



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 United States currently has no disposal facility for spent nuclear fuel.

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, which would be licensed by the Nuclear Regulatory Commission (NRC). 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 NRC on June 3, 2008. The state of Nevada strongly opposes the Yucca Mountain project, citing excessive water infiltration, earthquakes, volcanoes, human intrusion, and other technical flaws.

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, OCRWM, or NRC licensing was requested or provided for FY2011 or subsequent years. DOE filed a motion with NRC to withdraw the Yucca Mountain license application on March 3, 2010. An NRC licensing board denied DOE's withdrawal motion on June 29, 2010, a decision sustained by the NRC commissioners on a tie vote September 9, 2011. Despite that decision, NRC halted further consideration of the license application because of "budgetary limitations," but a federal appeals court on August 13, 2013, ordered NRC to continue the licensing process with previously appropriated funds.

After halting the Yucca Mountain project, the Administration established the Blue Ribbon Commission on America's Nuclear Future to develop an alternative nuclear waste policy. The commission issued its final report on January 26, 2012, recommending that a new, "single-purpose organization" be given the authority and resources to promptly begin developing one or more nuclear waste repositories and consolidated storage facilities. The commission recommended a "consent based" process for siting nuclear waste storage and disposal facilities and that long-term research, development, and demonstration be conducted on technologies that could provide waste disposal benefits.

After OCRWM was dismantled, responsibility for implementing the Administration's nuclear waste policy was given to DOE's Office of Nuclear Energy (NE). In January 2013, NE issued a nuclear waste strategy based on the Blue Ribbon Commission recommendations. The strategy calls for a pilot interim storage facility for spent fuel from closed nuclear reactors to open by 2021 and a larger storage facility, possibly at the same site, to open by 2025. A site for a permanent underground waste repository would be selected by 2026, and the repository would open by 2048. DOE requested \$60 million for FY2014 to carry out the new waste strategy, an amount approved by the Senate Appropriations Committee. However, the House denied funding for the new strategy and provided \$25 million for Yucca Mountain instead.

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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 the Department of Energy (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, but the Obama Administration has halted funding for the project and moved to withdraw the application.

An NRC licensing board denied DOE's withdrawal motion on June 29, 2010, a decision sustained by the NRC commissioners on a tie vote September 9, 2011. Despite that decision, NRC halted further consideration of the license application because of "budgetary limitations," but a federal appeals court on August 13, 2013, ordered NRC to continue the licensing process with previously appropriated funds. NRC responded November 18, 2013, by directing the agency's staff to complete the Yucca Mountain safety evaluation report, a key document that would provide the staff's conclusions about whether the proposed repository could be licensed. NRC also requested DOE to prepare a supplemental environmental impact statement that NRC needs to complete its environmental review of the Yucca Mountain application.

After taking action to terminate the Yucca Mountain project, the Administration established the Blue Ribbon Commission on America's Nuclear Future (BRC) to develop an alternative nuclear waste policy. The commission issued its final report on January 26, 2012, recommending that a new, "single-purpose organization" be given the authority and resources to promptly begin developing one or more nuclear waste repositories and consolidated storage facilities. The recommendations called for a "consent based" process in which the roles of various levels of government in siting and regulating nuclear waste facilities would be established through negotiations. The commission also recommended that long-term research, development, and demonstration be conducted on technologies that could provide waste disposal benefits.

In response to the BRC report, and to provide an outline for a new nuclear waste program, DOE issued a *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste* in January 2013. The DOE strategy calls for a new nuclear waste management entity to develop consent-based storage and disposal sites, similar to the BRC recommendation. Under the DOE strategy, a pilot interim spent fuel storage facility would be opened by 2021 and a larger-scale storage facility, which could be an expansion of the pilot facility, by 2025. A geologic disposal facility would open by 2048—50 years after the initially planned opening date for the Yucca Mountain repository.¹

President Obama's FY2014 federal budget, submitted to Congress April 11, 2013, included no funding for Yucca Mountain but requested \$60 million "to support the program of work" outlined by DOE's January 2013 nuclear waste strategy. The House provided none of the requested nuclear waste strategy funding in the FY2014 Energy and Water Development appropriations bill (H.R. 2609, H.Rept. 113-135), passed July 10, 2013. Instead, the House included \$25 million in

¹ DOE, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste*, January 2013, <http://energy.gov/sites/prod/files/Strategy%20for%20the%20Management%20and%20Disposal%20of%20Used%20Nuclear%20Fuel%20and%20High%20Level%20Radioactive%20Waste.pdf>.

the bill for work related to Yucca Mountain. The Senate Appropriations Committee endorsed the Administration's nuclear waste funding request in its version of the Energy and Water Bill (S. 1245, S.Rept. 113-47), approved June 27, 2013. FY2014 nuclear waste funding is currently provided through January 15, 2014, by a continuing resolution (P.L. 113-46), at about the spending rate requested by the Administration and with no new funds for Yucca Mountain.

Citing uncertainty about the future of the nuclear waste program, the U.S. Court of Appeals for the District of Columbia Circuit ordered DOE on November 19, 2013, to stop collecting fees on nuclear power that are supposed to pay for waste disposal. The fees, authorized by NWPA, are paid by nuclear power generators at the rate of a tenth of a cent per kilowatt-hour and total about \$800 million per year. NWPA requires the Secretary of Energy to adjust the fees as necessary to cover the waste program's anticipated costs, but the Court ruled that DOE's current waste plans are too vague to allow a reasonable estimate to be calculated. The Court noted that DOE's most recent cost estimate for the program had an uncertainty range of nearly \$7 trillion, a range "so large as to be absolutely useless" for determining the waste fee.²

On June 8, 2012, the Court of Appeals overturned NRC's Waste Confidence Decision, which determined that spent nuclear fuel could be safely stored at nuclear reactor sites for at least 60 years after they have shut down and that permanent disposal would be available "when necessary." The court ruled that NRC should have conducted an environmental review under the National Environmental Policy Act before issuing the Waste Confidence Decision in December 2010.³ Under previous court rulings, NRC must determine that waste from proposed nuclear plants can be safely managed before licensing them to operate. As a result, NRC has halted licensing of new facilities that rely on the Waste Confidence Decision, and it plans to complete an environmental impact statement and issue a new Waste Confidence rule by September 2014.⁴ The NRC commissioners approved a proposed Waste Confidence rule on August 5, 2013.⁵

The March 11, 2011, disaster at Japan's Fukushima Daiichi nuclear power plant increased concern about spent fuel stored in pools of water at nuclear plant sites. The loss of power at the site, caused by a huge earthquake and tsunami, disabled cooling systems at the plant's spent fuel pools. Water in the pools was initially feared to have boiled or leaked and dropped below the level of the stored spent fuel, but later analysis indicated that the spent fuel did not overheat. (For more details about Fukushima, see CRS Report R41694, *Fukushima Nuclear Disaster*, by Mark Holt, Richard J. Campbell, and Mary Beth D. Nikitin.) Nevertheless, the incident has prompted numerous recommendations for safety improvements at spent fuel pools. NRC approved an order March 9, 2012, requiring U.S. reactors to install improved water-level monitoring equipment at their spent fuel pools.⁶

² See CRS Legal Sidebar WSLG734, *Court Neither Razzled Nor Dazzled by DOE's Failure to Assess Nuclear Waste Fund Fee*, by Todd Garvey.

³ U.S. Circuit Court of Appeals for the District of Columbia Circuit, *State of New York, et al. v. Nuclear Regulatory Commission*, No. 11-1045, Decided June 8, 2012, [http://www.cadc.uscourts.gov/internet/opinions.nsf/57ACA94A8FFAD8AF85257A1700502AA4/\\$file/11-1045-1377720.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/57ACA94A8FFAD8AF85257A1700502AA4/$file/11-1045-1377720.pdf).

⁴ Nuclear Regulatory Commission, "Waste Confidence," web page, February 20, 2013, <http://www.nrc.gov/waste/spent-fuel-storage/wcd.html>.

⁵ NRC, "Proposed Rule: Waste Confidence," August 5, 2013, <http://pbadupws.nrc.gov/docs/ML1321/ML13217A358.pdf>.

⁶ Nuclear Regulatory Commission, "NRC to Issue Orders, Information Request as Part of Implementing Fukushima-Related Recommendations," press release, March 9, 2012, <http://www.nrc.gov/reading-rm/doc-collections/news/2012/12-023.pdf>.

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 long-standing issue.

Spent Nuclear Fuel Program

The Nuclear Waste Policy Act of 1982 (NWPAA, P.L. 97-425), as amended in 1987, required the Department of Energy (DOE) to focus on Yucca Mountain, Nevada, as the site of 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, as specified by NWPAA. 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 established by NWPAA.⁷

However, the Obama Administration made a policy decision that the Yucca Mountain repository should not be opened, largely because of Nevada's continuing opposition, 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 and elimination of the Office of Civilian Radioactive Waste Management (OCRWM), which had run the program. In line with the request, the FY2011 Continuing Appropriations Act (P.L. 112-10) provided no DOE funding for the program. DOE shut down the Yucca Mountain project at the end of FY2010 and transferred OCRWM's remaining functions to the Office of Nuclear Energy.

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.⁸ 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."⁹

⁷ Nuclear Energy Institute, Key Issues, Yucca Mountain, <http://www.nei.org/keyissues/nuclearwastedisposal/yuccamountain/>, viewed April 11, 2008.

⁸ *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.

⁹ National Association of Regulatory Utility Commissioners, "NARUC Seeks Party Status at NRC, Says Yucca Review (continued...)"

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.¹⁰ The NRC commissioners sustained the ASLB decision on a tie vote September 9, 2011. However, NRC halted further consideration of the license application because of "budgetary limitations."¹¹ Lawsuits to overturn the Yucca Mountain license withdrawal on statutory grounds were filed with the U.S. Court of Appeals for the District of Columbia Circuit, which ruled on August 13, 2013, that NRC must continue work on the Yucca Mountain license application as long as funding is available. The Court determined that NRC has at least \$11.1 million in previously appropriated funds for that purpose.¹²

NRC responded November 18, 2013, by directing the agency's staff to complete the Yucca Mountain safety evaluation report (SER), a key document that would provide the staff's conclusions about whether the proposed repository could be licensed. NRC also requested DOE to prepare a supplemental environmental impact statement that NRC needs to complete its environmental review of the Yucca Mountain application. Documents previously used in the licensing process will be loaded into NRC's database and made public if they are used for the SER. Additional documents may also be made public if funds are available. However, NRC does not plan to resume the adjudication of Yucca Mountain licensing issues.¹³

To develop alternative waste disposal strategies, the Administration established the Blue Ribbon Commission on America's Nuclear Future (BRC). The BRC issued its final report on January 26, 2012, recommending that a new, "single-purpose organization" be given the authority and resources to promptly begin developing one or more nuclear waste repositories and consolidated storage facilities. The new organization would use a "consent based" process to select waste facility sites.¹⁴ The BRC had commissioned a series of reports on various aspects of nuclear waste policy to assist in its deliberations.¹⁵ In response to the BRC report, and to provide an outline for a new nuclear waste program, DOE issued its *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste* in January 2013. The DOE strategy calls for a new nuclear waste management entity to develop consent-based storage and disposal sites, similar to the BRC recommendation. Under the DOE strategy, a pilot interim spent fuel storage facility would be opened by 2021 and a larger-scale storage facility, which could be an expansion of the pilot

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Must Continue," press release, March 16, 2010, <http://www.naruc.org/News/default.cfm?pr=191&pdf=>.

¹⁰ U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, Docket No. 63-001-HLW, Memorandum and Order, June 29, 2010.

¹¹ Nuclear Regulatory Commission, "In the Matter of U.S. Department of Energy (High-Level Waste Repository)," CLI-11-07, September 9, 2011, <http://www.nrc.gov/reading-rm/doc-collections/commission/orders/2011/2011-07cli.pdf>.

¹² U.S. Court of Appeals for the District of Columbia Circuit, *In re: Aiken County et al.*, No. 11-1271, writ of mandamus, August 13, 2013, [http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/\\$file/11-1271-1451347.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/$file/11-1271-1451347.pdf).

¹³ Nuclear Regulatory Commission, "NRC Directs Staff to Complete Yucca Mountain Safety Evaluation Report," news release No. 13-097, November 18, 2013, <http://pbadupws.nrc.gov/docs/ML1332/ML13322B228.pdf>.

¹⁴ Blue Ribbon Commission on America's Nuclear Future, *Report to the Secretary of Energy*, January 2012, http://brc.gov/sites/default/files/documents/brc_finalreport_jan2012.pdf (BRC Final Report).

¹⁵ Blue Ribbon Commission on America's Nuclear Future, Commissioned Papers, <http://brc.gov/index.php?q=library/documents/commissioned-papers>.

facility, by 2025. A geologic disposal facility would open by 2048—50 years after the initially planned opening date for the Yucca Mountain repository.¹⁶

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 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.¹⁷

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 unacceptable levels of radioactivity into the environment. Much of the problem results from the inherent uncertainty involved in predicting waste site performance for the 1 million years that nuclear waste is to be isolated under current regulations. Widespread public controversy has also arisen over potential waste transportation routes to the sites under consideration.

President Obama’s budgets for FY2014 and previous years have included 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 NWPAA. 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).¹⁸

¹⁶ DOE, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste*, op. cit.

¹⁷ 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.

¹⁸ 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.

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, Texas, 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 by a Utah commercial disposal facility from anywhere in the United States.

Threats by states to close their disposal facilities led to congressional authorization of regional compacts for low-level waste disposal in 1985. The first, and so far only, new disposal site under the regional compact system opened on November 10, 2011, near Andrews, TX.¹⁹ The Texas Legislature approved legislation in May 2011 to allow up to 30% of the facility's capacity to be used by states outside the Texas Compact, which consists of Texas and Vermont.²⁰

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. As required by NWPA, the "standard contract" specified that DOE would begin disposing of nuclear waste no later than January 31, 1998.²¹

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.

Through the end of September 2012, nuclear waste payments from the Judgment Fund totaled \$2.6 billion from settlements as well as court awards, according to one of the primary attorneys involved in the litigation. Of the 74 lawsuits filed for waste delays, 31 had been settled, 16 resulted in court awards, and 27 were pending.²² The payments resulting from the court

¹⁹ Waste Control Specialists LLC, "Historic Texas Compact Disposal Facility Ready for Business," <http://www.wcstexas.com>.

²⁰ Waste Control Specialists LLC, "Waste Control Specialists Commends Passage of Legislation," press release, May 31, 2011, http://www.wcstexas.com/PDF_downloads/WCSAnnounceslegislation.pdf?nxd_id=98546.

²¹ The Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste can be found at 10 CFR 961.11.

²² Derek Sands and Elaine Hiruo, "Piloting Spent Fuel Storage Is Path to Larger Facility: DOE Official," *Nucleonics* (continued...)

judgments and settlements 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. 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.

Utilities that have not settled with the Department of Justice have continued seeking damage compensation 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.

(For more information about nuclear waste litigation, see CRS Report R40996, *Contract Liability Arising from the Nuclear Waste Policy Act (NWPA) of 1982*, by Todd Garvey.)

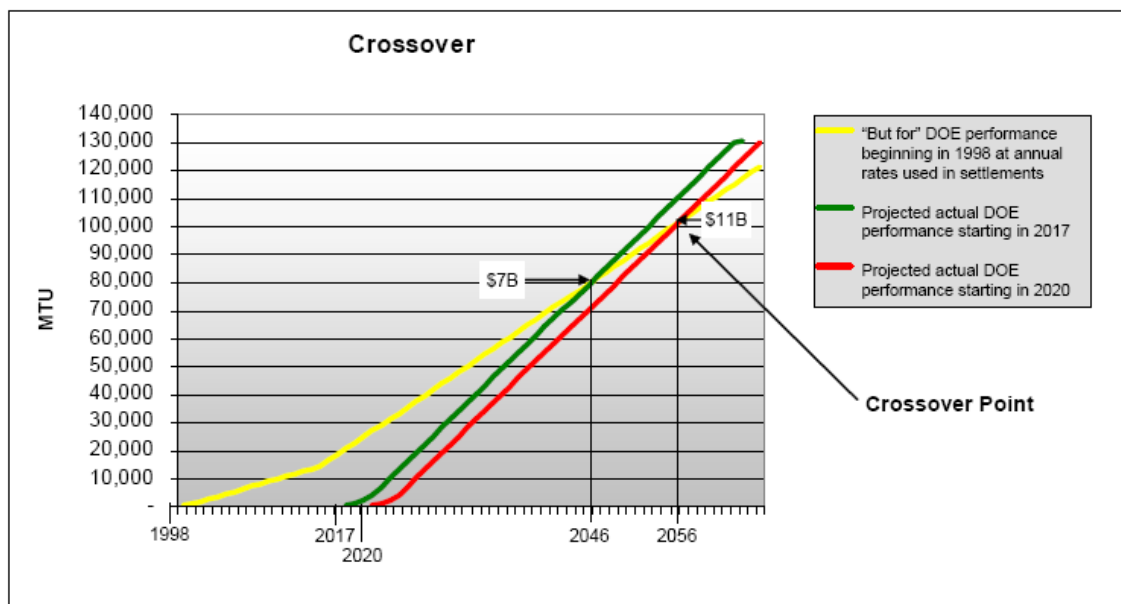
Future Liability Estimates

DOE estimates that its potential liabilities for waste program delays would total as much as \$23 billion during the next 50 years (in current dollars) if the department were able to begin taking spent nuclear fuel from plant sites by 2020, which had been the most recent goal under the Bush Administration.²³ DOE's methodology for estimating its nuclear waste liability is shown in **Figure 1** (although the liability estimate has more than doubled since this graph was issued in 2008). 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).

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Week, January 17, 2013.

²³Ernest J. Moniz, Secretary of Energy, Statement before the Senate Energy and Natural Resources Committee, July 30, 2013, http://energy.gov/sites/prod/files/2013/07/f2/7-30-13_Ernest_Moniz%20FT%20SENR.pdf.

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.

Note: MTU stands for metric tons of uranium in the initial fuel. MTU in the graph are cumulative.

The green and red lines in **Figure 1** show DOE's planned waste acceptance rate if waste shipments were to 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.²⁴ At that 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. As noted above, estimates of future payments have already risen substantially since the 2008 estimates shown in **Figure 1**. If damage awards by the Court of Claims (currently involving about two-thirds of U.S. reactors) exceed the rates paid under the settlements, then future payments could further exceed those estimates.

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

²⁴ 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, DC, July 2008, p. 20, http://ocrwm.doe.gov/about/budget/pdf/TSLCC_2007_8_05_08.pdf.

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.²⁵

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.²⁶ However, funding for the Yucca Mountain project was halted in FY2011, as noted above. As a result, 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. As noted above, DOE's January 2013 waste strategy calls for a pilot storage site to open by 2022 and a full-scale disposal facility by 2025.

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 (NEI), representing the nuclear industry, filed petitions with the U.S. Court of Appeals on April 2 and April 5, 2010, respectively, 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.²⁷ DOE responded that the federal 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.²⁸ Energy Secretary Steven Chu issued a formal determination on November 1, 2010, that there was "no reasonable basis at this time" to conclude that excess funds were being collected for future nuclear waste disposal activities.²⁹

The U.S. Court of Appeals for the District of Columbia Circuit ruled June 1, 2012, that Secretary Chu's determination that the nuclear waste fee should continue unchanged was not "a valid evaluation" and ordered him to conduct a more thorough study of the fee within six months. The court noted that the Secretary's finding relied primarily on costs that had been projected for the Yucca Mountain site, which the Administration had terminated as "unworkable." The court concluded that the Secretary must evaluate the likely costs of reasonable alternatives and the timing of those costs, all of which would affect the level of nuclear waste fees required.³⁰

²⁵ BRC Final Report, op. cit., p. 80.

²⁶ Ibid., p. B-2.

²⁷ 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.

²⁸ Jeff Beattie, "NARUC, Utilities Sue DOE Over Nuke Waste Fee," *Energy Daily*, April 6, 2010, p. 1.

²⁹ Secretary of Energy Steven Chu, "Secretarial Determination of the Adequacy of the Nuclear Waste Fund Fee," November 1, 2010, http://energy.gov/sites/prod/files/gcprod/documents/Secretarial_Determination_WasteFee.pdf.

³⁰ U.S. Court of Appeals for the District of Columbia Circuit, *National Association of Regulatory Utility* (continued...)

DOE responded with a new fee adequacy assessment in January 2013 that evaluated the total costs of a variety of waste management scenarios. The costs of some scenarios exceeded projected revenues from the existing waste fee by as much as \$2 trillion, but other scenarios resulted in a surplus of up to \$5 trillion. Because of the widely varying results, DOE concluded that there was no clear evidence that the fee should be immediately raised or lowered.³¹

After NEI and NARUC asked for a review of DOE's latest fee adequacy assessment, the Circuit Court ordered DOE on November 19, 2013, to stop collecting the nuclear waste fees altogether. The Court ruled that DOE's current waste plans were too vague to allow a reasonable estimate to be calculated. The Court noted that DOE's \$7 trillion uncertainty range for the program's cost was "so large as to be absolutely useless" for determining the waste fee.³²

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. Subsequent DOE statements have reiterated that the license withdrawal motion was not based on scientific or technical findings. Instead, the policy change was prompted by the perceived difficulty in overcoming continued opposition from the state of Nevada and a desire to find a waste solution with greater public acceptance, according to DOE.³³ DOE contended that the license application should be withdrawn "with prejudice" because of the need to "provide finality in ending the Yucca Mountain project."³⁴

The state of Nevada strongly endorsed DOE's motion to withdraw the license application with prejudice³⁵ and has moved to intervene in a court challenge to the license withdrawal.³⁶ 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

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Commissioners v. United States Department of Energy, No. 11-1066, decided June 1, 2012, [http://www.cadc.uscourts.gov/internet/opinions.nsf/4B11622F4FF75FEC85257A100050A681/\\$file/11-1066-1376508.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/4B11622F4FF75FEC85257A100050A681/$file/11-1066-1376508.pdf).

³¹ DOE, "Nuclear Waste Fund Fee Adequacy Report," January 2013, http://energy.gov/sites/prod/files/January%2016%202013%20Secretarial%20Determination%20of%20the%20Adequacy%20of%20the%20Nuclear%20Waste%20Fund%20Fee_0.pdf.

³² See CRS Legal Sidebar WSLG734, *Court Neither Razzled Nor Dazzled by DOE's Failure to Assess Nuclear Waste Fund Fee*, by Todd Garvey.

³³ Statement of Peter B. Lyons, Assistant Secretary for Nuclear Energy, U.S. Department of Energy, before the Committee on Energy and Commerce, Subcommittee on Environment and the Economy, June 1, 2011.

³⁴ DOE Motion to Withdraw, op. cit.

³⁵ Nicole E. Matthews, "DOE Withdraws Application for Yucca Nuke Dump," *Fox5Vegas.com*, March 3, 2010, <http://www.fox5vegas.com/news/22734591/detail.html>.

³⁶ *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>.

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.³⁷ Also seeking to intervene were Aiken County, SC, and the Prairie Island Indian Community in Minnesota.

The ASLB 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.'"³⁸

In appealing the ASLB decision to the NRC commissioners, DOE argued in a July 9, 2010, 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."³⁹ After more than a year of deliberation, the NRC commissioners sustained the licensing board's decision on a tie vote September 9, 2011. However, NRC halted further consideration of the license application because of "budgetary limitations."⁴⁰

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. After NRC rejected the license withdrawal motion, the plaintiffs in that case, including Nye County, NV, where Yucca Mountain is located, petitioned the court to order NRC to continue the licensing proceedings, as noted above.⁴¹ The court held oral arguments in the case May 2, 2012. NRC filed an update with the court on January 4, 2013, contending that the reelection of President Obama and the exclusion of additional Yucca Mountain funding from

³⁷ 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=>.

³⁸ U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, Docket No. 63-001-HLW, Memorandum and Order, June 29, 2010.

³⁹ *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.

⁴⁰ Nuclear Regulatory Commission, Memorandum and Order, CLI-11-07, September 9, 2011, <http://www.nrc.gov/reading-rm/doc-collections/commission/orders/2011/2011-07cli.pdf>.

⁴¹ U.S. Circuit Court of Appeals for the District of Columbia Circuit, USCA Case #11-1271, Yucca Mountain Reply Brief of Petitioners Mandamus Action, February 13, 2012, <http://www.naruc.org/policy.cfm?c=filings>.

the most recent FY2013 Continuing Resolution reinforced NRC's suspension of further action on the repository license.⁴²

The Court of Appeals ruled on August 13, 2013, that NRC must continue work on the Yucca Mountain license application as long as funding is available. The Court determined that NRC has at least \$11.1 million in previously appropriated funds for that purpose.⁴³

Waste Confidence Decision

Before issuing licenses to nuclear reactors and waste storage facilities, NRC is required by a 1979 court decision to determine that waste from those facilities can be safely disposed of.⁴⁴ To meet that requirement, NRC issued a Waste Confidence Decision in 1984 that found that nuclear waste could be safely stored at reactor sites for at least 30 years after plant closure and that a permanent repository would be available by 2007-2009.⁴⁵ At that time, DOE officially planned to meet the NWA repository deadline of 1998.

After DOE's schedule for opening a nuclear waste repository began to slip, NRC updated the Waste Confidence Decision in 1990 to find that a repository would be available by the first quarter of the next century.⁴⁶ When the Yucca Mountain repository was delayed further and then terminated by the Obama Administration, NRC issued another Waste Confidence update in 2010 that found that a repository would be available "when necessary" and that waste could be safely stored at reactor sites for at least 60 years after shutdown.⁴⁷

The state of New York, environmental groups, and others filed lawsuits to overturn the 2010 Waste Confidence update on the grounds that NRC had not adequately considered the environmental risks of long-term waste storage at reactor sites. The U.S. Court of Appeals for the District of Columbia Circuit largely agreed, ruling on June 8, 2012, that NRC would have to conduct an environmental review of the Waste Confidence Decision under the National Environmental Policy Act (NEPA). The court found two major flaws in NRC's rulemaking process:

First, in concluding that permanent storage will be available "when necessary," the Commission did not calculate the environmental effects of failing to secure permanent storage—a possibility that cannot be ignored. Second, in determining that spent fuel can safely be stored on site at nuclear plants for sixty years after the expiration of a plant's license, the Commission failed to properly examine future dangers and key consequences.⁴⁸

⁴² Freebairn, William, "NRC Says Lack of Funding Supports Decision to Stop Yucca Review," *NuclearFuel*, January 21, 2013.

⁴³ U.S. Court of Appeals for the District of Columbia Circuit, In re: Aiken County et al., No. 11-1271, writ of mandamus, August 13, 2013, [http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/\\$file/11-1271-1451347.pdf](http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/$file/11-1271-1451347.pdf).

⁴⁴ U.S. Circuit Court of Appeals for the District of Columbia Circuit, *Minnesota v. NRC*, 602 F.2d 412 (D.C. Cir. 1979).

⁴⁵ NRC, "Waste Confidence Decision," 49 *Federal Register* 34,658, August 31, 1984.

⁴⁶ NRC, "Waste Confidence Decision Review," 55 *Federal Register* 38,474, September 18, 1990.

⁴⁷ NRC, "Waste Confidence Decision Update," 75 *Federal Register* 81,037, December 23, 2010.

⁴⁸ U.S. Circuit Court of Appeals for the District of Columbia Circuit, *State of New York, et al. v. Nuclear Regulatory Commission*, No. 11-1045, Decided June 8, 2012, <http://www.cadc.uscourts.gov/internet/opinions.nsf/> (continued...)

NRC has halted licensing of new facilities that rely on the Waste Confidence Decision and plans to complete an environmental impact statement and issue a new Waste Confidence rule by September 2014.⁴⁹ The NRC commissioners approved a proposed Waste Confidence rule on August 5, 2013.⁵⁰

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, with the discussion intensified by the release of DOE's January 2013 nuclear waste strategy. The House has consistently opposed the Obama Administration's efforts to abandon Yucca Mountain, while the Senate has generally expressed more interest in alternative waste management proposals.

Senator Wyden, along with Senators Murkowski, Feinstein, and Alexander, introduced legislation June 27, 2013, to redirect the nuclear waste program along the lines recommended by the Blue Ribbon Commission (S. 1240). The bill would establish an independent Nuclear Waste Administration to develop nuclear waste storage and disposal facilities. Siting of such facilities would require the consent of the affected state, local, and tribal governments.

The Nuclear Waste Administration would be required to develop a mission plan for opening a pilot storage facility for nuclear waste from shutdown reactors and other emergency deliveries by the end of 2021. A larger storage facility for all other highly radioactive waste would have an operational target of December 31, 2025, and a permanent repository would have to be scheduled to open by the end of 2048 (the same dates as in the DOE strategy). The current disposal limit of 70,000 metric tons for the nation's first permanent repository would be repealed.

Nuclear waste fees collected after enactment of the bill would be held in a newly established Working Capital Fund. The Nuclear Waste Administration could immediately draw from that fund any amounts needed to carry out S. 1240, unless limited by annual appropriations or authorizations. Receipts and disbursements of waste fees, as well as the level of the fee, would be overseen by a Nuclear Waste Oversight Board appointed by the President with Senate confirmation. Fee collection would halt after 2025 if a waste facility had not been opened. The existing Nuclear Waste Fund would be available for appropriation by Congress to the Nuclear Waste Administration.

The Senate Committee on Energy and Natural Resources held a hearing on S. 1240 on July 30, 2013. Energy Secretary Ernest J. Moniz, a member of the Blue Ribbon Commission, said the bill provided "a promising framework for addressing key issues." NARUC Electricity Committee Chairman David C. Boyd called the bill "a step in the right direction," but urged that it require continued licensing action on the Yucca Mountain repository. Boyd noted that S. 1240 would not

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57ACA94A8FFAD8AF85257A1700502AA4/\$file/11-1045-1377720.pdf.

⁴⁹ Nuclear Regulatory Commission, "Waste Confidence," web page, February 20, 2013, <http://www.nrc.gov/waste/spent-fuel-storage/wcd.html>.

⁵⁰ NRC, "Proposed Rule: Waste Confidence," August 5, 2013, <http://pbadupws.nrc.gov/docs/ML1321/ML13217A358.pdf>.

preclude enforcement of existing NWPAs deadlines for action on Yucca Mountain. Natural Resources Defense Council Senior Attorney Geoffrey H. Fettus opposed the bill on the grounds that it would allow temporary waste storage facilities to be opened without progress on a permanent repository and that states would have inadequate authority to regulate repository safety, among other concerns.⁵¹

A pilot program to develop one or more voluntary interim storage sites for nuclear waste was included in the FY2014 Energy and Water Development appropriations bill passed by the Senate Appropriations Committee June 27, 2013 (S. 1245, §309). Before moving forward with any proposed waste storage facility, DOE would have to reach siting agreements with the governor of the proposed host state, each unit of local government with jurisdiction over the facility, and each affected Indian tribe. Such agreements would have to be approved by Congress, which would then appropriate funding for the project. Similar language was included by the committee in its FY2013 measure (S. 2465, §312). Corresponding House appropriations bills have not included such an authorization, and it has not been enacted.

The debate over nuclear waste policy was strongly affected by the March 11, 2011, Fukushima Daiichi nuclear accident in Japan. The loss of power at the Fukushima site, caused by a huge earthquake and tsunami, disabled cooling systems at the plant's spent fuel pools. Water in the pools was initially suspected to have boiled or leaked and dropped below the level of the stored spent fuel, potentially leading to fuel damage and radioactive releases into the atmosphere. However, later analysis indicated that the spent fuel did not overheat.

Concerns have been raised in Congress about the risk posed by stored spent fuel, particularly that cancellation of the Yucca Mountain repository would leave growing amounts of spent fuel indefinitely stored at nuclear plant sites throughout the United States. Legislation introduced by Representative Engel on October 28, 2013, would require spent fuel at nuclear power plants to be moved from pools to dry casks after it has sufficiently cooled (H.R. 3354). Costs of the expedited spent fuel transfers would be offset by lower payments into the Nuclear Waste Fund. NRC released a study on November 12, 2013, concluding that "expedited transfer of spent fuel to dry cask storage would provide only a minor or limited safety benefit" and "its expected implementation costs would not be warranted."⁵²

Nuclear waste policy was also the subject of numerous hearings in the 112th Congress, in both appropriations and authorizing committees. In a hearing June 1, 2011, Representative Shimkus, chairman of the Subcommittee on Environment and the Economy of the House Committee on Energy and Commerce, criticized DOE for halting the Yucca Mountain project without citing a technical basis for the decision. "Politics, not science, is driving the debate," he said in his opening statement.⁵³ At a June 14, 2011, hearing, the subcommittee questioned NRC Chairman Gregory Jaczko's decision to terminate the Yucca Mountain license review during FY2011,

⁵¹ Senate Committee on Energy and Natural Resources, Full Committee Hearing to Consider the Nuclear Waste Administration Act of 2013, July 30, 2013, <http://www.energy.senate.gov/public/index.cfm/2013/7/full-committee-hearing-to-consider-the-nuclear-waste-administration-act-of-2013>.

⁵² Nuclear Regulatory Commission, "Staff Evaluation and Recommendations for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel," COMSECY-13-0030, November 12, 2013, <http://www.nrc.gov/reading-rm/doc-collections/commission/comm-secy/2013/2013-0030comsecy.pdf>.

⁵³ Opening Statement, Chairman John Shimkus, Environment Subcommittee Hearing, "DOE's Role in Managing Civilian Radioactive Waste," June 1, 2011, <http://republicans.energycommerce.house.gov/Media/file/Hearings/Environment/060111/Shimkus.pdf>.

including the nearly completed safety evaluation report by the NRC staff.⁵⁴ After examining NRC's unreleased draft safety review, the majority staff of the House Committee on Science, Space, and Technology reported in June 2011 that NRC staff had "made over 1500 findings related to the scientific and technical research efforts of the Department of Energy" and that 98.5% of those findings had been in agreement with DOE's conclusions that the license should be issued.⁵⁵ As noted above, NRC has responded to a recent court decision by ordering its staff to complete the Yucca Mountain safety evaluation report with previously appropriated funds.

Characteristics and Handling 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 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:⁵⁶

Spent nuclear fuel. Fuel rods that have been withdrawn from a nuclear reactor after irradiation, usually because they can no longer efficiently sustain a nuclear chain reaction. (The term "spent nuclear fuel" is defined in NWPA. The nuclear industry typically refers to spent fuel as "used nuclear fuel," because it contains 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). Radiation 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,

⁵⁴ House Energy and Commerce Subcommittee on Environment and the Economy, "Bipartisan Concern Over Administration's Haste to Terminate Permanent Nuclear Repository," press release, June 15, 2011, <http://energycommerce.house.gov/news/PRArticle.aspx?NewsID=8710>.

⁵⁵ *Yucca Mountain: The Administration's Impact on U.S. Nuclear Waste Management Policy*, Report by the Majority Staff of the House Science, Space, and Technology Committee, June 2011, p. 34, <http://science.house.gov/press-release/committee-releases-report-outlining-administration%E2%80%99s-actions-undermine-us-nuclear>.

⁵⁶ 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.

long-term isolation is required. TRU waste is being sent to a deep underground repository, the Waste Isolation Pilot Plant (WIPP), near Carlsbad, NM.

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).

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 to 3%-5% from its natural level of 0.7%). 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 and then decayed to become radioactive plutonium, some of which has also split into fission products. Radioactive gases are contained in the spent fuel rods as well. 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. NRC currently requires spent fuel to cool for at least 7-10 years before being transferred to dry storage.⁵⁷

Spent fuel discharged from U.S. commercial nuclear reactors is currently stored at 61 operating nuclear plant sites, 13 shutdown plant sites, and the Idaho National Laboratory.⁵⁸ A typical large commercial nuclear reactor discharges an average of 20-30 metric tons of spent fuel per year—an

⁵⁷ Nuclear Regulatory Commission, "Staff Evaluation and Recommendations for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel," op. cit., Enclosure 1, p. 77.

⁵⁸ Gutherman Technical Services, *2012 Used Fuel Data*, January 30, 2013. Adjusted for three sites closed during 2013. Includes General Electric's spent fuel storage facility at Morris, IL, located adjacent to the Dresden nuclear plant. Also, the Hope Creek and Salem nuclear plants in New Jersey are counted as a single site.

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 69,718 metric tons at the end of 2012, including 20,104 metric tons in dry storage and other separate storage facilities.⁵⁹ 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 exceed NWPAs 70,000-metric-ton limit for the repository.

As long as nuclear power continues to be generated, the amount of spent fuel 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's most recent estimates of the total amount of U.S. commercial spent fuel that may eventually require disposal range from 105,000 metric tons⁶⁰ to 130,000 metric tons.⁶¹

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. Fifty-six licensed dry storage facilities are currently operating in the United States.⁶² NRC has determined that spent fuel could be stored safely at reactor sites for at least 60 years after a site's reactors cease operation (for a total of 120 years, assuming reactors are licensed for 60 years).⁶³ However, as noted above, that "waste confidence" determination is currently being revisited.

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.⁶⁴ 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.

As noted above, the Fukushima accident heightened concerns that spent fuel pools could be vulnerable to accidental damage resulting from the loss of cooling systems. The safety of spent

⁵⁹ Gutherman Technical Services, op. cit.

⁶⁰ DOE Office of Civilian Radioactive Waste Management, *OCRWM Annual Report to Congress, Fiscal Year 2002*, DOE/RW-0560, October 2003, Appendix C.

⁶¹ 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.

⁶² Gutherman Technical Services, op. cit. In addition, GE operates an independent pool storage facility near Morris, IL.

⁶³ Nuclear Regulatory Commission, *Waste Confidence Decision Update*, 75 *Federal Register* 81037, December 23, 2010, <http://www.federalregister.gov/articles/2010/12/23/2010-31637/waste-confidence-decision-update#p-372>.

⁶⁴ National Academy of Sciences, *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report*, released April 6, 2005, p. 2.

fuel pools is one of the areas examined by an NRC task force that identified near-term lessons that the Fukushima accident may hold for U.S. nuclear power plant regulation. The task force recommended that assured sources of electrical power as well as water spray systems be available for spent fuel pools.⁶⁵ NRC approved an order March 9, 2012, requiring U.S. reactors to install improved water-level monitoring equipment at their spent fuel pools.⁶⁶ As noted above, NRC released a study on November 12, 2013, that found only minor safety benefits in expedited transfers of spent fuel from pools to dry casks.⁶⁷ For more background, see CRS Report R42513, *U.S. Spent Nuclear Fuel Storage*, by James D. Werner.

Commercial Low-Level Waste

About 1.7 million cubic feet of low-level waste with about 9,400 curies of radioactivity was shipped to commercial disposal sites in 2012, according to DOE.⁶⁸ 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. The radioactivity of low-level waste is only a tiny fraction of the amount in annual discharges of spent fuel.

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. As discussed below, most of the nation's Class B and C waste has been stored where it has been generated since June 2008 for lack of a permanent disposal site. The official opening of a new disposal facility for Class A, B, and C low-level waste near Andrews, TX, may alleviate the problem. Although the facility is intended to serve primarily Texas and Vermont, limited amounts of waste may be accepted from other states.⁶⁹ 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

Disposal of spent fuel and high-level waste is a federal responsibility, while states are authorized to develop disposal facilities for commercial low-level waste. The Obama Administration has halted the Yucca Mountain project for high-level waste, although it remains the sole candidate repository site under current law. DOE issued a new waste management strategy in January 2013 that calls for a pilot facility for spent fuel storage to open at a voluntary site by 2021 and a new repository by 2048. New legislation would be required to carry out the strategy.

⁶⁵ U.S. Nuclear Regulatory Commission, Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, *Recommendations for Enhancing Reactor Safety in the 21st Century*, p. 46, <http://pbadupws.nrc.gov/docs/ML1118/ML111861807.pdf>.

⁶⁶ Nuclear Regulatory Commission, "NRC to Issue Orders, Information Request as Part of Implementing Fukushima-Related Recommendations," press release, March 9, 2012, <http://www.nrc.gov/reading-rm/doc-collections/news/2012/12-023.pdf>.

⁶⁷ Nuclear Regulatory Commission, "Staff Evaluation and Recommendations for Japan Lessons-Learned Tier 3 Issue on Expedited Transfer of Spent Fuel," *op.cit.*

⁶⁸ U.S. Department of Energy, Management Information Manifest System, <http://mims.apps.em.doe.gov/mims.asp#>.

⁶⁹ Low Level Waste Forum, "WCS Announces Opening of Texas Compact Disposal Facility," November 10, 2011.

Spent Nuclear Fuel

Current Program and Proposed Policy Changes

The Nuclear Waste Policy Act 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. The fee, set at a tenth of a cent per kilowatt-hour, can be adjusted by the Secretary of Energy based on projected total program costs after a congressional review period. DOE was required to select three candidate sites for the first national high-level waste repository.

After much controversy over DOE's implementation of NWPAA, 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, and construction of an MRS cannot begin until Yucca Mountain receives a construction permit. The repository recommendation was made in February 2002, but DOE has not announced any plans for siting an MRS.

Along with halting all funding for the Yucca Mountain project, the Obama Administration terminated OCRWM at the end of FY2010 and transferred its remaining functions to DOE's Office of Nuclear Energy. The Administration established the Blue Ribbon Commission on America's Nuclear Future (BRC) to develop a new waste management strategy, and the BRC issued its final report on January 26, 2012.⁷⁰

As required by its charter, the BRC did not evaluate specific sites for new nuclear waste facilities, including Yucca Mountain. However, the commission concluded that the existing nuclear waste policy, with Yucca Mountain identified by law as the sole candidate site, "has now all but completely broken down" and "seems destined to bring further controversy, litigation, and protracted delay." The BRC recommended instead that Congress establish "a new, consent-based approach to siting." Under that approach, potential sites would be the subject of extensive negotiations with affected states, tribes, and local governments. Such negotiations would result in legally binding agreements on the roles of the affected parties, including local oversight, and other project parameters.

The BRC noted that previous U.S. efforts to find voluntary waste sites had failed, but it nevertheless expressed confidence that such a process could eventually succeed. In particular, the commission highlighted the U.S. experience with the Waste Isolation Pilot Plant (WIPP) in New

⁷⁰ BRC Final Report, op. cit.

Mexico, which, after many years of controversy, began receiving transuranic defense waste in 1999 with state and local government approval.

Local officials near the WIPP facility have long supported the development of additional waste facilities at the site, which was originally planned to hold high-level waste before the state objected. A presentation by a top New Mexico official on March 1, 2012, described conditions under which the state might be willing to accept high-level waste and spent fuel at the WIPP site, such as assistance with cleaning up the state's contaminated uranium production sites.⁷¹ A local government consortium near the WIPP site, the Eddy-Lea Energy Alliance, sent a letter to NRC on February 26, 2013, that it would submit a license application for the consolidated spent fuel storage facility envisioned by DOE's waste strategy report. "As details of the DOE strategy are implemented, we will keep the NRC staff advised of our progress," the letter said.⁷² Interest in hosting nuclear waste sites has also been expressed by groups in Mississippi and Loving County, Texas.⁷³

To carry out the new waste management program, the BRC recommended that a congressionally chartered federal corporation be established. Such a corporation would be independent from Administration control and have "assured access to funds" but be subject to congressional oversight and to regulation by NRC. Pending establishment of the corporation, the BRC recommended that administrative and legislative changes be implemented in the Nuclear Waste Fund to allow funds to be used for the waste management program without having to compete with other budget priorities.

The BRC called for "prompt efforts" to develop a permanent underground nuclear waste repository and to develop one or more interim central storage facilities. Interim storage facilities are especially needed so that waste can be removed from shutdown reactor sites, the commission said. Development of a permanent site would have to be undertaken along with the interim storage effort to assure that interim sites would not become "de facto" permanent repositories, according to the commission.

In response to the BRC report, and to provide an outline for a new nuclear waste program, DOE issued its *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste* in January 2013.⁷⁴ Under the DOE strategy, a pilot interim spent fuel storage facility would be opened by 2021, focusing primarily on spent fuel from decommissioned nuclear plants. A larger-scale interim storage facility, which could be an expansion of the pilot facility, would open by 2025 with a capacity of 20,000 metric tons or more.

The DOE strategy called for the interim storage facility to be linked to development of a permanent repository so that the storage facility would not become a *de facto* repository. However, the strategy noted that the existing NWA restrictions on the MRS are so rigid that the MRS cannot currently be built. Without describing specific provisions, the DOE strategy

⁷¹ Elaine Hiruo and Herman Wang, "New Mexico Interested in Facilities for Waste Storage, Disposal: Officials," *NuclearFuel*, March 5, 2012, p. 3.

⁷² Maddox, James M., Chairman, Eddy-Lea Energy Alliance, LLC, "Notice of Intent to Submit a License Application for Consolidated Used Nuclear Fuel Storage Facility," February 26, 2013, <http://pbadupws.nrc.gov/docs/ML1306/ML13067A278.pdf>.

⁷³ Housley Carr and Elaine Hiruo, "Group Urges Mississippi to Become Home to Spent Fuel Facilities," *NuclearFuel*, September 2, 2013.

⁷⁴ DOE, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Waste*, op. cit.

recommended that “this linkage should not be such that it overly restricts forward movement on a pilot or larger storage facility that could make progress against the waste management mission.”

Under the DOE strategy, a geologic disposal facility would open by 2048—50 years after the initially planned opening date for the Yucca Mountain repository. A site for the repository is to be selected by 2016, and site suitability studies, design, and licensing are to be completed by 2042.

Sites for the proposed storage and disposal facilities would be selected through a “consent based” process, as recommended by the BRC. However, the DOE strategy included few details on how such a process would be implemented. Instead, the strategy said the Obama Administration would soon begin consultations with Congress and interest groups on “defining consent, deciding how that consent is codified, and determining whether or how it is ratified by Congress.” The program would be implemented by a new nuclear waste management entity, as recommended by the BRC, but the nature of the new organization was not specified by the DOE strategy. A bill introduced by Senator Wyden (S. 1240), discussed under “Congressional Action,” would largely authorize the Administration’s new waste strategy.

Private Interim Storage

When it became apparent that DOE would miss the 1998 deadline for taking nuclear waste from reactor sites, 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 a 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.⁷⁵ The 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.⁷⁶

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.⁷⁷ A federal district court judge on July 26, 2010, ordered the Department of the Interior to reconsider its decisions on the PFS permits.⁷⁸ However, PFS asked NRC to terminate its license on December 20, 2012.⁷⁹

⁷⁵ 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.

⁷⁶ 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.

⁷⁷ Winslow, Ben, “Goshutes, PFS Sue Interior,” *Deseret Morning News*, July 18, 2007.

⁷⁸ U.S. District Court for the District of Utah, *Skull Valley Band of Goshute Indians and Private Fuel Storage v. United States Department of the Interior*, Civil Action No. 07-cv-0526-DME-DON, July 26, 2010, <http://64.38.12.138/docs/court/goshute/order072610.pdf>.

⁷⁹ Palmberg, Robert M., Chairman of the Board, Private Fuel Storage LLC, letter to Nuclear Regulatory Commission, (continued...)

Regulatory Requirements for Yucca Mountain

Although the Obama Administration wants to redirect the nuclear waste program, current law still focuses on Yucca Mountain. NWPA requires that high-level waste repositories be licensed by 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 repository 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 and an MRS facility would have to use NRC-certified casks and comply with NRC requirements for notifying state and local governments. Shipments would also have to 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 is required to 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.

Specific standards for Yucca Mountain were required because of concerns that some of EPA's general standards might be impossible or impractical to meet at Yucca Mountain.⁸⁰ 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, 1995.⁸¹ 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.

Pursuant to the Energy Policy Act of 1992, 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

(...continued)

December 20, 2012, <http://pbadupws.nrc.gov/docs/ML1235/ML12356A063.pdf>.

⁸⁰ 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.

⁸¹ National Research Council. *Technical Bases for Yucca Mountain Standards*. National Academy Press. 1995.

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.⁸² 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.⁸³ Nevada state officials called EPA's proposed standard far too lenient and charged that it was "unlawful and arbitrary."⁸⁴

EPA issued its final rule to amend the Yucca Mountain standards on September 30, 2008. The final rule reduced 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.⁸⁵ NRC revised its repository licensing regulations to conform to the new EPA standards on April 13, 2009.⁸⁶ (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."⁸⁷

⁸² *Nuclear Energy Institute v. Environmental Protection Agency*, U.S. Court of Appeals for the District of Columbia Circuit, No. 01-1258, July 9, 2004.

⁸³ 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.

⁸⁴ 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.

⁸⁵ Posted on the EPA website at <http://www.epa.gov/radiation/yucca>.

⁸⁶ Nuclear Regulatory Commission, "Implementation of a Dose Standard After 10,000 Years," 74 *Federal Register* 10811, March 13, 2009.

⁸⁷ FSEIS, p. S-42. Posted on the DOE website at http://www.rw.doe.gov/ym_repository/seis/docs/002_Summary.pdf.

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. Emplacing waste in deep boreholes, at much greater depths than most proposed repositories, has also been suggested.

DOE’s Fuel Cycle Research and Development Program conducts “long-term, science-based” research on a wide variety of technologies for improving the management of spent nuclear fuel, according to the DOE budget justification. The total FY2014 funding request for this program was \$165.1 million, down from the FY2013 level of \$187.4 million.

Under the Obama Administration, the program has been redirected toward development of technology options for a wide range of nuclear fuel cycle approaches, including direct disposal of spent fuel (the “once through” cycle) and partial and full recycling, according to the justification. The fuel cycle R&D program “will research and develop a suite of technology options that will enable future decision-makers to make informed decisions about how best to manage nuclear waste and used fuel from reactors,” the FY2014 justification says.

Funding

The Obama Administration’s FY2011 budget request called for a complete halt in funding for the Yucca Mountain project and elimination of OCRWM. In line with the request, the FY2011 Continuing Appropriations Act (P.L. 112-10) provided no DOE funding for the program. DOE shut down the Yucca Mountain project at the end of FY2010 and transferred OCRWM’s remaining functions to the Office of Nuclear Energy.

President Obama’s FY2014 federal budget, submitted to Congress April 11, 2013, included no funding for Yucca Mountain but requested \$60 million “to support the program of work” outlined by DOE’s January 2013 nuclear waste strategy. The House provided none of the requested nuclear waste funding in the FY2014 Energy and Water Development appropriations bill (H.R. 2609, H.Rept. 113-135), passed July 10, 2013. Instead, the House included \$25 million in the bill for work related to Yucca Mountain. The Senate Appropriations Committee endorsed the Administration’s nuclear waste funding request in its version of the Energy and Water Bill (S. 1245, S.Rept. 113-47), approved June 27, 2013. FY2014 nuclear waste funding is currently provided through January 15, 2014, by a continuing resolution (P.L. 113-46), at about the spending rate requested by the Administration and with no new funds for Yucca Mountain.

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. At the end of FY2012, the Waste Fund balance stood at \$28.7 billion, according to the

Treasury Department.⁸⁸ Before the Obama Administration halted the Yucca Mountain project, \$7.41 billion had been disbursed from the Waste Fund, according to DOE's program summary report.⁸⁹ 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, 2008.⁹⁰ According to that estimate, the Yucca Mountain program as then planned would cost \$96.2 billion in 2007 dollars from the beginning of the program in 1983 to repository closure in 2133.

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, near Beatty, NV, closed. The remaining two—at Barnwell, SC, and Hanford, WA—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. A site in Texas, discussed below, is authorized to import class A, B, and C waste, but until those imports begin, most of the nation's class B and C waste is being stored at the sites where it is generated.

The commercial low-level waste disposal site under the jurisdiction of the Texas Compact, consisting of Texas and Vermont, opened on November 10, 2011.⁹¹ The site received its first shipment of waste, from a company in Vermont, on April 27, 2012.⁹² Texas also enacted a law in 2011 to allow up to 30% of the Texas disposal site's capacity to be used by states outside of the compact, and final regulations for the waste imports were issued March 23, 2012.⁹³

Legislation providing congressional consent to the Texas compact, which originally also included Maine as well as Vermont, was signed by President Clinton September 20, 1998 (P.L. 105-236). However, on October 22, 1998, a proposed disposal site near Sierra Blanca, TX, was rejected by the Texas Natural Resource Conservation Commission, and Maine subsequently withdrew. Texas Governor Perry signed legislation June 20, 2003, authorizing the Texas Commission on

⁸⁸ E-mail from Thomas Santaniello, Bureau of the Fiscal Service, March 29, 2013.

⁸⁹ DOE, Office of Civilian Radioactive Waste Management, Office of Program Management, *Monthly Summary of Program Financial and Budget Information*, as of January 31, 2010, available at <http://www.thenwsc.org/ym/DOE%20Financial%20&%20Budget%20Summary%20013110.pdf>.

The report notes that some figures may not add due to independent rounding.

⁹⁰ Available on the DOE website at http://energy.gov/sites/prod/files/gcprod/documents/FY_2007_TotalSystemLifeCycleCost_Pub2008.pdf.

⁹¹ Waste Control Specialists LLC, "Historic Texas Compact Disposal Facility Ready for Business," <http://www.wcstexas.com>.

⁹² Bionomics, Inc., "Bionomics Makes First Shipment to Texas Low Level Waste Site," press release, April 27, 2012, <http://www.bionomics-inc.com/documents/Newsletter/First%20Shipment%20to%20Texas.pdf>.

⁹³ Conley, Maureen, "Texas Commission Approves Import of LLW to New Disposal Facility," *Nucleonics Week*, March 29, 2012, p. 8.

Environmental Quality (TCEQ) to license adjoining disposal facilities for commercial and federally generated low-level waste. Pursuant to that statute, an application to build the Andrews County disposal facility 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 had been acquired and approved construction of the facility January 7, 2011.⁹⁴

The disposal facility at Barnwell, SC, 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.⁹⁵

The only other existing disposal facility for all three major classes of low-level waste is at Hanford, WA. 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, and pending planned imports by the Texas compact, the 34 states and the District of Columbia that are outside the Northwest, Rocky Mountain, Atlantic, and Texas compacts have had no disposal site for Class B and C low-level waste.

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. Concern about spent fuel storage safety has been heightened by the March 2011 disaster at Japan’s Fukushima Daiichi nuclear plant.

⁹⁴ TCEQ website: http://www.tceq.state.tx.us/permitting/radmat/licensing/wcs_license_app.html#wcs_status.

⁹⁵ *Alabama et al. v. North Carolina*, S. Ct. (2010), <http://www.supremecourt.gov/opinions/09pdf/132Orig.pdf>.

Under current law, the federal government's nuclear waste disposal policy is focused on the Yucca Mountain site. However, President Obama's moves to terminate the Yucca Mountain project and develop a new waste strategy through the Blue Ribbon Commission on America's Nuclear Future have brought most activities in the DOE waste program to a halt. Congress is continuing to debate the project's termination, particularly through the 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 above \$20 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 rise by 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.⁹⁶ In addition, further repository delays could force DOE to miss compliance deadlines for defense waste disposal.

Problems being created by nuclear waste disposal delays were addressed by the Blue Ribbon Commission in its final report, issued in January 2012. 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. The commission recommended that a congressionally chartered corporation be established to undertake a negotiated process for siting new waste storage and disposal facilities. However, 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, including those of the Blue Ribbon Commission.

Selected Legislation

H.R. 2081 (Thornberry)

No More Excuses Energy Act of 2013. Includes provisions to prohibit NRC from considering nuclear waste storage when licensing new nuclear facilities, and to establish a tax credit for obtaining nuclear component manufacturing certification. Introduced May 21, 2013; referred to multiple committees.

H.R. 2609 (Frelinghuysen)/S. 1245 (Feinstein)

Energy and Water Development and Related Agencies Appropriations Act, 2014. Provides funding for DOE nuclear programs and NRC. House bill introduced July 2, 2013; reported as original measure by Committee on Appropriations July 2, 2013 (H.Rept. 113-135); passed House

⁹⁶ Lovell, David L., Wisconsin Legislative Council Staff, *State Statutes Limiting the Construction of Nuclear Power Plants*, October 5, 2006.

July 10, 2013, by vote of 227-198. Senate bill introduced June 27, 2013; reported as original measure by Committee on Appropriations June 27, 2013 (S.Rept. 113-47).

H.R. 3354 (Engel)

Dry Cask Storage Act. Requires spent fuel at nuclear power plants to be moved from spent fuel pools to dry casks after it has sufficiently cooled. Costs of the fuel transfers would be offset by a reduction in nuclear waste fees owed to the federal government. Introduced October 28, 2013; referred to Committee on Energy and Commerce.

S. 1240 (Wyden)

Nuclear Waste Administration Act of 2013. Establishes an independent Nuclear Waste Administration to develop nuclear waste storage and disposal facilities. Siting of such facilities would require the consent of the affected state, local, and tribal governments. The Nuclear Waste Administration could spend nuclear waste fees collected after the bill's enactment without the need for further appropriation. Fee collection would halt after 2025 if a waste facility had not been opened. Introduced June 27, 2013; referred to Committee on Energy and Natural Resources. Committee hearing held July 30, 2013.

For Additional Reading

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