SERVICE

I herby certify that on the 12th day of April, 2010, a copy of the State of Washington's Petition for Review and for Declaratory and Injunctive Relief was served by overnight mail upon the following:

U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Stephen G. Burns
General Counsel
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Steven Chu, Secretary
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Scott B. Harris
General Counsel
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Mr. Eric H. Holder
U.S. Attorney General
United States Department of Justice
950 Pennsylvania Ave. N.W.
Washington, D.C. 20530

Diana MacDonald

Diana MacDonald

(2) WARN and Employee Separations
   i. USA RS issues letters to employees of project closure and employee separation (60 day notice required if WARN applicable; 30 days notice required if WARN not applicable) – April 23, 2010
   ii. USA RS initiates employee separations (If WARN is not applicable) – May 24, 2010
   iii. USA RS initiates employee separations (If WARN is applicable) – June 22, 2010

c. Environmental, Safety, Security, and Health

   (1) Security
      i. Clearances transferred or terminated?
      ii. Safeguards Information disposition
      iii. Turning in of employee badges

   (2) Health
      i. Transfer or terminate Occupational Medical Program
      ii. Disposition of employee medical records

d. Finance and Accounting

   (1) Closeout of Letter-of-Credit Bank Account

   (2) Who will submit the final USA RS STARS upload file, final financial statements, Statement of Costs Incurred and Claimed, Payment equal to taxes (PETT) report and any other financial required reporting?

   (3) Who will file final W-2s and 1099s?

e. Information Systems and Technology

   (1) What systems are to be archived, preserved, or retired?

   (2) What systems, if any, will be transferred to another organization?

   (3) What systems need to remain operational, and for what time period?

f. Records

   DOE transfers LSN, Records, and other elements of key scientific knowledge to Legacy Management – July 31, 2010

g. Litigation

   USA RS will identify to DOE all open litigation issues – June 30, 2010

(3) Property

i. Building 1
   (a) DOE decides on what to do with the Technical Information Center (TIC) – March 15, 2010
   (b) DOE and USA RS clear out TIC – May 1, 2010
   (c) DOE and USA RS remove equipment and communication closets and desks from building 1 – June 19, 2010

ii. Building 2
   (a) DOE and USA RS remove equipment and communication closets and desks from building 2 – May 20, 2010

iii. Building 3
   (a) DOE and USA RS remove equipment and communication closets and desks from building 3 – May 20, 2010

iv. Building 5
   (a) DOE provides direction to USA RS to abandon rolling rack

v. Building 6
   (a) USA RS removes Xerox Machine – May 1, 2010

vi. Building 13
   (a) USA RS relocates from building 13 to DOE Hillshire facility so building 13 lease can be terminated – May 28, 2010

vii. Data Center
   (a) DOE and USA RS remove communication equipment - ????

viii. DOE transfers responsibility and accountability of property from USA RS to DOE or other DOE contractor - July 31, 2010

b. Contractor Human Resources

(1) Pension Plan and Other Benefits

i. DOE determines path forward for USA RS pension plan and other worker benefits (displaced workers' medical, workers' compensation claims, and long-term disability and medical benefits); possible path forward is transferring to Hanford contractor – April 2, 2010
ii. USA RS transfers salaried pension plan to URS Hanford contractor (or other contractor); including notification to retirees and vested individuals of the plan's status – April 20, 2010
iii. USA RS transitions other worker benefits to URS Hanford contractor or other contractor – June 30, 2010

1. PURPOSE

The purpose of this document is to serve as the contract termination plan for Contract Number DE-RW0000005 between USA Repository Services LLC (USA RS) and the U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM).

2. BACKGROUND

On February 1, 2010, the President of the United States submitted his proposed Fiscal Year (FY) 2011 budget to Congress. This budget proposal identified a zero dollar budget for OCRWM. In addition, this budget proposal directs DOE to terminate all of its contracts related to OCRWM including the management and operating contract between USA RS and DOE/OCRWM.

3. SCOPE

4. FUNCTIONAL AREAS

a. Contracts, Procurement, and Property

(1) Contracts and Procurement
- i. USA RS provides DOE with a listing of active Lease Agreements, Software License Agreements, Subcontracts, and Purchase Orders – March 18, 2010
- ii. USA RS terminates or transfers Lease Agreements, Software License Agreements, Subcontracts, and Purchase Orders to DOE – June 30, 2010
- iii. USA RS to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts, the cost of which would be reimbursable in whole or in part, under this contract;

(2) USA RS Prime Contract
- i. DOE issues Termination Letter to USA RS – April 16, 2010
- ii. USA RS stops work as specified in the termination letter – April 16, 2010
- iii. USA RS submits resource loaded and priced Termination/Closure plan – April 23, 2010
- iv. DOE transfers responsibility and accountability of property from USA RS to DOE or other DOE contractor – July 31, 2010
- v. DOE determines final fee payment – July 31, 2010
- vi. DOE transfers M&O contract to DOE office responsible for contract closeout – July 31, 2010

**OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
MANAGEMENT AND OPERATING CONTRACT
TERMINATION PLAN**

Exhibit 10