Civilian Nuclear Waste Disposal

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Summary

Management of civilian radioactive waste has posed difficult issues for Congress since the beginning of the nuclear power industry in the 1950s. Federal policy is based on the premise that nuclear waste can be disposed of safely, but proposed storage and disposal facilities have frequently been challenged on safety, health, and environmental grounds. Although civilian radioactive waste encompasses a wide range of materials, most of the current debate focuses on highly radioactive spent fuel from nuclear power plants.

The Nuclear Waste Policy Act of 1982 (NWPA) calls for disposal of spent nuclear fuel in a deep geologic repository. NWPA established the Office of Civilian Radioactive Waste Management (OCRWM) in the Department of Energy (DOE) to develop such a repository and required the program's civilian costs to be covered by a fee on nuclear-generated electricity, paid into the Nuclear Waste Fund. Amendments to NWPA in 1987 restricted DOE's repository site studies to Yucca Mountain in Nevada.

DOE submitted a license application for the proposed Yucca Mountain repository to the Nuclear Regulatory Commission (NRC) on June 3, 2008, and NRC docketed the application September 8, 2008. The NRC license must be based on radiation exposure standards set by the Environmental Protection Agency (EPA), which issued revised standards September 30, 2008. The State of Nevada strongly opposes the Yucca Mountain project, disputing DOE's analysis that the repository would meet EPA's standards. Risks cited by repository opponents include excessive water infiltration, earthquakes, volcanoes, and human intrusion.

The Obama Administration "has determined that developing the Yucca Mountain repository is not a workable option and the Nation needs a different solution for nuclear waste disposal," according to the DOE FY2011 budget justification. As a result, no funding for Yucca Mountain or OCRWM is being requested for FY2011. DOE filed a motion with NRC to withdraw the Yucca Mountain license application on March 3, 2010. DOE's withdrawal motion has drawn legal challenges from states that have defense-related and civilian waste awaiting permanent disposal. An NRC licensing board denied DOE's withdrawal motion on June 29, 2010, a decision that may be reviewed by the NRC commissioners.

Alternatives to Yucca Mountain are to be evaluated by the Blue Ribbon Commission on America's Nuclear Future, which held its first meeting March 25-26, 2010. Congress provided $5 million for the Commission in the FY2010 Energy and Water Development Appropriations Act. The Commission is to study options for temporary storage, treatment, and permanent disposal of highly radioactive nuclear waste, along with an evaluation of nuclear waste research and development programs and the need for legislation. A draft report is to be issued within 18 months and a final report within two years.

DOE's Office of Nuclear Energy (NE) is to take over the remaining functions of OCRWM and "lead all future waste management activities," according to the FY2011 budget justification. Substantial funding has been requested for NE to conduct research on nuclear waste disposal technologies and options and to provide support for the Blue Ribbon Commission.

Congress provided $198.6 million to OCRWM for FY2010 to continue the Yucca Mountain licensing process but terminate all development activities related to the proposed repository. DOE plans to reprogram the FY2010 funding toward shutting down the program.

Contents

Figures

Tables

Contacts

Most Recent Developments

The Obama Administration's nuclear waste policy calls for termination of the Yucca Mountain repository project and the development of alternative approaches to waste management. Under the Nuclear Waste Policy Act (NWPA), the Yucca Mountain site in Nevada has been the only location under consideration by DOE for construction of a national high-level radioactive waste repository. DOE had submitted a license application for the Yucca Mountain repository to the Nuclear Regulatory Commission (NRC) on June 3, 2008.

The Administration's FY2010 budget request, approved by Congress October 15, 2009, called for a halt in design and development of the proposed Yucca Mountain repository while continuing the NRC licensing process "consistent with the provisions of the Nuclear Waste Policy Act." Also as requested, the approved DOE FY2010 budget included funding for a "blue ribbon" commission to recommend an alternative waste strategy.

However, the Administration's FY2011 budget request, submitted to Congress February 1, 2010, reversed the previous year's plan to continue licensing the repository and called for a complete halt in funding. The House Appropriations Committee's Subcommittee on Energy and Water Development approved the Yucca Mountain funding termination on July 15, 2010, after defeating a Republican amendment to restore $100 million for the program.[1]

DOE moved to implement the Administration's policy by filing a motion to withdraw the Yucca Mountain license application on March 3, 2010, "with prejudice," meaning the application could not be resubmitted to NRC in the future.[2] DOE's motion to withdraw the license application, filed with NRC's Atomic Safety and Licensing Board (ASLB), received strong support from the State of Nevada but drew opposition from states with defense-related and civilian radioactive waste that had been expected to go to Yucca Mountain. State utility regulators also filed a motion to intervene on March 15, 2010, contending that "dismissal of the Yucca Mountain application will significantly undermine the government's ability to fulfill its outstanding obligation to take possession and dispose of the nation's spent nuclear fuel and high level nuclear waste."[3]

The ASLB denied DOE's license withdrawal motion June 29, 2010, ruling that the NWPA prohibits DOE from withdrawing the license application until NRC determines whether the repository is acceptable.[4] The next day, the NRC commissioners invited briefs on whether it should review the ASLB decision, and DOE filed a brief on July 9 urging that the ruling be reversed. Petitions to block the Yucca Mountain license withdrawal on statutory grounds are also being considered by the U.S. Court of Appeals for the District of Columbia Circuit.

The Administration's Blue Ribbon Commission on America's Nuclear Future held its first meeting March 25-26, 2010. The Commission's charter, filed with Congress March 1, 2010, calls for a "comprehensive review of policies for managing the back end of the nuclear fuel cycle,

[1] Otto Kreisher, "Panel Passes Bill After Swatting Down GOP Amendments," *Congress Daily*, July 16, 2010, p. 9.

[2] *U.S. Department of Energy's Motion to Withdraw*, NRC Atomic Safety and Licensing Board, Docket No. 63-0001, March 3, 2010, http://www.energy.gov/news/documents/DOE_Motion_to_Withdraw.pdf.

[3] National Association of Regulatory Utility Commissioners, "NARUC Seeks Party Status at NRC, Says Yucca Review Must Continue," press release, March 16, 2010, http://www.naruc.org/News/default.cfm?pr=191&pdf=.

[4] U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, Docket No. 63-001-HLW, Memorandum and Order, June 29, 2010.

including all alternatives for the storage, processing, and disposal of civilian and defense used nuclear fuel, high-level waste, and materials derived from nuclear activities."[5] The Commission is to submit its final report within two years.

Introduction

Nuclear waste has sometimes been called the Achilles' heel of the nuclear power industry; much of the controversy over nuclear power centers on the lack of a disposal system for the highly radioactive spent fuel that must be regularly removed from operating reactors. Low-level radioactive waste generated by nuclear power plants, industry, hospitals, and other activities is also a longstanding issue.

Spent Nuclear Fuel Program

The Nuclear Waste Policy Act of 1982 (NWPA), as amended in 1987, required the Department of Energy (DOE) to focus on Yucca Mountain, Nevada, to house a deep underground repository for spent nuclear fuel and other highly radioactive waste. The State of Nevada has strongly opposed DOE's efforts on the grounds that the site is unsafe, pointing to potential volcanic activity, earthquakes, water infiltration, underground flooding, nuclear chain reactions, and fossil fuel and mineral deposits that might encourage future human intrusion.

Under the George W. Bush Administration, DOE determined that Yucca Mountain was suitable for a repository and that licensing of the site by the Nuclear Regulatory Commission (NRC) should proceed. DOE submitted a license application for the repository to NRC on June 3, 2008, and projected that the repository could begin receiving waste in 2020, about 22 years later than the 1998 goal specified by NWPA.[6]

However, the Obama Administration decided that the Yucca Mountain repository should not be opened, although it requested FY2010 funding to continue the NRC licensing process. But the Administration's FY2011 budget request reversed the previous year's plan to continue licensing the repository and called for a complete halt in funding. In line with that policy, DOE filed a motion to withdraw the Yucca Mountain license application on March 3, 2010, "with prejudice," meaning the application could not be resubmitted to NRC in the future. To develop alternative waste disposal strategies, the Administration established the Blue Ribbon Commission on America's Nuclear Future, which held its first meeting on March 25-26, 2010. (For a discussion of policy options, see CRS Report R40202, *Nuclear Waste Disposal: Alternatives to Yucca Mountain*, by Mark Holt.)

The safety of geologic disposal of spent nuclear fuel and high-level waste (HLW), as planned in the United States, depends largely on the characteristics of the rock formations from which a repository would be excavated. Because many geologic formations are believed to have remained undisturbed for millions of years, it appeared technically feasible to isolate radioactive materials

[5] Department of Energy, *Blue Ribbon Commission on America's Nuclear Future*, Advisory Committee Charter, Washington, DC, March 1, 2010, http://www.energy.gov/news/documents/BRC_Charter.pdf.

[6] Nuclear Energy Institute, Key Issues, Yucca Mountain, http://www.nei.org/keyissues/nuclearwastedisposal/yuccamountain/, viewed April 11, 2008.

from the environment until they decayed to safe levels. "There is strong worldwide consensus that the best, safest long-term option for dealing with HLW is geologic isolation," according to the National Research Council.[7]

But, as the Yucca Mountain controversy indicates, scientific confidence about the concept of deep geologic disposal has turned out to be difficult to apply to specific sites. Every high-level waste site that has been proposed by DOE and its predecessor agencies has faced allegations or discovery of unacceptable flaws, such as water intrusion or earthquake vulnerability, that could release radioactivity into the environment. Much of the problem results from the inherent uncertainty involved in predicting waste site performance for the one million years that nuclear waste is to be isolated.

President Obama's FY2011 budget calls for long-term research on a wide variety of technologies that could reduce the volume and toxicity of nuclear waste. The Bush Administration had proposed to demonstrate large-scale facilities to reprocess and recycle spent nuclear fuel by separating long-lived elements, such as plutonium, that could be made into new fuel and "transmuted" into shorter-lived radioactive isotopes. Spent fuel reprocessing, however, has long been controversial because of the potential weapons use of separated plutonium and cost concerns. The Obama Administration has refocused DOE's nuclear waste research toward fundamental science and away from the near-term design and development of reprocessing facilities.

President Bush had recommended the Yucca Mountain site to Congress on February 15, 2002, and Nevada Governor Guinn submitted a notice of disapproval, or "state veto," April 8, 2002, as allowed by NWPA. The state veto would have blocked further repository development at Yucca Mountain if a resolution approving the site had not been passed by Congress and signed into law within 90 days of continuous session. An approval resolution was signed by President Bush July 23, 2002 (P.L. 107-200).[8]

Other Programs

Other types of civilian radioactive waste have also generated public controversy, particularly low-level waste, which is produced by nuclear power plants, medical institutions, industrial operations, and research activities. Civilian low-level waste currently is disposed of in large trenches at sites in the states of South Carolina and Washington. However, the Washington facility does not accept waste from outside its region, and the South Carolina site is available only to the three members of the Atlantic disposal compact (Connecticut, New Jersey, and South Carolina) as of June 30, 2008. The lowest-concentration class of low-level radioactive waste (class A) is accepted from any waste generator by a Utah commercial disposal facility.

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[7] National Research Council, Board on Radioactive Waste Management, *Rethinking High-Level Radioactive Waste Disposal: A Position Statement of the Board on Radioactive Waste Management* (1990), p. 2.

[8] Senator Bingaman introduced the approval resolution in the Senate April 9, 2002 (S.J.Res. 34), and Representative Barton introduced it in the House April 11, 2002 (H.J.Res. 87). The Subcommittee on Energy and Air Quality of the House Committee on Energy and Commerce approved H.J.Res. 87 on April 23 by a 24-2 vote, and the full Committee approved the measure two days later, 41-6 (H.Rept. 107-425). The resolution was passed by the House May 8, 2002, by a vote of 306-117. The Senate Committee on Energy and Natural Resources approved S.J.Res. 34 by a 13-10 vote June 5, 2002 (S.Rept. 107-159). Following a 60-39 vote to consider S.J.Res. 34, the Senate passed H.J.Res. 87 by voice vote July 9, 2002.

Threats by states to close their disposal facilities led to congressional authorization of regional compacts for low-level waste disposal in 1985. No new sites have been opened by any of the 10 approved disposal compacts, although a site in Texas received conditional approval in January 2009 and might open in 2010.

Nuclear Waste Litigation

NWPA section 302 authorized DOE to enter into contracts with U.S. generators of spent nuclear fuel and other highly radioactive waste; under the contracts, DOE was to dispose of the waste in return for a fee on nuclear power generation. The act prohibited nuclear reactors from being licensed to operate without a nuclear waste disposal contract with DOE, and all reactor operators subsequently signed them.[9] As required by NWPA, the contracts specified that DOE would begin disposing of nuclear waste no later than January 31, 1998.

After DOE missed the contractual deadline, nuclear utilities began filing lawsuits to recover their additional storage costs—costs they would not have incurred had DOE begun accepting waste in 1998 as scheduled. DOE reached its first settlement with a nuclear utility, PECO Energy Company (now part of Exelon), on July 19, 2000. The agreement allowed PECO to keep up to $80 million in nuclear waste fee revenues during the subsequent 10 years. However, other utilities sued DOE to block the settlement, contending that nuclear waste fees may be used only for the DOE waste program and not as compensation for missing the disposal deadline. The U.S. Court of Appeals for the 11th Circuit agreed, ruling September 24, 2002, that any compensation would have to come from general revenues or other sources than the waste fund.

The Department of Justice has since negotiated 10 settlements of the 72 lawsuits filed against DOE through February 2010 for missing the waste disposal deadline.[10] Under the settlements, utilities submit annual reimbursement claims to DOE for any delay-related nuclear waste storage costs they incurred during that year. Any disagreements over reimbursable claims between DOE and a utility would go to arbitration. Through the end of calendar year 2008, $406 million had been paid under the settlements. The payments are made from the U.S. Treasury's Judgment Fund, a permanent account that is used to cover damage claims against the U.S. government.[11]

Other nuclear utilities have not reached settlements, but have continued pursuing their damage claims through the U.S. Court of Federal Claims. Unlike the settlements, which cover all past and future damages resulting from DOE's nuclear waste delays, awards by the Court of Claims can cover only damages that have already been incurred; therefore, utilities must continue filing claims as they accrue additional delay-related costs. About 20 cases involving initial damage claims have been tried in the Court of Claims so far, of which four have reached final judgment, and about 52 more are pending. In addition, about half a dozen second-round suits have been filed by utilities that had already filed initial claims. According to the Congressional Budget Office

[9] The Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste can be found at 10 CFR 961.11.

[10] Statement of Kim Cawley, Chief, Natural and Physical Resources Costs Estimates Unit, Congressional Budget Office, before the House Committee on the Budget, July 16, 2009, p. 6-7.

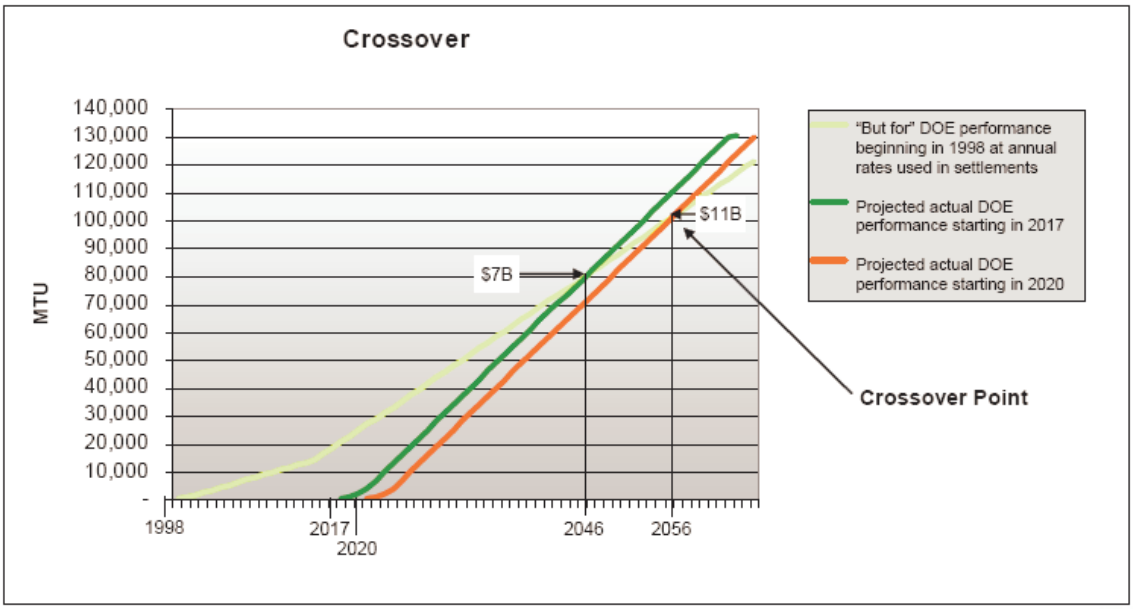
[11] Telephone conversation with David K. Zabransky, Nuclear Utility Specialist, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, March 25, 2009.

(CBO), the federal government's current liability for settlements, final judgments, and entered judgments under appeal stands at $1.3 billion.[12]

Future Liability Estimates

DOE estimates that its potential liabilities for waste program delays will total $11 billion through 2056 (in current dollars) if the Department is able to begin taking spent nuclear fuel from plant sites by 2020, which had been the most recent goal under the previous Administration. DOE's methodology for this estimate is shown in **Figure 1**. The yellow line shows DOE's estimate of how much spent fuel would have been removed from nuclear plant sites had shipments begun on the NWPA deadline of January 1998. The rate of waste acceptance under that scenario is 900 metric tons per year from 1998 through 2015 and 2,100 tons/year thereafter. That assumed acceptance rate was negotiated by DOE as part of the settlements discussed above. The annual costs reimbursed by DOE under the settlements cover utilities' expenses for storing waste that would have already been taken away under the assumed acceptance rate (the yellow line).

Figure 1. DOE Estimate of Future Liabilities for Nuclear Waste Delays



Source: Christopher A. Kouts, Principal Deputy Director, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, "Yucca Mountain Program Status Update," July 22, 2008, p. 18.

The green and red lines in **Figure 1** show DOE's planned waste acceptance rate if waste shipments begin by 2017 or 2020. Under those scenarios, DOE would take away 400 metric tons the first year, 600 the second year, 1,200 the third year, 2,000 the fourth year, and 3,000 per year thereafter. This is the rate assumed by DOE's Total System Life Cycle Cost Report.[13] At that

[12] Statement of Kim Cawley, *op. cit*.

[13] U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, Fiscal Year 2007*, DOE/RW-0591, Washington, (continued...)

higher acceptance rate, DOE would be able to eventually catch up with the amount of waste that it was assumed to take under the settlements (the yellow line). If waste acceptance began by 2017 (the green line), the backlog would be eliminated by 2046, and if acceptance began by 2020 (the red line) the backlog would be gone by 2056. Under the settlements, therefore, there would be no further annual damage payments after those years, if DOE were able to achieve the 2017 or 2020 acceptance scenario.

DOE bases its estimate of the total damage payments that would be paid through 2046 or 2056 on the amounts paid to date under the settlement claims. If damage awards by the Court of Claims (currently involving about two-thirds of U.S. reactors) exceed those assumed levels, then future payments would be higher than the DOE estimate in **Figure 1**.

Further delays in the start of waste acceptance would delay the point at which DOE would catch up to the cumulative waste shipments assumed under the settlement scenario (yellow line) and would no longer have to make annual damage payments. DOE estimates that each year's delay in the startup date would increase the total eventual damage payments by as much as $500 million.

DOE filed a license application with the Nuclear Regulatory Commission (NRC) for the proposed Yucca Mountain repository in June 2008, and has estimated that annual program spending would have to increase to nearly $2 billion (from around $300 million in FY2009) to allow waste shipments to begin by 2020 if the license were approved.[14] However, President Obama's FY2011 budget request would eliminate Yucca Mountain funding, as noted above.

FY2010 funds for the nuclear waste program, already sharply reduced from the previous year, are being used to close down the Yucca Mountain project, so it appears unlikely that spent nuclear fuel shipments to Yucca Mountain could begin by 2020, even if full funding for the project were to be restored in the future. Waste acceptance by 2020 might be possible if Congress were to authorize one or more temporary storage sites within the next few years, although previous efforts to develop such facilities have been blocked by state and local opposition.

Delays in the federal waste disposal program could also lead to future environmental enforcement action over DOE's own high-level waste and spent fuel, mostly resulting from defense and research activities. Some of the DOE-owned waste is currently being stored in non-compliance with state and federal environmental laws, making DOE potentially subject to fines and penalties if the waste is not removed according to previously negotiated compliance schedules.

The National Association of Regulatory Utility Commissioners (NARUC), representing state utility regulators, and the Nuclear Energy Institute, representing the nuclear industry, filed petitions with the U.S. Court of Appeals on April 2 and April 5, 2010, to halt the federal government's collection of fees on nuclear power under the NWPA contracts. The suits argue that the fees, totaling about $800 million per year, should not be collected while the federal government's nuclear waste disposal program has been halted.[15] DOE responded that the federal

(...continued)

DC, July 2008, p. 20, http://ocrwm.doe.gov/about/budget/pdf/TSLCC_2007_8_05_08.pdf.

[14] *Ibid.*, p. B-2.

[15] NARUC, "State Regulators Go to Court with DOE over Nuclear Waste Fees, news release, April 2, 2010, http://www.naruc.org/News/default.cfm?pr=193; *Nuclear Energy Institute et al. v. U.S. DOE*, Joint Petition for Review, U.S. Court of Appeals for the District of Columbia Circuit, April 5, 2010.

government still intends to dispose of the nation's nuclear waste and that the fees must continue to be collected to cover future disposal costs.[16]

License Withdrawal

DOE's motion to withdraw the Yucca Mountain license application "with prejudice," meaning that it could not be resubmitted in the future, was filed with NRC's Atomic Safety and Licensing Board (ASLB) on March 3, 2010. DOE's motion argued that the licensing process should be terminated because "the Secretary of Energy has decided that a geologic repository at Yucca Mountain is not a workable option" for long-term nuclear waste disposal. DOE contended that the license application should be withdrawn "with prejudice" because of the need to "provide finality in ending the Yucca Mountain project."[17]

The State of Nevada strongly endorsed DOE's motion to withdraw the license application with prejudice[18] and has moved to intervene in a court challenge to the license withdrawal.[19] Nevada has long contended that the geology of the site is unsuitable for long-term nuclear waste disposal.

However, DOE's withdrawal motion has drawn opposition from states and localities with defense-related and civilian nuclear waste that had been expected to go to Yucca Mountain. The State of South Carolina, which has large amounts of high-level radioactive waste at DOE's Savannah River Site, and the State of Washington, which hosts extensive nuclear waste storage facilities at DOE's Hanford Site, filed motions to intervene in the Yucca Mountain licensing proceeding to oppose the license application withdrawal.

NARUC also filed a motion to intervene in the Yucca Mountain licensing proceedings, contending that "dismissal of the Yucca Mountain application will significantly undermine the government's ability to fulfill its outstanding obligation to take possession and dispose of the nation's spent nuclear fuel and high level nuclear waste." NARUC's motion also contends that $17 billion collected from utility ratepayers for the nuclear waste program will be wasted if the Yucca Mountain license application is withdrawn.[20] Also seeking to intervene were Aiken County, SC, and the Prairie Island Indian Community in Minnesota.

South Carolina and Aiken County filed challenges to the Yucca Mountain license withdrawal in the U.S. Court of Appeals for the District of Columbia Circuit, contending that NWPA requires the licensing process to proceed. The court has scheduled hearings on the case for September 23, 2010. The ASLB issued an order April 6, 2010, withholding its decision on the license withdrawal motion until a ruling is issued by the Court of Appeals. In the meantime, the licensing board

[16] Jeff Beattie, "NARUC, Utilities Sue DOE Over Nuke Waste Fee," *Energy Daily,* April 6, 2010, p. 1.

[17] DOE Motion to Withdraw, *op. cit.*

[18] Nicole E. Matthews, "DOE Withdraws Application for Yucca Nuke Dump," *Fox5Vegas.com*, March 3, 2010, http://www.fox5vegas.com/news/22734591/detail.html.

[19] *Motion for the State of Nevada for Leave to Intervene as Intervenor-Respondent*, U.S. Court of Appeals for the Fourth Circuit, Case No. 10-1229, March 19, 2010, http://www.state.nv.us/nucwaste/licensing/nv100319motion3.pdf.

[20] National Association of Regulatory Utility Commissioners, "NARUC Seeks Party Status at NRC, Says Yucca Review Must Continue," press release, March 16, 2010, http://www.naruc.org/News/default.cfm?pr=191&pdf=.

noted that the NRC staff plans to continue its technical review of the Yucca Mountain license application as previously planned.[21]

However, the NRC commissioners overruled the ASLB on April 23, 2010, and ordered the licensing board to consider DOE's withdrawal motion. The ASLB resumed its consideration and denied DOE's license withdrawal motion June 29, 2010, ruling that NWPA prohibits DOE from withdrawing the license application until NRC determines whether the repository is acceptable. According to the Board, "Surely Congress did not contemplate that, by withdrawing the Application, DOE might unilaterally terminate the Yucca Mountain review process in favor of DOE's independent policy determination that 'alternatives will better serve the public interest.'"[22]

The next day, the NRC commissioners invited briefs on whether it should review the ASLB decision, and DOE filed a brief on July 9, 2010, urging that the ruling be reversed. DOE argued in its brief that the Secretary of Energy has broad authority under the Atomic Energy Act and Department of Energy Organization Act "to make policy decisions regarding disposal of nuclear waste and spent nuclear fuel." DOE contended that such authority includes "the authority to discontinue the Yucca Mountain project" and that NRC rules provide "that applicants in NRC licensing proceedings may withdraw their applications."[23]

Controversy has arisen over NRC's consideration of the Yucca Mountain withdrawal motion because of statements made by three of the five NRC commissioners at their confirmation hearing on February 11, 2010, before the Senate Committee on Environment and Public Works. Commissioners George Apostolakis, William Magwood, and William Ostendorff were asked at the hearing by Senator Boxer, "If confirmed, would you second-guess the Department of Energy's decision to withdraw the license application for Yucca Mountain from NRC's review?" All three answered "no," which led to a request by South Carolina officials that the three recuse themselves from considering the withdrawal motion.[24] Because such recusal would deny NRC a quorum on the matter, the ASLB decision would then stand, pending a decision in federal court.

(For more details about nuclear waste legal proceedings, see CRS Report R40996, *The Yucca Mountain Litigation: Liability Under the Nuclear Waste Policy Act (NWPA) of 1982*, by Todd Garvey.)

Congressional Action

President Obama's proposal to terminate the Yucca Mountain project and search for disposal alternatives has prompted substantial congressional debate and a number of legislative proposals.

[21] NRC Atomic Safety and Licensing Board, Memorandum and Order, ASLBP No. 09-892-HLW-CAB04, April 6, 2010.

[22] U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, Docket No. 63-001-HLW, Memorandum and Order, June 29, 2010.

[23] *U.S. Department of Energy's Brief in Support of Review and Reversal of the Board's Ruling on the Motion to Withdraw*, Docket No. 63-001-HLW, July 9, 2010.

[24] *Aiken County Response in Opposition to Commission Review of ASLB Order*, Docket No. 63-001-HLW, ASLBP No. 09-892-HLW-CAB04, July 8, 2010.

Much of the debate in the second session of the 111th Congress has taken place in appropriations hearings on the FY2011 budget request. In a March 4 hearing by the Senate Appropriations Committee's Subcommittee on Energy and Water Development, Senator Murray sharply criticized DOE's proposal to eliminate funding for licensing the Yucca Mountain repository without an alternative disposal process in place.[25] Members of the House Energy and Water Development Subcommittee have expressed opposition to DOE's request to reprogram FY2010 funding that had been appropriated for Yucca Mountain licensing toward termination of the licensing effort. Energy Secretary Steven Chu sent the House subcommittee a letter on March 26, 2010, stating that the reprogramming would not require approval by the House and Senate Appropriations Committees.[26] Ninety-one members of Congress signed a letter to the Energy Secretary on July 6, 2010, requesting that DOE "halt all efforts to reprogram funds or terminate contracts related to Yucca Mountain."[27]

Senator Graham introduced a bill (S. 861) that would require the President to certify that the Yucca Mountain site continues to be the designated location for a nuclear waste repository under the Nuclear Waste Policy Act. If such a certification is not made within 30 days after enactment or is subsequently revoked, the Treasury is to refund all payments, plus interest, made by nuclear reactor owners to the Nuclear Waste Fund. The bill would require DOE to begin shipping defense-related high-level radioactive waste to Yucca Mountain by 2017 or pay $1 million per day to each state in which such waste is located.

Proposals have also been made to insulate the nuclear waste program from direct political control and provide a steady source of funding outside the appropriations process. Senator Voinovich introduced a bill May 6, 2010, to establish a U.S. Nuclear Fuel Management Corporation to take over DOE responsibility for managing spent nuclear fuel and high-level waste and to develop reprocessing facilities. Nuclear waste fees and other revenues would be available to the new corporation without further appropriation.

Delays in nuclear waste disposal could affect the approximately 30 new U.S. reactors currently being proposed, because new reactors cannot be licensed without an NRC determination that sufficient waste disposal capacity will be available. Several bills have been introduced (see Legislation section) to prohibit NRC from denying a reactor license because of a lack of disposal capacity.

Characteristics of Nuclear Waste

Radioactive waste is a term that encompasses a broad range of material with widely varying characteristics. Some waste has relatively slight radioactivity and is safe to handle in unshielded containers, while other types are intensely hot in both temperature and radioactivity. Some decays

[25] George Lobsenz, "Murray Slams Yucca Mountain Withdrawal as 'Irresponsible'," *Energy Daily*, March 5, 2010, p. 1.

[26] Letter from Energy Secretary Steven Chu to Peter J. Visclosky, Chairman, Subcommittee on Energy and Water Development, Committee on Appropriations, U.S. House of Representatives, March 26, 2010, http://www.sustainablefuelcycle.com/resources/20100326DOESecChuLetterToRepViscloskyOnHearngtestimony.pdf.

[27] Letter from 91 Members of Congress to Energy Secretary Steven Chu, July 6, 2010, http://murray.senate.gov/public/index.cfm?a=Files.Serve&File_id=f849572d-f3eb-44f2-931d-3a0129eb32d5.

to safe levels of radioactivity in a matter of days or weeks, while other types will remain dangerous for thousands of years. Major types of radioactive waste are described below:[28]

Spent nuclear fuel. Fuel rods that have been permanently withdrawn from a nuclear reactor because they can no longer efficiently sustain a nuclear chain reaction (although they contain uranium and plutonium that could be extracted through reprocessing to make new fuel). By far the most radioactive type of civilian nuclear waste, spent fuel contains extremely hot but relatively short-lived fission products (fragments of the nuclei of uranium and other fissile elements) as well as long-lived radionuclides (radioactive atoms) such as plutonium, which remains dangerously radioactive for tens of thousands of years or more.

High-level waste. Highly radioactive residue created by spent fuel reprocessing (almost entirely for defense purposes in the United States). High-level waste contains most of the radioactive fission products of spent fuel, but most of the uranium and plutonium usually has been removed for re-use. Enough long-lived radioactive elements typically remain, however, to require isolation for 10,000 years or more.

Transuranic (TRU) waste. Relatively low-activity waste that contains more than a certain level of long-lived elements heavier than uranium (primarily plutonium). Shielding may be required for handling of some types of TRU waste. In the United States, transuranic waste is generated almost entirely by nuclear weapons production processes. Because of the plutonium, long-term isolation is required. TRU waste is being sent to a deep underground repository, the Waste Isolation Pilot Plant (WIPP), near Carlsbad, New Mexico.

Low-level waste. Radioactive waste not classified as spent fuel, high-level waste, TRU waste, or byproduct material such as uranium mill tailings (below). Four classes of low-level waste have been established by NRC, ranging from least radioactive and shortest-lived to the longest-lived and most radioactive. Although some types of low-level waste can be more radioactive than some types of high-level waste, in general low-level waste contains relatively low amounts of radioactivity that decays relatively quickly. Low-level waste disposal facilities cannot accept material that exceeds NRC concentration limits.

Uranium mill tailings. Sand-like residues remaining from the processing of uranium ore. Such tailings have very low radioactivity but extremely large volumes that can pose a hazard, particularly from radon emissions or groundwater contamination.

Mixed waste. Chemically hazardous waste that includes radioactive material. High-level, low-level, and TRU waste, and radioactive byproduct material, often falls under the designation of mixed waste. Such waste poses complicated institutional problems, because the radioactive portion is regulated by DOE or NRC under the Atomic Energy Act, while the Environmental Protection Agency (EPA) and states regulate the non-radioactive elements under the Resource Conservation and Recovery Act (RCRA).

[28] Statutory definitions for "spent nuclear fuel," "high-level radioactive waste," and "low-level radioactive waste" can be found in Section 2 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101). "Transuranic waste" is defined in Section 11ee. of the Atomic Energy Act (42 U.S.C. 2014); Section 11e.(2) of the Act includes uranium mill tailings in the definition of "byproduct material." "Mixed waste" consists of chemically hazardous waste as defined by EPA regulations (40 CFR Part 261, Subparts C and D) that contains radioactive materials as defined by the Atomic Energy Act.

Spent Nuclear Fuel

When spent nuclear fuel is removed from a reactor, usually after several years of power production, it is thermally hot and highly radioactive. The spent fuel is in the form of fuel assemblies, which consist of arrays of metal-clad fuel rods 12-15 feet long.

A fresh fuel rod, which emits relatively little radioactivity, contains uranium that has been enriched in the isotope U-235 (usually 3%-5%). But after nuclear fission has taken place in the reactor, most of the U-235 nuclei in the fuel rods have been split into a variety of highly radioactive fission products. Some of the nuclei of the dominant isotope U-238 have absorbed neutrons to become radioactive plutonium, some of which has also split into fission products. Radioactive gases are also contained in the spent fuel rods. Newly withdrawn spent fuel assemblies are stored in deep pools of water adjacent to the reactors to keep them from overheating and to protect workers from radiation. To prevent the pools from filling up, older, cooler spent fuel often is sealed in dry canisters and transferred to radiation-shielded storage facilities elsewhere at reactor sites.

Spent fuel discharged from U.S. commercial nuclear reactors is currently stored at 72 power plant sites around the nation, plus two small central storage facilities. A typical large commercial nuclear reactor discharges an average of 20-30 metric tons of spent fuel per year—an average of about 2,150 metric tons annually for the entire U.S. nuclear power industry. The nuclear industry estimated that the total amount of commercial spent fuel was 62,683 metric tons at the end of 2009, including 13,865 metric tons in dry storage and other separate storage facilities.[29] Counting 7,000 metric tons of DOE spent fuel and high-level waste that had also been planned for disposal at Yucca Mountain, the total amount of existing waste would nearly reach NWPA's 70,000-metric-ton limit for the repository.

As long as nuclear power continues to be generated, the amounts stored at plant sites will continue to grow until an interim storage facility or a permanent repository can be opened—or until alternative treatment and disposal technology is developed. DOE recently updated its estimate of the total amount of U.S. commercial spent fuel that may eventually require disposal from 105,000 metric tons[30] to 130,000 metric tons.[31]

New storage capacity at operating nuclear plant sites or other locations will be required if DOE is unable to begin accepting waste into its disposal system for an indefinite period. Most utilities are expected to construct new dry storage capacity at reactor sites. Forty-nine licensed dry storage facilities are currently operating in the United States.[32] NRC has determined that spent fuel could be stored safely at reactor sites for up to 100 years.[33]

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[29] ACI Nuclear Energy Solutions, *2009 Used Fuel Data*, ACI-NES Letter No. L1010001, January 22, 2010.

[30] DOE Office of Civilian Radioactive Waste Management, *OCRWM Annual Report to Congress, Fiscal Year 2002*, DOE/RW-0560, October 2003, Appendix C.

[31] DOE Office of Civilian Radioactive Waste Management, *Draft Supplemental 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*, Summary, DOE/EIS-0250F-S1D, October 2007, p. S-47.

[32] ACI Nuclear Energy Solutions, *op. cit*.

[33] Nuclear Regulatory Commission, *Waste Confidence Decision Review*, 55 *Federal Register* 38474, September 18, 1990.

The terrorist attacks of September 11, 2001, heightened concerns about the vulnerability of stored spent fuel. Concerns have been raised that an aircraft crash into a reactor's pool area or acts of sabotage could drain the pool and cause the spent fuel inside to overheat. A report released by NRC January 17, 2001, found that overheating could cause the zirconium alloy cladding of spent fuel to catch fire and release hazardous amounts of radioactivity, although it characterized the probability of such a fire as low.

In a report released April 6, 2005, the National Academy of Sciences (NAS) found that "successful terrorist attacks on spent fuel pools, though difficult, are possible." To reduce the likelihood of spent fuel cladding fires, the NAS study recommended that hotter and cooler spent fuel assemblies be interspersed throughout spent fuel pools, that spray systems be installed above the pools, and that more fuel be transferred from pools to dry cask storage.[34] NRC has agreed to consider some of the recommendations, although it contends that current security measures would prevent successful attacks. The nuclear industry contends that the several hours required for uncovered spent fuel to heat up enough to catch fire would allow ample time for alternative measures to cool the fuel.

Commercial Low-Level Waste

Nearly 2.1 million cubic feet of low-level waste with about 800,000 curies of radioactivity was shipped to commercial disposal sites in 2008, according to DOE.[35] Volumes and radioactivity can vary widely from year to year, based on the status of nuclear decommissioning projects and cleanup activities that can generate especially large quantities.

Low-level radioactive waste is divided into three major categories for handling and disposal: Class A, B, and C. Classes B and C have constituted less than 1% of the volume of U.S. low-level waste disposal during the past five years but contain most of its radioactivity. For more background on radioactive waste characteristics, see CRS Report RL32163, *Radioactive Waste Streams: Waste Classification for Disposal*, by Anthony Andrews.

Current Policy and Regulation

Spent fuel and high-level waste are a federal responsibility, while states are authorized to develop disposal facilities for commercial low-level waste. In general, disposal requirements have grown more stringent over the years, in line with overall national environmental policy and heightened concerns about the hazards of radioactivity.

[34] National Academy of Sciences, *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report*, released April 6, 2005, p. 2.

[35] U.S. Department of Energy, Management Information Manifest System, http://mims.apps.em.doe.gov/mims.asp#.

Spent Nuclear Fuel

Current Program

The Nuclear Waste Policy Act of 1982 (NWPA, P.L. 97-425) established a system for selecting a geologic repository for the permanent disposal of up to 70,000 metric tons (77,000 tons) of spent nuclear fuel and high-level waste. DOE's Office of Civilian Radioactive Waste Management (OCRWM) was created to carry out the program. The Nuclear Waste Fund, holding receipts from a fee on commercial nuclear power and federal contributions for emplacement of high-level defense waste, was established to pay for the program. DOE was required to select three candidate sites for the first national high-level waste repository.

After much controversy over DOE's implementation of NWPA, the act was substantially modified by the Nuclear Waste Policy Amendments Act of 1987 (Title IV, Subtitle A of P.L. 100-203, the Omnibus Budget Reconciliation Act of 1987). Under the amendments, the only candidate site DOE may consider for a permanent high-level waste repository is at Yucca Mountain, Nevada. If that site cannot be licensed, DOE must return to Congress for further instructions.

The 1987 amendments also authorized construction of a monitored retrievable storage (MRS) facility to store spent fuel and prepare it for delivery to the repository. But because of fears that the MRS would reduce the need to open the permanent repository and become a de facto repository itself, the law forbids DOE from selecting an MRS site until recommending to the President that a permanent repository be constructed. The repository recommendation occurred in February 2002, but DOE has not announced any plans for an MRS.

Along with halting all funding for the Yucca Mountain project, President Obama's FY2011 budget request calls for OCRWM to be eliminated and its remaining functions to be transferred to DOE's Office of Nuclear Energy. The Blue Ribbon Commission on America's Nuclear Future, which held its first meeting March 25-26, 2010, is to issue recommendations on a new nuclear waste strategy within two years.

Private Interim Storage

In response to delays in the federal nuclear waste program, a utility consortium signed an agreement with the Skull Valley Band of the Goshute Indians in Utah on December 27, 1996, to develop a private spent fuel storage facility on tribal land. The Private Fuel Storage (PFS) consortium submitted a license application to NRC on June 25, 1997, and an NRC licensing board recommended approval on February 24, 2005. On September 9, 2005, NRC denied the State of Utah's final appeals and authorized the NRC staff to issue the license. The 20-year license for storing up to 44,000 tons of spent fuel in dry casks was issued on February 21, 2006, although NRC noted that Interior Department approval would also be required.

On September 7, 2006, the Department of the Interior issued two decisions against the PFS project. The Bureau of Indian Affairs disapproved a proposed lease of tribal trust lands to PFS, concluding there was too much risk that the waste could remain at the site indefinitely.[36] The

[36] Bureau of Indian Affairs, *Record of Decision for the Construction and Operation of an Independent Spent Fuel Storage Installation (ISFSI) on the Reservation of the Skull Valley Band of Goshute Indians (Band) in Tooele County, Utah,* September 7, 2006.

Bureau of Land Management rejected the necessary rights-of-way to transport waste to the facility, concluding that a proposed rail line would be incompatible with the Cedar Mountain Wilderness Area and that existing roads would be inadequate.[37]

In reaction to the Interior Department decisions, Senator Hatch, a staunch opponent of the PFS proposal, declared the project "stone cold dead."[38] However, the Skull Valley Band of Goshutes and PFS filed a federal lawsuit July 17, 2007, to overturn the Interior decisions on the grounds that they were politically motivated.[39]

Regulatory Requirements

NWPA requires that high-level waste facilities be licensed by the NRC in accordance with general standards issued by EPA. Under the Energy Policy Act of 1992 (P.L. 102-486), EPA was required to write new standards specifically for Yucca Mountain. NWPA also requires the repository to meet general siting guidelines prepared by DOE and approved by NRC. Transportation of waste to storage and disposal sites is regulated by NRC and the Department of Transportation (DOT). Under NWPA, DOE shipments to Yucca Mountain must use NRC-certified casks and comply with NRC requirements for notifying state and local governments. Yucca Mountain shipments must also follow DOT regulations on routing, placarding, and safety.

NRC's licensing requirements for Yucca Mountain, at 10 C.F.R. 63, require compliance with EPA's standards (described below) and establish procedures that DOE must follow in seeking a repository license. For example, DOE must conduct a repository performance confirmation program that would indicate whether natural and man-made systems were functioning as intended and assure that other assumptions about repository conditions were accurate.

The Energy Policy Act of 1992 (P.L. 102-486) made a number of changes in the nuclear waste regulatory system, particularly that EPA must issue new environmental standards specifically for the Yucca Mountain repository site. General EPA repository standards previously issued and subsequently revised no longer apply to Yucca Mountain. DOE and NRC had raised concern that some of EPA's general standards might be impossible or impractical to meet at Yucca Mountain.[40]

The new standards, which limit the radiation dose that the repository could impose on individual members of the public, were required to be consistent with the findings of a study by the National Academy of Sciences (NAS), which was issued August 1, 1995.[41] The NAS study recommended that the Yucca Mountain environmental standards establish a limit on risk to individuals near the repository, rather than setting specific limits for the releases of radioactive material or on radioactive doses, as under previous EPA standards. The NAS study also examined the potential for human intrusion into the repository and found no scientific basis for predicting human behavior thousands of years into the future.

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[37] Bureau of Land Management, *Record of Decision Addressing Right-of-Way Applications U 76985 and U 76986 to Transport Spent Nuclear Fuel to the Reservation of the Skull Valley Band of Goshute Indians*, September 7, 2006.

[38] Senator Orrin Hatch, *Utahns Deliver Killing Blow to Skull Valley Nuke Waste Plan*, News Release, September 7, 2006.

[39] Winslow, Ben, "Gosutes, PFS Sue Interior," *Deseret Morning News*, July 18, 2007.

[40] See, for example: NRC, "Analysis of Energy Policy Act of 1992 Issues Related to High-Level Waste Disposal Standards, SECY-93-013, January 25, 1993, attachment p. 4.

[41] National Research Council. *Technical Bases for Yucca Mountain Standards*. National Academy Press. 1995.

Pursuant to the Energy Policy Act, EPA published its proposed Yucca Mountain radiation protection standards on August 27, 1999. The proposal would have limited annual radiation doses to 15 millirems for the "reasonably maximally exposed individual," and to 4 millirems from groundwater exposure, for the first 10,000 years of repository operation. EPA calculated that its standard would result in an annual risk of fatal cancer for the maximally exposed individual of seven chances in a million. The nuclear industry criticized the EPA proposal as being unnecessarily stringent, particularly the groundwater standard. On the other hand, environmental groups contended that the 10,000-year standard proposed by EPA was too short, because DOE had projected that radioactive releases from the repository would peak after about 400,000 years.

EPA issued its final Yucca Mountain standards on June 6, 2001. The final standards included most of the major provisions of the proposed version, including the 15 millirem overall exposure limit and the 4 millirem groundwater limit. Despite the Department's opposition to the EPA standards, DOE's site suitability evaluation determined that the Yucca Mountain site would be able to meet them. NRC revised its repository regulations September 7, 2001, to conform to the EPA standards.

A three-judge U.S. Court of Appeals panel on July 9, 2004, struck down the 10,000-year regulatory compliance period in the EPA and NRC Yucca Mountain standards.[42] The court ruled that the 10,000-year period was inconsistent with the NAS study on which the Energy Policy Act required the Yucca Mountain regulations to be based. In fact, the court found, the NAS study had specifically rejected a 10,000-year compliance period because of analysis that showed peak radioactive exposures from the repository would take place several hundred thousand years in the future.

In response to the court decision, EPA proposed a new version of the Yucca Mountain standards on August 9, 2005. The proposal would have retained the dose limits of the previous standard for the first 10,000 years but allowed a higher annual dose of 350 millirems for the period of 10,000 years through 1 million years. EPA also proposed to base the post-10,000-year Yucca Mountain standard on the median dose, rather than the mean, potentially making it easier to meet.[43] Nevada state officials called EPA's proposed standard far too lenient and charged that it was "unlawful and arbitrary."[44]

EPA issued its final rule to amend the Yucca Mountain standards on September 30, 2008. The final rule reduces the annual dose limit during the period of 10,000 through 1 million years from the proposed 350 millirems to 100 millirems, which the agency contended was consistent with international standards. Under the final rule, compliance with the post-10,000-year standard will be based on the arithmetic mean of projected doses, rather than the median as proposed. The 4 millirem groundwater standard will continue to apply only to the first 10,000 years.[45] NRC revised its repository licensing regulations to conform to the new EPA standards on April 13,

[42] *Nuclear Energy Institute v. Environmental Protection Agency*, U.S. Court of Appeals for the District of Columbia Circuit, No. 01-1258, July 9, 2004.

[43] Especially high doses at the upper end of the exposure range would raise the mean, or average, more than the median, or the halfway point in the data set.

[44] Office of the Governor, Agency for Nuclear Projects. *Comments by the State of Nevada on EPA's Proposed New Radiation Protection Rule for the Yucca Mountain Nuclear Waste Repository*. November 2005.

[45] Posted on the EPA website at http://www.epa.gov/radiation/yucca.

2009.[46] (For more information, see CRS Report RL34698, *EPA's Final Health and Safety Standard for Yucca Mountain*, by Bonnie C. Gitlin.)

DOE estimated in its June 2008 Final Supplemental Environmental Impact Statement (FSEIS) for the Yucca Mountain repository that the maximum mean annual individual dose after 10,000 years would be 2 millirems. That is substantially below the level estimated by the 2002 Final Environmental Impact Statement, which calculated that the peak doses—occurring after 400,000 years—would be about 150 millirems (Volume 1, Chapter 5). The FSEIS attributed the reduction to changes in DOE's computer model and in the assumptions used, noting that "various elements of DOE's modeling approach may be challenged as part of the NRC licensing process."[47]

Alternative Technologies

Several alternatives to the geologic disposal of spent fuel have been studied by DOE and its predecessor agencies, as well as technologies that might reduce waste disposal risks. However, most of these technologies involve large technical obstacles, uncertain costs, and potential public opposition.

Among the primary long-term disposal alternatives to geologic repositories are disposal below the seabed and transport into space, neither of which is currently being studied by DOE. Other technologies have been studied that, while probably not replacing geologic disposal, might make geologic disposal safer and more predictable. Chief among these is the reprocessing or "recycling" of spent fuel so that plutonium, uranium, and other long-lived radionuclides could be converted to faster-decaying fission products in special nuclear reactors or particle accelerators.

Funding

President Obama's FY2011 budget would provide no funding for Yucca Mountain or OCRWM. Alternatives to Yucca Mountain are to be evaluated by the Blue Ribbon Commission on America's Nuclear Future, for which $5 million was included in the FY2010 Energy and Water Development Appropriations Act.

DOE's Office of Nuclear Energy (NE) is to take over the remaining functions of OCRWM and "lead all future waste management activities," according to DOE's budget justification. Substantial funding is being requested for NE to conduct research on nuclear waste disposal technologies and options and to provide support for the Blue Ribbon Commission.

President Obama's budget request for FY2010 had called for termination of the Yucca Mountain project but included $198.6 million to continue the Yucca Mountain licensing process and fund the Blue Ribbon Commission. Congress ultimately approved the Administration's OCRWM budget as requested. As a result, all work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted during FY2010, according to DOE. The FY2011 budget request would halt the licensing process as well, and, as noted, DOE has informed the House and Senate Appropriations Committees that it will reprogram OCRWM's

[46] Nuclear Regulatory Commission, "Implementation of a Dose Standard After 10,000 Years," 74 *Federal Register* 10811, March 13, 2009.

[47] FSEIS, p. S-42. Posted on the DOE website at http://www.rw.doe.gov/ym_repository/seis/docs/002_Summary.pdf.

FY2010 funding toward shutdown of the program and has moved to withdraw the Yucca Mountain license application. According to media reports, DOE's shutdown plan for the Yucca Mountain program calls for all contractor personnel not involved in specific shutdown activities to be terminated by August 9, 2010, and all program records to be transferred to DOE's Office of Legacy Management by August 13.[48] The House Appropriations Committee's Subcommittee on Energy and Water Development approved the Yucca Mountain funding termination on July 15, 2010, after defeating a Republican amendment to restore $100 million for the program. An amendment to suspend collection of the nuclear waste fee was also defeated.[49]

During consideration of the FY2010 budget request, the House Appropriations Committee had stipulated that the Blue Ribbon Commission consider the continuation of the Yucca Mountain project under current law as one of the future waste management alternatives, and the Senate Appropriations Committee had called for the Secretary of Energy to suspend the Nuclear Waste Fee on nuclear power generation, which pays for the waste program. However, both provisions were dropped in conference.

Funding for the nuclear waste program has historically been provided under two appropriations accounts, as shown in **Table 1**. These accounts are, first, appropriations from the Nuclear Waste Fund, which holds fees paid by nuclear utilities, and, second, the Defense Nuclear Waste Disposal account, which pays for disposal of high-level waste from the nuclear weapons program.

NRC is requesting $10 million from the Nuclear Waste Fund in FY2011 for the Yucca Mountain licensing process. In light of DOE's motion to withdraw the Yucca Mountain license application, the NRC funding request would cover the costs of adjudicating the license withdrawal motion as well as "work related to an orderly closure of the agency's Yucca Mountain licensing support activities such as archiving material, knowledge capture and management, and maintenance of certain electronic systems," according to NRC's budget presentation.

Although nuclear utilities pay fees to the Nuclear Waste Fund to cover the disposal costs of civilian nuclear spent fuel, DOE cannot spend the money in the fund until it is appropriated by Congress. Through January 31, 2010, utility nuclear waste fees and interest totaled $31.69 billion, of which $7.41 billion had been disbursed to the waste disposal program, according to DOE's program summary report, leaving a balance of $24.276 billion in the Nuclear Waste Fund. In addition to the disbursements from the Nuclear Waste Fund, the waste disposal program received defense waste disposal appropriations totaling $3.974 billion through FY2010, according to DOE.[50]

[48] Elaine Hiruo, "91 Lawmakers to DOE: Stop Dismantling Yucca," *NuclearFuel*, July 12, 2010, p. 1.

[49] Otto Kreisher, "Panel Passes Bill After Swatting Down GOP Amendments," *Congress Daily*, July 16, 2010, p. 9.

[50] DOE, Office of Civilian Radioactive Waste Management, Office of Program Management, *Monthly Summary of Program Financial and Budget Information*, as of July 1, 2009, available at http://www.rw.doe.gov/about//Monthly_Financial_and_Budget_Summary.shtml. The report notes that some figures may not add due to independent rounding.

Table 1. DOE Civilian Spent Fuel Management Funding

(in millions of current dollars)

Program	FY2007 Approp.	FY2008 Approp.	FY2009 Approp.	FY2010 Approp.	FY2011 Request
Yucca Mountain	298.1	267.1	183.3	116.1	0
Transportation	35.3	18.3	2.1	0	0
Management and Integration	46.7	26.4	26.2	10.7	0
Program Direction and Other	64.4	69.8	76.8	70.0	0
Total	**445.7**	**386.4**	**288.4**	**196.8**	**0**
Source of Funding					
Nuclear Waste Fund appropriations	99.2	187.3	145.4	98.4	0
Defense waste appropriations	346.5	199.2	143.0	98.4	0

Sources: DOE FY2011 Congressional Budget Request, H.Rept. 111-203, S.Rept. 111-45.

DOE's most recent update of its Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program was released on August 5, 2008.[51] According to that estimate, the Yucca Mountain program would cost $96.2 billion in 2007 dollars from the beginning of the program in 1983 to repository closure in 2133. DOE's previous estimate, issued in 2001, was $57.5 billion in 2000 dollars. Major factors in the increase are inflation and a higher estimate of spent fuel to be generated by existing reactors. Spent fuel from proposed new reactors is not included in the cost estimate.

Low-Level Radioactive Waste

Current Policy

Selecting disposal sites for low-level radioactive waste, which generally consists of low concentrations of relatively short-lived radionuclides, is authorized to be conducted by states under the 1980 Low-Level Radioactive Waste Policy Act and 1985 amendments. Most states have joined congressionally approved interstate compacts to handle low-level waste disposal. Under the 1985 amendments, the nation's three (at that time) operating commercial low-level waste disposal facilities could start refusing to accept waste from outside their regional interstate compacts after the end of 1992. One of the three sites closed, and the remaining two are using their congressionally granted authority to prohibit waste from outside their regional compacts. Another site, in Utah, has since become available nationwide for most Class A low-level waste, but no site is currently open to nationwide disposal of all major types of low-level waste.

Despite the 1992 deadline, no new disposal sites have been opened under the Low-Level Waste Act. Legislation providing congressional consent to a disposal compact among Texas, Maine, and Vermont was signed by President Clinton September 20, 1998 (P.L. 105-236). However, on

[51] Available on the OCRWM website at http://www.rw.doe.gov/about/budget/pdf/TSLCC_2007_8_05_08.pdf.

October 22, 1998, a proposed disposal site near Sierra Blanca, Texas, was rejected by the Texas Natural Resource Conservation Commission, and Maine has since withdrawn. Texas Governor Perry signed legislation June 20, 2003, authorizing the Texas Commission on Environmental Quality (TCEQ) to license adjoining disposal facilities for commercial and federally generated low-level waste. Pursuant to that statute, an application to build a disposal facility for commercial and federal low-level waste in Andrews County, Texas, was filed August 2, 2004, by Waste Control Specialists LLC. TCEQ voted January 14, 2009, to issue the license after the necessary land and mineral rights have been acquired.[52] Waste Control Specialists currently expects the facility to start receiving waste by mid-2011.[53]

The Midwestern Compact voted June 26, 1997, to halt development of a disposal facility in Ohio. Nebraska regulators rejected a proposed waste site for the Central Compact December 21, 1998, drawing a lawsuit from five utilities in the region. A U.S. district court judge ruled September 30, 2002, that Nebraska had exercised bad faith in disapproving the site and ordered the state to pay $151 million to the compact. A settlement was reached August 9, 2004, resulting in a payment of $145.8 million,[54] and the compact is seeking access to the planned Texas disposal facility. Most other regional disposal compacts and individual states that have not joined compacts are making little progress toward finding disposal sites.

The disposal facility at Barnwell, South Carolina, is currently accepting all Class A, B, and C low-level waste from the Atlantic Compact (formerly the Northeast Compact), in which South Carolina joined original members Connecticut and New Jersey on July 1, 2000. Under the compact, South Carolina can limit the use of the Barnwell facility to the three compact members, and a state law enacted in June 2000 phased out acceptance of non-compact waste through June 30, 2008. The Barnwell facility previously had stopped accepting waste from outside the Southeast Compact at the end of June 1994. The Southeast Compact Commission in May 1995 twice rejected a South Carolina proposal to open the Barnwell site to waste generators outside the Southeast and to bar access to North Carolina until that state opened a new regional disposal facility, as required by the compact. The rejection of those proposals led the South Carolina General Assembly to vote in 1995 to withdraw from the Southeast Compact and begin accepting waste at Barnwell from all states but North Carolina. North Carolina withdrew from the Southeast Compact July 26, 1999. The U.S. Supreme Court ruled on June 1, 2010, that the withdrawal did not subject North Carolina to sanctions under the compact.[55]

The only other existing disposal facility for all three major classes of low-level waste is at Hanford, Washington. Controlled by the Northwest Compact, the Hanford site will continue taking waste from the neighboring Rocky Mountain Compact under a contract. Since the South Carolina facility closed to out-of-region waste, the 36 states and the District of Columbia that are outside the Northwest, Rocky Mountain, and Atlantic Compacts have had no disposal site for Class B and C low-level waste. Waste generators in those states must store their Class B and C waste on site until new disposal sites are available.

[52] TCEQ website: http://www.tceq.state.tx.us/permitting/radmat/licensing/wcs_license_app.html#wcs_status.

[53] E-mail from Tom Jones, Vice President for Community Relations, Waste Control Specialists, July 16, 2010.

[54] USAToday.com, August 1, 2005, http://www.usatoday.com/news/nation/2005-08-01-nukewaste_x.htm.

[55] *Alabama et al. v. North Carolina*, S. Ct. (2010), http://www.supremecourt.gov/opinions/09pdf/132Orig.pdf.

Regulatory Requirements

Licensing of commercial low-level waste facilities is carried out under the Atomic Energy Act by NRC or by "agreement states" with regulatory programs approved by NRC. NRC regulations governing low-level waste licenses must conform to general environmental protection standards and radiation protection guidelines issued by EPA. Transportation of low-level waste is jointly regulated by NRC and the Department of Transportation.

Concluding Discussion

Disposal of radioactive waste will be a key issue in the continuing nuclear power debate. Without a national disposal system, spent fuel from nuclear power plants must be stored on-site indefinitely. This situation may raise public concern near proposed reactor sites, particularly at sites without existing reactors where spent nuclear fuel is already stored.

Under current law, the federal government's nuclear waste disposal policy is focused on the Yucca Mountain site. However, President Obama's plan to terminate the Yucca Mountain project and develop a new waste strategy through the Blue Ribbon Commission on America's Nuclear Future has brought most activities in the DOE waste program to a halt. Congress will consider the project's termination during the FY2011 appropriations process.

Because of their waste-disposal contracts with DOE, owners of existing reactors are likely to continue seeking damages from the federal government if disposal delays continue. DOE's 2004 settlement with the nation's largest nuclear operator, Exelon, could require payments of up to $600 million from the federal judgment fund, for example. DOE estimates that payments could rise to $11 billion if the federal government cannot begin taking waste from reactor sites before 2020, as previously planned. The nuclear industry has predicted that future damages could reach tens of billions of dollars if the federal disposal program fails altogether.

Lack of a nuclear waste disposal system could also affect the licensing of proposed new nuclear plants, both because of NRC licensing guidelines and various state laws.[56] In addition, further repository delays could force DOE to miss compliance deadlines for defense waste disposal.

Problems being created by nuclear waste disposal delays are expected to be addressed by the Blue Ribbon Commission. Major options include centralized interim storage, continued storage at existing nuclear sites, reprocessing and waste treatment technology, development of alternative repository sites, or a combination. Given the delays resulting from the ongoing shutdown of the nuclear waste program, longer on-site storage is almost a certainty under any option. Any of the options would also face intense controversy, especially among states and regions that might be potential hosts for future waste facilities. As a result, substantial debate would be expected over any proposals to change the Nuclear Waste Policy Act.

[56] Lovell, David L., Wisconsin Legislative Council Staff, *State Statutes Limiting the Construction of Nuclear Power Plants*, October 5, 2006.

Legislation

H.R. 513 (Forbes)

New Manhattan Project for Energy Independence. Includes grants and prizes for nuclear waste treatment technology. Introduced January 14, 2009; referred to Committee on Science and Technology.

H.R. 2250 (Burton)

Energy Independence Now Act of 2009. Includes a provision prohibiting the Nuclear Regulatory Commission from denying a nuclear reactor license because of a lack of nuclear waste disposal capacity. Introduced May 5, 2009; referred to multiple committees.

H.R. 2300 (Rob Bishop)

Among other provisions, would authorize DOE to enter into temporary spent nuclear fuel storage agreements with volunteer sites, establish payments to settle nuclear utility breach-of-contract claims for DOE waste disposal delays, and prohibit NRC from considering nuclear waste storage when licensing new nuclear facilities. Introduced May 7, 2009; referred to multiple committees.

H.R. 2539 (Thornberry)

No More Excuses Energy Act of 2009. Includes a provision prohibiting the Nuclear Regulatory Commission from denying a nuclear reactor license because of a lack of nuclear waste disposal capacity. Introduced May 5, 2009; referred to multiple committees.

H.R. 3183 (Pastor)

Energy and Water Development and Related Agencies Appropriations Act, 2010. Includes funding for nuclear waste programs. Reported as an original measure by the House Appropriations Committee July 13, 2009. Passed House July 17, 2009, by vote of 320-97 (H.Rept. 111-203); passed Senate July 29, 2009, by vote of 85-9 (S.Rept. 111-45). Signed by the President October 28, 2009 (P.L. 111-85).

H.R. 3385 (Barton)

Would authorize DOE to use the Nuclear Waste Fund to pay for grants or long-term contracts for spent nuclear fuel recycling or reprocessing and place the Waste Fund off-budget. Introduced July 29, 2009; referred to committees on Energy and Commerce and the Budget.

H.R. 3505 (Gary Miller)

American Energy Production and Price Reduction Act. Among other provisions, would prohibit the Nuclear Regulatory Commission from denying a nuclear reactor license because of a lack of nuclear waste disposal capacity. Introduced July 31, 2009; referred to multiple committees.

H.R. 4741 (Fattah)/S. 2776 (Alexander)

Clean Energy Act of 2010. Among other provisions, requires NRC to assume that sufficient disposal capacity will be available for nuclear waste that would be produced from proposed reactors, and authorizes annual appropriations of $150 million to DOE through 2020 for spent nuclear fuel recycling research and development. Senate bill introduced November 16, 2009; referred to Committee on Energy and Natural Resources. House bill introduced March 3, 2010; referred to multiple committees.

S. 807 (Nelson of Nebraska)

SMART Energy Act. Includes provision authorizing DOE to begin construction of a spent fuel recycling research and development facility. Introduced April 2, 2009; referred to Committee on Finance.

S. 861 (Graham)

Rebating America's Deposits Act. Requires the President to certify that the Yucca Mountain site continues to be the designated location for a nuclear waste repository under the Nuclear Waste Policy Act. If such a certification is not made within 30 days after enactment or is subsequently revoked, the Treasury is to refund all payments, plus interest, made by nuclear reactor owners to the Nuclear Waste Fund. DOE is to begin shipping defense-related high-level radioactive waste to Yucca Mountain by 2017 or pay $1 million per day to each state in which such waste is located. Introduced April 22, 2009; referred to Committee on Energy and Natural Resources.

S. 1333 (Barrasso)

Clean, Affordable, and Reliable Energy Act of 2009. Includes provisions to take the Nuclear Waste Fund off-budget, authorize DOE to use the Nuclear Waste Fund to pay for grants or long-term contracts for spent nuclear fuel recycling or reprocessing, and prohibit NRC from denying licenses for new nuclear facilities because of a lack of waste disposal capacity. Introduced June 24, 2009; referred to Committee on Finance.

S. 1462 (Bingaman)

American Clean Energy Leadership Act of 2009. Establishes Clean Energy Deployment Administration to administer DOE assistance, including loan guarantees, for nuclear energy and other energy technologies. Establishes a national commission to study nuclear waste management alternatives and requirements for nuclear fuel cycle research. Introduced and reported as an original measure from the Committee on Energy and Natural Resources July 16, 2009 (S.Rept. 111-48).

S. 1733 (Kerry)

Clean Energy Jobs and American Power Act. Authorizes programs for nuclear worker training, nuclear safety, and nuclear waste research. Establishes a carbon dioxide cap-and-trade program. Introduced September 30, 2009; referred to Committee on Environment and Public Works. Ordered reported November 5, 2009 (S.Rept. 111-121).

S. 3322 (Voinovich)

United States Nuclear Fuel Management Corporation Establishment Act of 2010. Establishes a government corporation to take over DOE responsibility for managing spent nuclear fuel and high-level waste and to develop reprocessing facilities. Introduced May 6, 2010; referred to Committee on Committee on Environment and Public Works.

For Additional Reading

Harvard University. John F. Kennedy School of Government. Belfer Center for Science and International Affairs. *The Economics of Reprocessing vs. Direct Disposal of Spent Nuclear Fuel.* DE-FG26-99FT4028. December 2003.

Nuclear Waste Technical Review Board. *Survey of National Programs for Managing High-Level Radioactive Waste and Spent Nuclear Fuel*. October 2009. http://www.nwtrb.gov/reports/reports.html

University of Illinois. Program in Arms Control, Disarmament, and International Security. *'Plan D' for Spent Nuclear Fuel.* 2009. http://acdis.illinois.edu/publications/207/publication-PlanDforSpentNuclearFuel.html.

U.S. Department of Energy. *Office of Civilian Radioactive Waste Management home page*; covers DOE activities for disposal, transportation, and other management of civilian nuclear waste. http://www.ocrwm.doe.gov.

U.S. General Accounting Office. *Low-Level Radioactive Waste: Disposal Availability Adequate in the Short Term, but Oversight Needed to Identify Any Future Shortfalls.* GAO-04-604. June 2004. 53 p.

Walker, J. Samuel. *The Road to Yucca Mountain: The Development of Radioactive Waste Policy in the United States.* University of California Press. 2009. 228 p.

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