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Civilian Nuclear Waste Disposal

Updated September 6, 2018

Congressional Research Service
https://crsreports.congress.gov
RL33461

CRS REPORT
Prepared for Members and
Committees of Congress

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 permanent disposal facility for spent nuclear fuel or other highly radioactive waste.

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 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 issues.

Licensing and design work for the proposed Yucca Mountain repository was halted under the Obama Administration, which cited continued opposition from Nevada. To develop an alternative nuclear waste policy, the Obama Administration established the Blue Ribbon Commission on America's Nuclear Future, which in 2012 recommended a "consent based" process for siting nuclear waste storage and disposal facilities.

The Trump Administration included funds to restart Yucca Mountain licensing in its FY2018 and FY2019 budget submissions to Congress. The FY2018 Yucca Mountain funding request was not enacted. For FY2019, the House voted to provide $100 million above the Administration's request for Yucca Mountain, while the Senate zeroed it out (H.R. 5895).

Although no funding has been appropriated for Yucca Mountain activities since FY2010, a federal appeals court on August 13, 2013, ordered NRC to continue the licensing process with previously appropriated funds. The NRC staff completed its safety evaluation report on Yucca Mountain on January 29, 2015, concluding that the repository would meet NRC standards after specific additional actions were taken, such as acquisition of land and water rights.

A bill to provide the necessary land controls for the planned Yucca Mountain repository (H.R. 3053, H.Rept. 115-355) passed the House on May 10, 2018. In addition, the House-passed bill would authorize DOE to store commercial waste from nuclear power plants at a nonfederal interim storage facility. It would also increase the capacity limit on the Yucca Mountain repository from 70,000 to 110,000 metric tons, in comparison with the approximately 80,000 metric tons currently stored at U.S. nuclear plants.

Nonfederal interim storage facilities for spent nuclear fuel are being proposed in New Mexico and Texas. An NRC license application for the New Mexico facility was filed March 30, 2017. Developers of the proposed Texas storage site filed a license application in 2016, subsequently withdrew it because of rising costs, and then submitted a renewed application with an additional partner on June 11, 2018. Interim storage proponents contend that DOE could fulfill its disposal obligations under NWPA by taking title to spent fuel at nuclear plant sites and storing it at private facilities until a permanent underground repository could be opened.

NWPA required DOE to begin removing spent fuel from reactor sites by January 31, 1998. Because that deadline was missed, nuclear utilities have sued DOE to recover the additional storage costs they have incurred, with damage payment so far totaling $6.9 billion.

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Most Recent Developments

President Trump proposes to resume development of the long-planned nuclear waste repository at Yucca Mountain, Nevada, which had been suspended under the Obama Administration.

The Trump Administration's congressional budget request for FY2019, submitted February 12, 2018, continued the Administration's FY2018 funding request for the Yucca Mountain nuclear waste repository project. As in the FY2018 request, which Congress did not approve, the FY2019 request would provide the Department of Energy (DOE) with $120 million for Yucca Mountain and interim nuclear waste storage.[1] An additional $47.7 million was requested for the Nuclear Regulatory Commission (NRC) in FY2019 (up from $30 million in FY2018) to resume its licensing process for Yucca Mountain.[2] The House passed an FY2019 appropriations bill for Energy and Water Development, Legislative Branch, and Military Construction and Veterans Affairs (H.R. 5895) on June 8, 2018, that includes $100 million more than the Administration requested for Yucca Mountain. But the Senate version of the bill, which passed June 25, 2018, includes no Yucca Mountain funding.

Under the Nuclear Waste Policy Act of 1982 (NWPA, P.L. 97-425), the Yucca Mountain site has been the only location under consideration by DOE for construction of a national high-level radioactive waste repository. DOE had submitted a license application for the Yucca Mountain repository to the NRC on June 3, 2008, as required by NWPA. However, the Obama Administration announced it would request no further funding for the project and moved to withdraw the application on March 3, 2010. Although Congress approved the Obama Administration's halt in Yucca Mountain funding after FY2010, it has not amended NWPA, which still names Yucca Mountain as the sole repository candidate site.

After deciding to terminate the Yucca Mountain repository project, the Obama Administration established the Blue Ribbon Commission on America's Nuclear Future (BRC) to develop a new 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.[3]

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 called 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 was to open 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. After holding public meetings around the country during 2016, DOE issued a draft

[1] DOE, *FY 2019 Congressional Budget Justification*, vol. 3, part 2, p. 403, https://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf.

[2] NRC, *Congressional Budget Justification Fiscal Year 2019*, p. 39, https://www.nrc.gov/docs/ML1802/ML18023B460.pdf.

[3] 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).

consent-based siting process on January 12, 2017, shortly before the start of the Trump Administration.[4]

Yucca Mountain Licensing

The House approved a bill on May 10, 2018 (H.R. 3053, H.Rept. 115-355) that would withdraw the Yucca Mountain site from other uses under the public lands laws. The land withdrawal would satisfy one of the remaining licensing conditions identified by the NRC staff in its Yucca Mountain repository Safety Evaluation Report (SER), the final two volumes of which were issued on January 29, 2015.

NRC completed the SER in response to a court order that the Yucca Mountain repository licensing process continue as long as previously appropriated funding was available. The SER contains the NRC staff's determination of whether the repository would meet all applicable standards. Volume 3 of the SER, issued in October 2014, concluded that DOE's Yucca Mountain repository design would comply with safety and environmental standards after being permanently sealed.[5]

However, the staff said upon completing the SER that NRC should not authorize construction of the repository until all land and water rights requirements were met and a supplement to DOE's environmental impact statement (EIS) was completed.[6] NRC completed the supplemental EIS in May 2016[7] and made its database of Yucca Mountain licensing documents publicly available, using all the remaining previously appropriated licensing funds.[8]

Then-NRC Chairman Stephen Burns testified March 4, 2015, that his agency would need $330 million in additional appropriations to complete the licensing process, including adjudicatory hearings on as many as 300 issues that have been raised by the State of Nevada and others.[9] As noted above, the Trump Administration is requesting $47.7 million in FY2019 for NRC licensing activities for Yucca Mountain, plus $120 million for DOE to defend its license application for the repository and develop interim storage facilities.

Separate Disposal Facility for Defense Waste

The Obama Administration issued a draft plan on December 16, 2016, for a separate underground repository for high-level radioactive waste and spent fuel generated by nuclear defense activities. The effort to develop a defense waste repository would reverse a 1985 decision by the Reagan Administration to dispose of defense and civilian nuclear waste together. Then-Energy Secretary Ernest Moniz described the proposed defense-only repository as potentially easier to site, license, and construct than a combined defense-civilian repository, because defense waste constitutes a

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[4] DOE, "Consent-Based Siting," https://www.energy.gov/ne/consent-based-siting.

[5] NRC, "NRC Staff Issues Volume 3 of Yucca Mountain Safety Evaluation Report," news release 14-069, October 16, 2014, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1949/v3/.

[6] NRC, "NRC Publishes Final Two Volumes of Yucca Mountain Safety Evaluation," news release 15-005, January 29. 2015, http://www.nrc.gov/reading-rm/doc-collections/news/2015/.

[7] NRC, Supplement to the U.S. Department of Energy's 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, NUREG-2184, Final Report, May 2016, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2184/.

[8] NRC, "NRC Makes Yucca Mountain Hearing Documents Publicly Available," news release, August 19, 2016, http://www.nrc.gov/docs/ML1623/ML16232A429.pdf.

[9] Hiruo, Elaine, and Steven Dolley, "NRC Says Staff Can Finish Yucca Supplemental EIS in 12-15 Months," NuclearFuel, March 16, 2015.

relatively small portion of total high-level waste volumes and radioactivity, and some defense waste is in forms that might be optimized for certain types of disposal, such as deep boreholes.[10]

In a report issued in October 2014, DOE concluded that a defense-only nuclear waste repository "could be sited and developed outside the framework of the Nuclear Waste Policy Act." Under this reasoning, NWPA would not have to be amended to allow a defense-only repository to proceed. However, according to the DOE report, "Any such repository would be subject to licensing by the U.S. Nuclear Regulatory Commission and would have to comply with other NWPA requirements related to state and local participation in the siting process."[11] DOE's draft plan estimated that disposal of defense waste could begin about 22 years after a consent-based siting process were started. However, the Government Accountability Office (GAO) issued a report in January 2017 that assessed DOE's analysis of the defense-only repository as excluding major costs "that could add tens of billions of dollars" and including a schedule that "appears optimistic," in light of "past repository siting experiences."[12]

Republican leaders of the House Committee on Energy and Commerce issued a statement on March 24, 2015, criticizing DOE's plan for a defense-only nuclear waste repository as a way to deflect efforts to resume progress on Yucca Mountain.[13] Legislation introduced January 11, 2017 (H.R. 433) would block development of a defense-only repository before NRC has issued a licensing decision on the Yucca Mountain repository. A similar provision is included in nuclear waste legislation (H.R. 3053) passed by the House May 10, 2018.

Consent-Based Siting Legislation

Provisions to authorize DOE to develop consent-based pilot interim storage facilities for spent nuclear fuel were included in the FY2019 appropriations bill for Energy and Water Development, Legislative Branch, and Military Construction and Veterans Affairs (H.R. 5895) passed by the Senate on June 25, 2018. Under Section 304 of Division A, priority for storage at the pilot facilities would be given to spent fuel that is currently stored at closed nuclear plant sites. DOE could not select a site for a pilot storage facility without the consent of the governor of the host state, all localities with jurisdiction over the site, and any affected Indian tribes. DOE would be required to report to Congress on the potential need for compensation or incentives for host jurisdictions, as well as recommendations for a mechanism to ensure that waste stored at a pilot storage facility would be moved to a permanent underground repository using a consent-based siting process "within a reasonable time."

Similar provisions on a consent-based pilot program for interim storage have also been included by the Senate Appropriations Committee in previous years' Energy and Water Development funding bills, but they were not included in the enacted legislation. The House has not included such provisions in its past or present Energy and Water bills.

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[10] DOE Office of Nuclear Energy, "Deep Borehole Disposal Research: Demonstration Site Selection Guidelines, Borehole Seals Design, and RD&D Needs," undated web page, http://www.energy.gov/ne/downloads/deep-borehole-disposal-research-demonstration-site-selection-guidelines-borehole-seals.

[11] DOE, *Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel*, October 2014, p. iii.

[12] GAO, Nuclear Waste: Benefits and Costs Should Be Better Understood Before DOE Commits to a Separate Repository for Defense Waste, January 2017, GAO-17-174, http://www.gao.gov/assets/690/682385.pdf.

[13] House Committee on Energy and Commerce, "Committee Leaders Respond to DOE's Nuclear Waste Delay," March 24, 2015, http://energycommerce.house.gov/press-release/committee-leaders-respond-doe%E2%80%99s-nuclear-waste-delay.

Consent-based siting provisions for a monitored retrievable storage (interim storage) facility are included in a nuclear waste bill (H.R. 3053) passed by the House on May 10, 2018. The bill would authorize DOE to store spent nuclear fuel at interim storage facilities owned by non-federal entities, if consent were provided by the governor of the host state, units of local government with jurisdiction over the site, and affected Indian tribes.

In the 114th Congress, bipartisan legislation to implement several of the major BRC recommendations, the Nuclear Waste Administration Act of 2015 (S. 854), was introduced but not enacted. Introduced March 24, 2015, by Senator Lamar Alexander, S. 854 would have established an independent Nuclear Waste Administration to find sites for nuclear waste storage and disposal facilities with the consent of state and local officials and affected Indian tribes.[14]

Private-Sector Waste Storage Sites

An NRC license application for a spent fuel storage facility in New Mexico was filed March 30, 2017, by Holtec International, a manufacturer of spent fuel storage systems.[15] The facility would be located on a 1,000-acre site provided by a local government consortium near the Waste Isolation Pilot Plant in New Mexico, the Eddy-Lea Energy Alliance (ELEA). According to Holtec, the storage facility when fully developed is to hold 10,000 canisters of spent fuel in below-grade concrete silos.[16] The facility is to be developed in 20 phases over 20 years, with each phase consisting of 500 canisters containing up to a combined 8,680 metric tons of spent fuel.[17] Total storage capacity is to be about 120,000 metric tons.[18]

The waste management company Waste Control Specialists (WCS) filed an application on April 28, 2016, for an NRC license to develop an interim storage facility for spent nuclear fuel in Texas. WCS asked NRC to suspend consideration of the license application April 18, 2017, citing estimated licensing costs that were "significantly higher than we originally estimated."[19] However, WCS subsequently formed a joint venture with Orano USA called Waste Control Partners, which submitted a renewed application for the Texas facility on June 11, 2018.[20]

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[14] Cosponsoring S. 854 were Senator Feinstein, ranking Democrat on the Energy and Water subcommittee, Senator Murkowski, chairman of the Energy and Natural Resources Committee, and Senator Cantwell, ranking Democrat on the Energy and Natural Resources Committee. The bill was similar to S. 1240 in the 113th Congress.

[15] NRC, "Holtec International—HI-STORE CISF," April 5, 2018, https://www.nrc.gov/waste/spent-fuel-storage/cis/holtec-international.html.

[16] Holtec International, "The HI-STORE Consolidated Interim Storage (CIS) Program Reaches a Major Milestone," news release, March 30, 2017, https://holtecinternational.com/2017/03/30/the-hi-store-consolidated-interim-storage-cis-program-reaches-a-major-milestone.

[17] Nuclear Regulatory Commission, "Holtec International's HI-STORE Consolidated Interim Storage Facility for Interim Storage of Spent Nuclear Fuel," *Federal Register*, July 16, 2018, https://www.federalregister.gov/documents/2018/07/16/2018-15079/holtec-internationals-hi-store-consolidated-interim-storage-facility-for-interim-storage-of-spent.

[18] Holtec International, "Holtec's Proposed Consolidated Interim Storage Facility in Southeastern New Mexico," 2018, https://holtecinternational.com/productsandservices/hi-store-cis/.

[19] NRC, "Joint Request to Withdraw the *Federal Register* Notice Providing an Opportunity to Submit Hearing Requests" (including WCS letter of April 18, 2017), April 19, 2017, https://www.nrc.gov/docs/ML1710/ML17109A480.pdf.

[20] Orano USA, "Interim Storage Partners Submits Renewed NRC License Application for Used Nuclear Fuel Consolidated Interim Storage Facility in West Texas," press release, June 11, 2018, http://us.areva.com/EN/home-4216/orano-orano-usa—interim-storage-partners-submits-renewed-nrc-license-application-for-used-nuclear-fuel-consolidated-interim-storage-facility-in-west-texas.html.

The proposed WCS spent fuel storage facility would be built at a 14,000-acre site near Andrews, TX, where the company currently operates two low-level radioactive waste storage facilities with local support. Before requesting suspension of the license application, WCS had said it would complete construction "as early as 2022."[21] Under the WCS proposal, DOE would take title to spent fuel at nuclear plant sites, ship it to the Texas site, and pay WCS for storage for as long as 40 years with possible extensions, according to the company. DOE's costs would be covered through appropriations from the Nuclear Waste Fund, as were most costs for the Yucca Mountain project. WCS contends that a privately developed spent fuel storage facility would not be bound by NWPA restrictions that prohibit DOE from building a storage facility without making progress on Yucca Mountain.[22]

Provisions to explicitly authorize DOE to enter into contracts with non-federal interim storage facilities for spent fuel were included in legislation (H.R. 3053) passed by the House on May 10, 2018. A related bill (H.R. 474) was introduced January 12, 2017, by Representative Issa. It is similar to bills (H.R. 3643, H.R. 4745) introduced in the 114th Congress by Representatives Conaway and Mulvaney, respectively, but not enacted. Under those bills, DOE would take title to all spent nuclear fuel from commercial reactors delivered to the private storage facility. Annual interest earned by the Nuclear Waste Fund, estimated at $1.5 billion in FY2017,[23] could be used by DOE without further congressional appropriation to pay for private interim storage.

Waste Program Appropriations

The Trump Administration's FY2018 budget request would have provided the first new Yucca Mountain funding since FY2010, although it was not approved by Congress. For FY2019, the Administration is again seeking funding for Yucca Mountain: DOE would receive $110 million to seek an NRC license for the repository, and NRC would receive $47.7 million to consider DOE's application. DOE would also receive $10 million to develop interim nuclear waste storage facilities. DOE's total of $120 million in nuclear waste funding for FY2019 would come from two appropriations accounts: $90 million from Nuclear Waste Disposal and $30 million from Defense Nuclear Waste Disposal (to pay for defense-related nuclear waste that would be disposed of in Yucca Mountain).

DOE funding is included in the annual Energy and Water Development Appropriations bill, which for FY2019 has been combined with the Legislative Branch Appropriations bill and the Military Construction and Veterans Affairs Appropriations bills (H.R. 5895). The bill passed the House June 8, 2018, with $100 million more than requested for Yucca Mountain ($190 million for Nuclear Waste Disposal and $30 million for Defense Nuclear Waste Disposal). The Senate version of the bill, passed June 25, 2018, included no Yucca Mountain funding. This situation continues a pattern seen in recent years, in which the funding ultimately has not been approved.

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[21] Waste Control Specialists, "WCS Files License Application with Nuclear Regulatory Commission (NRC) to Operate a Consolidated Interim Storage Facility (CISF) for Used Nuclear Fuel," April 28, 2016, news release, http://www.wcstexas.com/wp-content/uploads/2016/04/4_28_16.WCS_Release.pdf; Valhi, Inc., "Valhi's Waste Control Specialists Subsidiary to Apply for License to Store Used Nuclear Fuel," February 7, 2015, http://www.valhi.net/phoenix.zhtml?c=103380&p=irol-newsArticle&ID=2014598.

[22] Beattie, Jeff, "Waste Control Specialists Sets 2020 Date to Open Spent Fuel Storage Facility," *IHS The Energy Daily*, February 10, 2015, p. 1; Hiruo, Elaine, "Texas Company Seeks License for Spent Fuel Storage," *Nucleonics Week*, February 12, 2015, p. 1.

[23] Office of Management and Budget, *Budget of the U.S. Government*, Fiscal Year 2017, Appendix, p. 421, https://www.govinfo.gov/content/pkg/BUDGET-2017-APP/pdf/BUDGET-2017-APP.pdf.

Nuclear Waste Fee Collections

DOE stopped collecting nuclear waste fees from nuclear power generators on May 16, 2014, pursuant to a court ruling.[24] Citing uncertainty about the future of the nuclear waste program, the U.S. Court of Appeals for the District of Columbia Circuit had 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, had been paid by nuclear power generators at the rate of a tenth of a cent per kilowatt-hour and totaled about $750 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.[25]

In planning to restart the Yucca Mountain program, the Trump Administration announced in its FY2019 budget request (and the FY2018 request) that DOE would conduct a new cost assessment for determining the level of the nuclear waste fee, based on previous cost estimates for Yucca Mountain.[26]

Waste Confidence and Continued Storage Rulemaking

NRC approved a final rule August 26, 2014, on continued storage of spent nuclear fuel.[27] The continued storage rule takes the place of NRC's earlier "waste confidence" rule, which was struck down by the U.S. Court of Appeals for the District of Columbia on June 8, 2012. The waste confidence rule had spelled out NRC's formal findings that waste generated by nuclear power plants would be disposed of safely—specifically, that spent nuclear fuel could be safely stored at nuclear plants for at least 60 years after they had 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 most recent waste confidence findings in December 2010.[28]

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, after the court struck down the waste confidence rule, NRC halted licensing of new facilities that would generate radioactive waste. In approving the continued storage rule in August 2014, NRC ended its suspension of final licensing decisions for new reactors, spent fuel storage facilities, and license renewals. A

[24] Hiruo, Elaine, "DOE Implements Court-Ordered Suspension of Nuclear Waste Fee," *NuclearFuel*, May 26, 2014.

[25] U.S. Court of Appeals for the District of Columbia Columbia Circuit, National Association of Regulatory Utility Commissioners v. United States Department of Energy, No. 11-1066, November 19, 2013, https://www.cadc.uscourts.gov/internet/opinions.nsf/2708C01ECFE3109F85257C280053406E/$file/11-1066-1466796.pdf.

[26] DOE, *FY 2019 Congressional Budget Justification*, vol. 3, part 2, p. 414, https://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf.

[27] NRC, "NRC Approves Final Rule on Spent Fuel Storage and Ends Suspension of Final Licensing Actions for Nuclear Plants and Renewals," news release, August 26, 2014, http://pbadupws.nrc.gov/docs/ML1423/ML14238A326.pdf.

[28] 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.

consolidated lawsuit by several states and environmental groups to overturn NRC's continued storage rule was rejected by the U.S. Court of Appeals for the D.C. Circuit on June 3, 2016.[29]

Proposed Low-Level Waste Regulations

NRC proposed a significant modification of its low-level waste disposal regulations on March 26, 2015.[30] In contrast to highly radioactive spent nuclear fuel, low-level waste primarily contains low concentrations of radioactive materials and decays to background radiation levels more quickly. The NRC staff submitted a final version of the regulations for commission approval on September 15, 2016,[31] but the commission issued further revisions on September 8, 2017, that must be incorporated before it can be published as a supplemental proposed rule.[32] As drafted by the NRC staff, the regulations would for the first time establish time periods for technical analyses of low-level waste sites to ensure protection of the general population.

Policy Background

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.[33] 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 (P.L. 97-425), as amended in 1987, requires DOE to focus on Yucca Mountain, NV, as the site of a deep underground repository for spent nuclear fuel and other highly radioactive waste. The State of Nevada has strongly opposed the planned Yucca Mountain repository 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 should proceed, as specified by NWPA. 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 NWPA.

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 Obama Administration's FY2011

[29] U.S. Circuit Court of Appeals for the District of Columbia Circuit, State of New York, et al. v. Nuclear Regulatory Commission, No. 14-1210, decided June 3, 2016, https://www.cadc.uscourts.gov/internet/opinions.nsf/EC538E49837A3F4D85257FC700502E26/$file/14-1210-1616468.pdf.

[30] NRC, "Low-Level Radioactive Waste Disposal; Proposed Rule," 80 *Federal Register* 16082, March 26, 2015.

[31] NRC, "Final Rule: Low-Level Radioactive Waste Disposal," SECY-16-0106, September 15, 2016, https://www.nrc.gov/docs/ML1618/ML16188A290.html.

[32] NRC, "Staff Requirements—SECY-16-0106—Final Rule: Low-Level Radioactive Waste Disposal," September 8, 2017, https://www.nrc.gov/docs/ML1725/ML17251B147.pdf.

[33] The term "spent nuclear fuel" is defined by NWPA as "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." The nuclear industry refers to this material as "used fuel," because it contains potentially reusable uranium and plutonium after reprocessing.

budget request reversed the previous year's plan to continue licensing the repository and called for a complete halt in funding and closure 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.

President Trump intends to restart the Yucca Mountain licensing process, requesting $120 million for Yucca Mountain and interim waste storage in his FY2019 budget submission to Congress on February 12, 2018. (The Administration sought the same amount for FY2018 but it was not approved.) Under the FY2019 request, DOE would receive $110 million to seek an NRC license for the repository, and NRC would receive $47.7 million to consider DOE's application. DOE would also receive $10 million to develop interim nuclear waste storage facilities.

Under the Obama Administration, DOE had 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.[34] 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."[35]

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.[36] 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."[37] 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 had at least $11.1 million in previously appropriated funds for that purpose.[38]

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.[39] NRC issued Volume 3 of

[34] *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.

[35] 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=.

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

[37] 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.

[38] 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.

[39] 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.

the SER on October 16, 2014, concluding that DOE's Yucca Mountain repository design would comply with safety and environmental standards for 1 million years after being permanently sealed.[40] NRC issued the final two volumes of the Yucca Mountain SER on January 29, 2015.[41]

Upon completing the SER, the staff said that NRC should not authorize construction of the repository until all land and water rights requirements were met and a supplement to DOE's environmental impact statement (EIS) was completed. NRC completed the supplemental EIS in May 2016 and made its database of Yucca Mountain licensing documents publicly available, using all the remaining previously appropriated licensing funds.[42] NRC Chairman Stephen Burns testified March 4, 2015, that $330 million in additional appropriations would be needed to complete the licensing process, including adjudicatory hearings on as many as 300 issues that have been raised by the State of Nevada and others.[43]

After halting the Yucca Mountain project in 2010, the Obama Administration established the Blue Ribbon Commission on America's Nuclear Future (BRC) to develop alternative waste disposal strategies. 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.[44] The BRC had commissioned a series of reports on various aspects of nuclear waste policy to assist in its deliberations.[45]

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 called 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 was to 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 was to open by 2048—50 years after the initially planned opening date for the Yucca Mountain repository.[46]

To help develop a consent-based siting process, DOE in December 2015 invited public comment on the concept and announced a series of public meetings through mid-2016. Suggested issues to be addressed include fairness of the siting process, possible site-selection models, appropriate participants and their roles in the process, information requirements for adequate public participation, and any other relevant concerns.[47] Following the public meetings, DOE issued a

[40] NRC, "NRC Staff Issues Volume 3 of Yucca Mountain Safety Evaluation Report," news release 14-069, October 16, 2014, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1949/v3/.

[41] NRC, "NRC Publishes Final Two Volumes of Yucca Mountain Safety Evaluation," news release 15-005, January 29. 2015, http://www.nrc.gov/reading-rm/doc-collections/news/2015/.

[42] NRC, *Supplement to the U.S. Department of Energy's Environmental Impact Statement*, op. cit., and NRC, "NRC Makes Yucca Mountain Hearing Documents Publicly Available," op. cit.

[43] Hiruo, Elaine, and Steven Dolley, "NRC Says Staff Can Finish Yucca Supplemental EIS in 12-15 Months," NuclearFuel, March 16, 2015.

[44] 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).

[45] Blue Ribbon Commission on America's Nuclear Future, Commissioned Papers, http://cybercemetery.unt.edu/archive/brc/20120620214809/http://brc.gov/index.php?q=library/documents/commissioned-papers.

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

[47] DOE, "Invitation for Public Comment to Inform the Design of a Consent-Based Siting Process for Nuclear Waste Storage and Disposal Facilities," *Federal Register*, December 23, 2015, https://www.federalregister.gov/articles/2015/12/23/2015-32346/invitation-for-public-comment-to-inform-the-design-of-a-consent-based-siting-process-for-nuclear.

draft consent-based siting process on January 12, 2017, that included five phases (with estimated time for completion):

- Phase 1: siting process initiation and community outreach, 1-3 years. Legislation would authorize and fund a waste management agency to conduct a consent-based siting process agency and provide grants to interested communities to determine whether to request a preliminary site assessment.
- Phase 2: preliminary site assessment, 1-2 years for interim storage and 2-4 years for a permanent repository. After a preliminary site assessment, an interested community could request a detailed site assessment.
- Phase 3: detailed site assessment, 2-4 years for interim storage, 5-10 years for repository. After assessment, communities with sites found suitable would decide on their willingness to host storage or disposal facilities.
- Phase 4: agreement, 1-2 years for interim storage, 2-5 years for repository. The potential host community and the waste management agency would negotiate a siting agreement, which would be approved by "all required parties," presumably including the host state government.
- Phase 5: licensing, construction, operation, and closure. Licensing and construction are estimated to take up to 5 years for an interim storage facility and 15 years for a repository. An interim storage facility would operate for up to 100 years and a repository for up to 150 years before closure.[48]

The Trump Administration's proposal to restart the Yucca Mountain project in FY2019 would provide funding for a Yucca Mountain program office, legal and technical support for the Yucca Mountain license application to NRC, and the management of millions of documents supporting the application. The Administration's request for $10 million for interim storage would include planning for a solicitation for storage services, transportation planning, and other preparations for waste shipments.

The nuclear power industry has supported completion of NRC's licensing review of Yucca Mountain along with the pursuit of alternative storage and disposal facilities. "The target date for opening of Yucca Mountain or an alternative repository site should be no more than 20 years after a consolidated storage site is opened," according to an industry policy statement.[49]

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.[50]

However, 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

[48] DOE, Draft Consent-Based Siting Process for Consolidated Storage and Disposal Facilities for Spent Nuclear Fuel and High-Level Radioactive Waste, January 12, 2017, https://www.energy.gov/sites/prod/files/2017/01/f34/Draft%20Consent-Based%20Siting%20Process%20and%20Siting%20Considerations.pdf.

[49] Nuclear Energy Institute, "Nuclear Waste Management: Disposal," October 28, 2014, http://www.nei.org/Issues-Policy/Nuclear-Waste-Management/Disposal.

[50] 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.

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 FY2017 and previous years 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 cost concerns and the potential weapons use of separated plutonium. The Obama Administration had refocused DOE's nuclear waste research toward fundamental science and away from the near-term design and development of reprocessing facilities. The Trump Administration's FY2019 budget request would sharply reduce DOE funding for nuclear spent fuel reprocessing, while continuing to focus on "a long-term, science-based approach."[51]

President Bush had recommended the Yucca Mountain site to Congress on February 15, 2002, and Nevada Governor Guinn submitted a notice of disapproval, or "state veto," April 8, 2002, as allowed by NWPA. The state veto would have blocked further repository development at Yucca Mountain if a resolution approving the site had not been passed by Congress and signed into law within 90 days of continuous session. An approval resolution was signed by President Bush July 23, 2002 (P.L. 107-200).[52]

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.[53] The Texas

[51] DOE, *FY 2019 Congressional Budget Justification*, vol. 3, part 2, March 2018, p. 313, https://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf.

[52] 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.

[53] Waste Control Specialists LLC, "Historic Texas Compact Disposal Facility Ready for Business,"

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.[54]

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.[55]

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. Subsequent nuclear waste compensation to utilities has come from the U.S. Treasury's Judgment Fund, a permanent account that is used to cover damage claims against the U.S. government. Payments from the Judgment Fund do not require appropriations.

Through FY2017, nuclear waste payments from the Judgment Fund included $4.9 billion resulting from settlements and $2 billion from final court judgments, for a total of about $6.9 billion, according to DOE. By the end of FY2017, 39 lawsuits had been settled, representing utilities that generate 84% of U.S. nuclear electricity. Forty-six cases had received final court judgments.[56] 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.

DOE estimates that its potential liabilities for waste program delays could total as much as $34.1 billion, including the $6.9 billion already paid in settlements and final judgments.[57]

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http://www.wcstexas.com.

[54] 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.

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

[56] DOE, *Agency Financial Report Fiscal Year 2017*, DOE/CF-0138, p. 78, https://www.energy.gov/sites/prod/files/2018/05/f51/fy-2017-doe-agency-financial-report.pdf.

[57] DOE, *Agency Financial Report Fiscal Year 2017*, op. cit.

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 noncompliance 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.

Nuclear Waste Fee Collections

Under the nuclear waste disposal contracts required by NWPA, DOE must charge a fee on nuclear power generation to pay for the nuclear waste program. But after DOE halted the Yucca Mountain project, the nuclear industry and state utility regulators sued to stop further collection of the nuclear waste fees. A federal court ultimately agreed with the waste-fee opponents, and DOE suspended fee collections in May 2014.

Petitions to end the nuclear waste fee were filed with the U.S. Court of Appeals by the National Association of Regulatory Utility Commissioners (NARUC), representing state utility regulators, and the Nuclear Energy Institute (NEI), representing the nuclear industry, on April 2 and April 5, 2010, respectively. The suits argued that the fees, totaling about $750 million per year, should not be collected while the federal government's nuclear waste disposal program has been halted.[58] DOE responded that the federal government still intended to dispose of the nation's nuclear waste and that the fees must continue to be collected to cover future disposal costs.[59] 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.[60]

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 Obama 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.[61]

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.[62]

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[58] 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.

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

[60] 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.

[61] U.S. Court of Appeals for the District of Columbia Circuit, National Association of Regulatory Utility 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.

[62] 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%20

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.[63] Pursuant to the court ruling, DOE stopped collecting nuclear waste fees from nuclear power generators on May 16, 2014.[64]

In planning to restart the Yucca Mountain program, the Trump Administration said in its FY2019 budget request that DOE would conduct a new fee adequacy assessment that will be based on previous cost estimates for Yucca Mountain "until new information is available."[65]

License Application 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 reiterated that the license withdrawal motion was not based on scientific or technical findings. Instead, the Obama Administration's 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.[66] DOE contended that the license application should be withdrawn "with prejudice" because of the need to "provide finality in ending the Yucca Mountain project."[67]

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.'"[68]

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

Waste%20Fund%20Fee_0.pdf.

[63] U.S. Court of Appeals for the District of Columbia Columbia Circuit, National Association of Regulatory Utility Commissioners v. United States Department of Energy, No. 11-1066, November 19, 2013, https://www.cadc.uscourts.gov/internet/opinions.nsf/2708C01ECFE3109F85257C280053406E/$file/11-1066-1466796.pdf.

[64] Hiruo, Elaine, "DOE Implements Court-Ordered Suspension of Nuclear Waste Fee," *NuclearFuel*, May 26, 2014.

[65] DOE, *FY 2019 Congressional Budget Justification*, vol. 3, part 2, p. 414, https://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf.

[66] 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.

[67] DOE Motion to Withdraw, op. cit.

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

may withdraw their applications."[69] After more than a year of deliberation, the NRC commissioners sustained the licensing board's denial of the license withdrawal on a tie vote September 9, 2011. However, NRC halted further consideration of the license application because of "budgetary limitations."[70]

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.[71] The Court of Appeals ruled on August 13, 2013, that NRC must continue work on the Yucca Mountain license application as long as funding was available. The court determined that NRC had at least $11.1 million in previously appropriated funds for that purpose.[72] As noted above, NRC completed its Safety Evaluation Report for Yucca Mountain in January 2015 and used the remaining funds to complete a supplemental EIS and make the licensing database available to the public. Beyond those actions, additional funding of about $330 million would be required for NRC to complete the Yucca Mountain licensing review, including adjudicatory proceedings before the ASLB, according to NRC.[73] In addition, DOE has estimated that its costs as the license applicant would total about $1.9 billion.[74]

The Trump Administration proposes to resume consideration of the NRC license, which remains pending before the ASLB. DOE's FY2018 congressional budget request includes $110 million for a Yucca Mountain program office, legal and technical support for the license application, and the management of supporting documents. An additional $30 million is requested by NRC to restart the ASLB adjudicatory proceeding.

Waste Confidence Decision and Continued Storage Rule

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.[75] 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.[76] At that time, DOE officially planned to meet the NWPA repository deadline of 1998.

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[69] *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.

[70] 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.

[71] 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.

[72] 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.

[73] Hiruo, Elaine, and Steven Dolley, "NRC Says Staff Can Finish Yucca Supplemental EIS in 12-15 Months," NuclearFuel, March 16, 2015.

[74] DOE, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, Fiscal Year 2007*, DOE/RW-0591, July 2008, p. 17, https://www.nrc.gov/docs/ML0927/ML092710177.pdf. Estimate of future licensing costs adjusted to 2017 dollars using GDP chain-type price index, *Economic Report of the President*, February 2018, p. 536, https://www.whitehouse.gov/wp-content/uploads/2018/02/ERP_2018_Final-FINAL.pdf.

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

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

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 21st century.[77] When the Yucca Mountain repository was delayed further and then suspended by the Obama Administration, NRC issued another waste confidence rule 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.[78]

The State of New York, environmental groups, and others filed lawsuits to overturn the 2010 waste confidence rule 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.[79]

Final licensing of new facilities that would produce nuclear waste was halted for more than two years while NRC worked on its response to the court ruling. NRC approved a final rule August 26, 2014, on continued storage of spent nuclear fuel to replace the waste confidence rule that had been struck down.[80] Rather than make specific findings about the future availability of waste disposal facilities, the new continued storage rule describes environmental effects that may result from various periods of waste storage, based on the findings of a generic environmental impact statement (GEIS). The GEIS, issued along with the continued storage rule, responded to the court requirement for NEPA review.

The GEIS analyzed the environmental effects of three potential time periods of storage before a permanent repository would become available: "short-term timeframe," continued storage for up to 60 years after a reactor ceases operation; "long-term timeframe," for up to 160 years after reactor shutdown; and an "indefinite timeframe," in which a repository may never become available. The GEIS assumed that active management and oversight of the stored spent fuel would never end, and that "spent fuel canisters and casks would be replaced approximately once every 100 years." The environmental impact of all three time frames was judged to be minimal in almost all categories.[81] A consolidated lawsuit by several states and environmental groups to overturn NRC's continued storage rule was rejected by the U.S. Court of Appeals for the D.C. Circuit on June 3, 2016.[82]

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

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

[79] 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.

[80] NRC, "NRC Approves Final Rule on Spent Fuel Storage and Ends Suspension of Final Licensing Actions for Nuclear Plants and Renewals," news release, August 26, 2014, http://pbadupws.nrc.gov/docs/ML1423/ML14238A326.pdf.

[81] NRC, "Continued Storage of Spent Nuclear Fuel," 79 *Federal Register* 56238, September 19, 2014. Available at NRC, "Continued Storage of Spent Nuclear Fuel," http://www.nrc.gov/waste/spent-fuel-storage/wcd/documents.html.

[82] U.S. Circuit Court of Appeals for the District of Columbia Circuit, State of New York, et al. v. Nuclear Regulatory Commission, No. 14-1210, op. cit.

Congressional Action

The termination of work on the Yucca Mountain repository by the Obama Administration generated extensive congressional controversy. The House consistently voted to continue or restore Yucca Mountain funding, while the Senate repeatedly zeroed it out, with President Obama's support.

President Trump's proposal to restart the Yucca Mountain licensing process has changed the dynamics of the congressional debate on nuclear waste, along with the retirement of Senator Reid of Nevada, who had strongly opposed Yucca Mountain as the Democratic leader. However, the 115th Congress has so far not provided new funding for Yucca Mountain. For FY2018, as in recent years, the House approved funds for the project while the Senate did not, and none were included in the enacted appropriations bill (P.L. 115-141). In FY2019 appropriations legislation (H.R. 5895), the House included $100 million above the Administration's Yucca Mountain funding request, while no funds were provided by the Senate.

Concerns about nuclear waste were raised multiple times during the confirmation hearing for former Texas Governor Rick Perry on January 19, 2017, before the Senate Committee on Energy and Natural Resources, to be the Secretary of Energy.[83] After her vote in the committee to confirm Perry on January 31, 2017, Senator Catherine Cortez Masto of Nevada issued a statement that said,

> I pressed Governor Perry repeatedly in our private meeting and at his confirmation hearing on the issue of Yucca Mountain, reminding him that Nevada's residents and elected officials have been clear that we will not accept our state becoming a dumping ground for the rest of the nation's nuclear waste. While we do not see eye to eye on all issues, I believe Governor Perry understands the importance of this issue and is someone I can work with to ensure Yucca Mountain never sees the light of day.[84]

Yucca Mountain Land Withdrawal and Interim Storage Legislation

The Nuclear Waste Policy Amendments Act of 2017 (H.R. 3053), which passed the House on May 10, 2018, would satisfy a major condition for licensing the Yucca Mountain repository by withdrawing the repository site from use under public lands laws and placing it solely under DOE's control. It would also authorize DOE to store spent fuel at an NRC-licensed interim storage facility owned by a nonfederal entity. Another major provision would increase the capacity limit on the Yucca Mountain repository from 70,000 to 110,000 metric tons of spent nuclear fuel, in comparison with the 80,000 metric tons stored at U.S. nuclear plants at the end of 2017.[85]

The House-passed bill included substantial changes from the version of H.R. 3053 reported by the Energy and Commerce Committee (H.Rept. 115-355), such as the elimination of mandatory

[83] Senate Committee on Energy and Natural Resources, https://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?Id=F24BF4B8-02D1-4EE6-BE1A-3C21CA4B228E&Statement_id=22A692AA-0C5E-4ED8-855E-956C35D8E22C.

[84] Senator Catherine Cortez Masto, "Cortez Masto Statement on Energy Secretary Nominee Rick Perry," January 31, 2017, https://www.cortezmasto.senate.gov/content/cortez-masto-statement-energy-secretary-nominee-rick-perry.

[85] Vinson, Dennis, and Kathryn Metzger, *Spent Nuclear Fuel and High-Level Radioactive Waste Inventory Report*, prepared for DOE, FCRD-NFST-2013-000263, Rev. 5, August 2018, p. 1. Estimate excludes about 2,500 metric tons of government-managed spent nuclear fuel, as well as 4,440 canisters of high-level waste and untreated high-level waste.

funding provisions. To address criticism that the Nuclear Waste Fund has been used in the past for deficit reduction rather than waste management, the committee version of the bill would have provided mandatory funding for specific stages of repository development and would have allowed future nuclear waste fee collections to offset appropriations for the nuclear waste program.[86]

Following is a description of the bill's provisions as passed by the House.

Monitored Retrievable Storage

Monitored Retrievable Storage (MRS) facilities would be used for interim storage of spent nuclear fuel before disposal in a permanent repository. H.R. 3053 specifies that DOE's acceptance of spent nuclear fuel at commercial reactor sites for storage at an MRS facility would constitute the transfer of ownership of the spent fuel to the Secretary of Energy. DOE would be authorized to site, construct, and operate one or more MRS facilities. Alternatively, rather than building a federal MRS facility, DOE could store spent fuel from commercial reactors at MRS facilities developed by nonfederal entities with which DOE had reached an MRS agreement. DOE could not enter into an MRS agreement with a nonfederal entity before a license for the proposed facility had been issued by NRC. In addition, DOE could not enter into an MRS agreement unless the nonfederal entity had received waste storage approval from the governor of the state in which the MRS facility was to be located, any unit of local government with jurisdiction over the site, and any affected Indian tribe.

DOE could enter into one MRS agreement before NRC issued a final decision on the Yucca Mountain construction authorization. Priority would be given to a nonfederal MRS facility unless the Secretary of Energy determined that a federal MRS could be built more quickly and less expensively. Spent fuel currently stored at closed reactors would have priority for shipment to an MRS, to the extent allowable under DOE's standard waste disposal contract with nuclear plant operators. Appropriations for an MRS would be authorized from the general fund rather than the Nuclear Waste Fund.

Waste could not be stored at the initial MRS facility until NRC had made a final decision to approve or disapprove a construction authorization for the Yucca Mountain repository, or until the Secretary of Energy determined that such an NRC decision was "imminent." MRS construction would have to cease if the repository license were revoked. Under current law, construction of an MRS facility could begin only after the Yucca Mountain construction authorization were issued and would have to stop if the repository construction ceased or the license were revoked.

Repository Land Withdrawal and Regulation

The proposed Yucca Mountain repository would be located on 147,000 acres of federal land encompassing parts of DOE's Nevada Test Site and the Nellis Air Force Range, along with public land managed by the Bureau of Land Management. H.R. 3053 would permanently withdraw the site from uses authorized under federal public land laws, such as mineral leasing, and transfer jurisdiction to the Secretary of Energy for activities related to development of a permanent underground repository for spent nuclear fuel and high level waste. Withdrawal of the site is a requirement for DOE to obtain a repository license from NRC.

[86] For more information on this issue, see CRS Testimony TE10002, *Nuclear Waste Fund: Budgetary, Funding, and Scoring Issues*, by David M. Bearden.

Nuclear waste at, or being transported to, the repository would not be subject to Section 6001(a) of the Solid Waste Disposal Act (42 U.S.C. 6961(a)), which requires federal waste facilities to comply with all state, local, and federal hazardous waste requirements.

NRC's final decision on issuing a construction authorization for the Yucca Mountain repository would be required within 30 months after enactment. Before the decision on the construction authorization, DOE could conduct "infrastructure activities" at the Yucca Mountain site, such as site preparation and the construction of a rail line. The limit on the amount of spent nuclear fuel that could be disposed of at Yucca Mountain would be raised from 70,000 to 110,000 metric tons.

DOE would be prohibited from planning or developing a separate repository for defense-related high level waste and spent fuel until NRC reaches a final decision on issuing a construction authorization for the Yucca Mountain repository.

Waste Program Funding

The Secretary of Energy could not resume collection of nuclear waste fees until NRC issued a final decision to approve or disapprove a construction authorization for the Yucca Mountain repository. After that date, total collections of the nuclear waste fees would be limited to 90% of each fiscal year's appropriations for the DOE nuclear waste management program. Any fees that were not collected because of those limitations could be required to be paid "when determined necessary by the Secretary."

Nuclear waste fees collected after the date of enactment would offset appropriations to the nuclear waste program. Annual appropriations up to the amount of available fees would therefore net to zero during the appropriations process, so that such appropriations would not count against the annual discretionary funding allocations for the Energy and Water Development Appropriations bill. The existing balance of the Nuclear Waste Fund would remain available for appropriation as in current law, without offsets. The bill specifies that net direct spending for budget purposes would not be affected by these provisions, and that requirements for mandatory spending offsets under the Statutory Pay-As-You-Go Act of 2010 (P.L. 111-139) would not be triggered.

Repository Benefits Agreements

The Secretary of Energy would be authorized to enter into a benefits agreement with the State of Nevada, in consultation with affected units of local government, to provide annual payments of $15 million before spent fuel is received at Yucca Mountain (up from $10 million under current law). Nevada would receive $400 million upon the first spent fuel receipt (up from $20 million) and annual payments thereafter of $40 million (up from $20 million).

In addition, DOE could reach benefits agreements with units of local government in Nevada or other affected local governments. The acceptance of a benefits agreement by Nevada or a local government would not be considered consent to host the repository. All benefits agreements would be subject to congressional appropriation from the Nuclear Waste Fund.

Waste Program Management

The Director of the Office of Civilian Radioactive Waste Management (OCRWM) would be responsible for carrying out the functions of the Secretary of Energy established by NWPA and would report directly to the Secretary. The OCRWM Director would serve as many as two five-year terms and could be removed by the President only for "inefficiency, neglect of duty, or malfeasance in office," rather than serving at the pleasure of the President. Nuclear waste

management functions that currently may be assigned to a DOE Assistant Secretary under the Department of Energy Organization Act (P.L. 95-91) would be transferred to OCRWM.

Other Waste Bills in the 115th Congress

Senator Heller and Representative Titus introduced companion versions of the Nuclear Waste Informed Consent Act (S. 95, H.R. 456) on January 11, 2017, that would "require the Secretary of Energy to obtain the consent of affected State and local governments before making an expenditure from the Nuclear Waste Fund for a nuclear waste repository." In a statement released after the bill was introduced, Heller said the legislation would require "a consent-based approach" to siting nuclear waste repositories, as recommended by the Blue Ribbon Commission on America's Nuclear Future.[87] Similar legislation was introduced but not enacted in the 114th Congress.

Representative Joe Wilson introduced the Sensible Nuclear Waste Disposition Act (H.R. 433) on January 11, 2017. The measure would forbid DOE from developing a repository for only defense nuclear waste until NRC had issued a final decision on a construction permit for the Yucca Mountain repository. (See **Table 1** for a summary of recent bills.)

Proposals in Texas and New Mexico to construct private-sector interim storage facilities for commercial spent nuclear fuel have attracted congressional interest. A bill to explicitly authorize DOE to enter into contracts with privately owned spent fuel storage facilities (H.R. 474) was introduced on January 12, 2017, by Representative Issa. The Interim Consolidated Storage Act of 2017 is similar to legislation (H.R. 3643, H.R. 4745) introduced in the 114th Congress by Representatives Conaway and Mulvaney, respectively, but not enacted. Under the legislation, DOE would take title to all spent nuclear fuel from commercial reactors delivered to the private storage facility. Annual interest earned by the Nuclear Waste Fund could be used by DOE without further congressional appropriation to pay for private interim storage. Related provisions are included in the House-passed H.R. 3053). Representative Lowey introduced the Removing Nuclear Waste from our Communities Act of 2017 (H.R. 4442) on November 17, 2017, to authorize DOE to store spent fuel from nuclear plants at privately owned consolidated storage facilities. Priority would be given to nuclear plant sites with no currently operating reactors and that have a population of at least 15 million within a 50-mile radius.

Legislation to provide assistance to communities with stored spent fuel at closed reactor sites was introduced October 2, 2017, by Senator Duckworth and Representative Schneider (S. 1903 and H.R. 3970). The bills would provide communities $15 for each kilogram of nuclear waste, revive an expired tax credit for first-time homebuyers in stranded nuclear waste communities, and make such communities eligible for the existing New Markets Tax Credit. In addition, the bills would establish a task force to identify the programs that currently exist for communities with stranded nuclear waste, simplifying the process and making it easier for communities applying for government assistance. The bill would also require DOE to examine other options for hosting decommissioned nuclear waste and to study potential economic uses for secure closed reactor sites along with spent nuclear fuel storage.

Concerns have been raised in Congress for many years about the potential risks posed by spent fuel storage pools in nuclear power plants. A number of bills have been proposed to reduce the amount of spent fuel stored in pools by moving it to dry storage casks. In the 115th Congress, the

[87] Senator Dean Heller, "Members of Nevada Delegation Stand United Against Yucca Mountain," press release, January 11, 2017, http://www.heller.senate.gov/public/index.cfm/pressreleases?ID=5D20600D-88C2-4BBE-9E9D-4A23006D0264.

Dry Cask Storage Act of 2018 (H.R. 4891) was introduced by Representative Engel on February 2, 2018. It would require nuclear power plants to develop NRC-approved plans for removing spent fuel from storage pools. Within seven years after such plans had been submitted, spent fuel would have to be transferred to dry storage facilities if it has been in a storage pool for at least seven years. Emergency planning zones would have to be expanded from 10 to 50 miles in radius around any reactor determined by NRC to be out of compliance with its spent fuel transfer plan. NRC would be authorized to use interest earned by the Nuclear Waste Fund to provide grants to nuclear power plants to transfer spent fuel to dry storage. H.R. 4891 is similar to legislation introduced Representative Engel in the 114th Congress (H.R. 3587) and by Senator Markey in the 114th Congress (S. 945) and the 113th Congress (S. 2325).

Previous Congresses

In the 114th Congress, Senator Alexander, along with Senators Murkowski, Feinstein, and Cantwell, introduced legislation March 24, 2015, to redirect the nuclear waste program along the lines recommended by the Blue Ribbon Commission and the 2013 DOE waste strategy (S. 854). The bill, similar to S. 1240 in the 113th Congress, would have established an independent Nuclear Waste Administration (NWA) to develop nuclear waste storage and disposal facilities. Siting of such facilities would have required the consent of the affected state, local, and tribal governments.

Under S. 854, which was not enacted, NWA would have been required to prepare a mission plan to open a pilot storage facility by the end of 2021 for nuclear waste from shutdown reactors and other emergency deliveries (called "priority waste"). A storage facility for waste from operating reactors or other "nonpriority waste" was to open by the end of 2025, and a permanent repository by the end of 2048.

NWA would have been authorized to issue requests for proposals or select sites for storage facilities for nonpriority waste only if, during the first 10 years after enactment, the agency had obligated funds for developing a permanent waste repository. After 10 years, NWA could not request proposals for nonpriority waste or select sites unless a candidate site for a repository had been selected. NWA would have been authorized to offer financial compensation and other incentives for hosting nuclear waste storage and disposal facilities. Sites that would include storage facilities along with a repository were to receive preference.

Highly radioactive defense waste, which had been planned for commingling with commercial nuclear waste since the 1980s, could be placed in defense-only storage and disposal facilities under S. 854, subject to appropriations. President Obama had authorized DOE to pursue a defense-only repository on March 24, 2015.

Nuclear waste fees collected after enactment of the bill were to be held in a newly established Working Capital Fund. The Nuclear Waste Administration could have immediately drawn from that fund any amounts needed to carry out S. 854, unless limited by annual appropriations or authorizations. The current disposal limit of 70,000 metric tons for the first repository under NWPA would have been repealed.

The Senate Committee on Energy and Natural Resources held a hearing on S. 1240 on July 30, 2013. Then-Energy Secretary Ernest J. Moniz, who had been 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 preclude enforcement of existing NWPA 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.[88] As noted above, S. 854 would require certain actions on a permanent repository before a storage facility for nonpriority waste could be sited.

Authorization and initial funding for DOE to develop a pilot spent fuel interim storage facility were approved by the Senate Appropriations Committee in its version of the FY2017 Energy and Water bill on April 14, 2016 (S. 2804, S.Rept. 114-236). As subsequently passed by the Senate, [89] the bill included an authorization (§306) and a $10.0 million appropriation for DOE to develop a consent-based waste storage pilot facility.

The Senate Appropriations Committee had approved similar language in its version of the FY2016 Energy and Water bill on May 21, 2015 (S.Rept. 114-54, §306). Similar language was also included in the FY2014 Energy and Water Development appropriations bill passed by the Senate Appropriations Committee June 27, 2013 (S. 1245, §309), as well as in the committee's FY2013 measure (S. 2465, §312) and in the draft Senate FY2015 Energy and Water bill approved in subcommittee.[90] 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 found that the spent fuel did not overheat.

A bill introduced by Senator Barbara Boxer also on April 15, 2015 (S. 944), similar to S. 2324 in the 113th Congress, would require NRC to maintain full safety and security requirements at permanently closed reactors until all their spent fuel was moved to dry storage. Neither was enacted.

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."[91]

[88] 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.

[89] For floor consideration, the Senate called up the House-passed FY2016 Energy and Water Development bill (H.R. 2028) and substituted the language of S. 2804 as passed by the Senate Appropriations Committee. The Senate approved the measure May 12, 2016, by a vote of 90-8.

[90] Senate Committee on Appropriations, "FY15 Subcommittee Reported Bill and Draft Report," July 24, 2014, http://www.appropriations.senate.gov/news/fy-2015-ew-subcommittee-reported-bill-and-draft-report.

[91] 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/2013/2013-0030comscy.pdf.

Table 1. Selected Nuclear Waste Bills

Number	Sponsor	Title	Description	Introduced	Committee	Action
			115th Congress			
H.R. 433	J. Wilson	Sensible Nuclear Waste Disposition Act	Prohibits DOE from developing a repository for only defense nuclear waste until NRC has issued a final decision on a construction permit for the Yucca Mountain repository.	January 11, 2017	Energy and Commerce	
H.R. 456/ S. 95	Titus/Heller	Nuclear Waste Informed Consent Act	Requires the Secretary of Energy to obtain the consent of affected state and local governments before making an expenditure from the Nuclear Waste Fund for a nuclear waste repository	House: January 11, 2017 Senate: January 11, 2017	House: Energy and Commerce Senate: Environment and Public Works	
H.R. 474	Issa	Interim Consolidated Storage Act of 2017	Authorizes DOE to enter into contracts with privately owned spent fuel storage facilities. DOE would take title to all spent nuclear fuel from commercial reactors delivered to the private storage facility. Annual interest earned by the Nuclear Waste Fund could be used by DOE without further congressional appropriation to pay for private interim storage.	January 12, 2017	Energy and Commerce	
H.R. 3053	Shimkus	Nuclear Waste Policy Amendments Act of 2017	Provides land-use controls for development of Yucca Mountain repository, authorizes DOE contracts to store spent fuel at privately owned interim storage facilities, modifies funding mechanism for DOE nuclear waste program, and authorizes financial benefits for communities hosting waste facilities.	June 26, 2017	Energy and Commerce; Natural Resources; Armed Services	Energy and Commerce: Ordered reported June 28, 2017, by vote of 49-4, H.Rept. 115-355; passed House May 10, 2018, by vote of 340-72

Number	Sponsor	Title	Description	Introduced	Committee	Action
S. 1903/ H.R. 3970	Duckworth/ Schneider	Sensible, Timely Relief for America's Nuclear Districts' Economic Development (STRANDED) Act	For communities with closed nuclear power plants that are storing spent nuclear fuel, authorizes $15 for each kilogram of nuclear waste, revives an expired tax credit for first-time homebuyers, and adds eligibility for the existing New Markets tax credit.	Senate: October 2, 2017 House: October 5, 2017	Senate: Finance House: Energy and Commerce	
H.R. 4442	Lowey	Removing Nuclear Waste from our Communities Act of 2017	DOE is authorized to take title to spent fuel at nuclear plant sites for storage at a licensed interim consolidated storage facility. Costs of such storage would be paid from the Nuclear Waste Fund without further appropriation. Priority for interim storage would be given to sites without an operating reactor and that have a population of more than 15 million people within a 50-mile radius.	November 16, 2017	Energy and Commerce	
S. 1265/ H.R. 4891	Markey/Engel	Dry Cask Storage Act of 2017/2018	Requires nuclear power plants to develop NRC-approved plans for removing spent fuel from storage pools. Within seven years after such plans had been submitted, spent fuel would have to be transferred to dry storage facilities if it has been in a storage pool for at least seven years. Emergency planning zones would have to be expanded from 10 to 50 miles in radius around any reactor determined by NRC to be out of compliance with its spent fuel transfer plan. NRC would be authorized to use interest earned by the Nuclear Waste Fund to provide grants to nuclear power plants to transfer spent fuel to dry storage.	Senate: May 25, 2017 House: January 29, 2018	Senate: Environment and Public Works House: Energy and Commerce	

Number	Sponsor	Title	Description	Introduced	Committee	Action
H.R. 5643	Rosen	Jobs, Not Waste Act	DOE cannot take action toward developing the Yucca Mountain repository until the Office of Management and Budget issues a report on job-creating alternative uses of the site and Congress holds a hearing on alternative uses.	April 26, 2018	Energy and Commerce	
			114th Congress			
H.R. 1364/ S. 691	Titus/Reid	Nuclear Waste Informed Consent Act	Prohibits NRC from authorizing construction of a nuclear waste repository unless the Secretary of Energy has reached an agreement with the host state and affected units of local government and Indian tribes.	House: March 13, 2015 Senate: March 10, 2015	House: Energy and Commerce Senate: Environment and Public Works	
H.R. 3643	Conaway	Interim Consolidated Storage Act of 2015	Authorizes DOE to enter into contracts with privately owned spent fuel storage facilities. DOE would take title to all spent nuclear fuel from commercial reactors delivered to the private storage facility. Annual interest earned by the Nuclear Waste Fund could be used by DOE without further congressional appropriation to pay for private interim storage.	September 29, 2015	Energy and Commerce	

Number	Sponsor	Title	Description	Introduced	Committee	Action
H.R. 4745	Mulvaney	Interim Consolidated Storage Act of 2016	Authorizes DOE to enter into contracts with privately owned spent fuel storage facilities. DOE would take title to all spent nuclear fuel from commercial reactors delivered to the private storage facility. Annual interest earned by the Nuclear Waste Fund could be used by DOE without further congressional appropriation to pay for private interim storage.	March 18, 2016	Energy and Commerce	
H.R. 5632	Dold	Stranded Nuclear Waste Accountability Act of 2016	Directs the Secretary of Energy to provide payments to communities with closed nuclear power plants that store spent nuclear fuel onsite.	July 6, 2016	Energy and Commerce	

Number	Sponsor	Title	Description	Introduced	Committee	Action
S. 854	Alexander	Nuclear Waste Administration Act of 2015	Establishes an independent Nuclear Waste Administration (NWA) to develop nuclear waste storage and disposal facilities. Siting of such facilities would require the consent of the affected state, local, and tribal governments. NWA would be required to prepare a mission plan to open a pilot storage facility by the end of 2021 for nuclear waste from shutdown reactors and other emergency deliveries (called "priority waste"). A storage facility for waste from operating reactors or other "nonpriority waste" would open by the end of 2025, and a permanent repository by the end of 2048. 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. 854, unless limited by annual appropriations or authorizations.	March 24, 2015	Energy and Natural Resources	
S. 944	Boxer	Safe and Secure Decommissioning Act of 2015	Requires NRC to maintain full safety and security requirements at permanently closed reactors until all their spent fuel was moved to dry storage.	April 15, 2015	Environment and Public Works	

Number	Sponsor	Title	Description	Introduced	Committee	Action
S. 945/H.R. 3587	Markey/Engel	Dry Cask Storage Act of 2015	Requires nuclear power plants to develop NRC-approved plans for removing spent fuel from storage pools. Within seven years after such plans had been submitted, spent fuel would have to be transferred to dry storage facilities. After the seven-year period, additional spent fuel would have to be transferred to dry casks within a year after it had been determined to be sufficiently cool. Emergency planning zones would have to be expanded from 10 to 50 miles in radius around any reactor determined by NRC to be out of compliance with its spent fuel transfer plan. NRC would be authorized to use interest earned by the Nuclear Waste Fund to provide grants to nuclear power plants to transfer spent fuel to dry storage. Under the Senate bill, the emergency zone for a decommissioned reactor could not be reduced below a 10-mile radius until all its spent fuel had been placed in dry storage.	Senate: April 15, 2015 House: September 22, 2015	Senate: Environment and Public Works House: Energy and Commerce	
S. 1825	Reid	Nuclear Waste Informed Consent Act	Prohibits the Secretary of Energy from making any expenditure from the Nuclear Waste Fund for developing nuclear waste storage and disposal facilities and conducting waste transportation activities unless agreements have been reached with affected states, local governments, and Indian tribes.	July 22, 2015	Energy and Natural Resources	

Source: Congress.gov.

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:[92]

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 reuse. 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 the handling of some types of TRU waste. In the United States, transuranic waste is generated almost entirely by nuclear weapons production processes. Because of the plutonium, long-term isolation is required. The nation's only permanent repository for TRU waste, the Waste Isolation Pilot Plant (WIPP), near Carlsbad, NM, resumed underground waste emplacement January 4, 2017, after being suspended for nearly three years after a radioactive release. Waste currently undergoing disposal had already been stored at the WIPP site; shipments of additional waste to the site resumed April 10, 2017.[93]

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 concentrations 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.

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[92] Statutory definitions for "spent nuclear fuel," "high-level radioactive waste," and "low-level radioactive waste" can be found in §2 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101). "Transuranic waste" is defined in §11ee. of the Atomic Energy Act (42 U.S.C. 2014); §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 C.F.R. Part 261, Subparts C and D) that contains radioactive materials as defined by the Atomic Energy Act.

[93] DOE, "Secretary, N.M. Delegation Recognize WIPP Reopening," January 9, 2017; "WIPP Receives First Shipment Since Reopening," April 10, 2017, http://www.wipp.energy.gov/wipprecovery/recovery.html.

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 nonradioactive 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 (and some of which are gases). 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.[94]

Spent fuel discharged from U.S. commercial nuclear reactors is currently stored at 59 operating nuclear plant sites, 15 shutdown plant sites, and the Idaho National Laboratory.[95] A typical large commercial nuclear reactor discharges an average of 20-30 metric tons of spent fuel per year—an average of about 2,200 metric tons annually for the entire U.S. nuclear power industry during the past two decades. A recent report prepared for DOE estimates that about 80,000 metric tons of spent fuel was stored at U.S. nuclear plants at the end of 2017, including about 30,000 metric tons in dry casks.[96] The total amount of existing waste would exceed NWPA's 70,000-metric-ton limit for Yucca Mountain, even without counting 7,000 metric tons of DOE spent fuel and high-level waste that had also been planned for disposal at 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 spent fuel from existing U.S. reactors that may eventually require disposal range from 105,000 metric tons[97] to 130,000 metric tons.[98]

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[94] 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.

[95] Gutherman Technical Services, *2012 Used Fuel Data*, January 30, 2013. Adjusted for five sites closed since 2012. 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.

[96] Vinson, op. cit.

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

[98] 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,*

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. Seventy-two licensed dry storage facilities were operating at U.S. nuclear plant and DOE sites as of August 2017.[99]

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.[100] 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. NRC's report on this issue in 2013 found only minor safety benefits in expedited transfers of spent fuel from pools to dry casks.[101]

The safety of spent 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.[102] NRC approved an order March 9, 2012, requiring U.S. reactors to install improved water-level monitoring equipment at their spent fuel pools.[103] For more background, see CRS Report R42513, *U.S. Spent Nuclear Fuel Storage*, by James D. Werner.

Commercial Low-Level Waste

About 5.1 million cubic feet of low-level waste with 57,179 curies of radioactivity was shipped to commercial disposal sites in 2017, according to DOE.[104] 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. For example, the total volume reported for

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Nye County, Nevada, Summary, DOE/EIS-0250F-S1D, October 2007, p. S-47.

[99] NRC, *Information Digest 2017-2018*, Appendix N, August 2017, https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/. In addition, GE operates an independent pool storage facility near Morris, IL.

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

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

[102] 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.

[103] 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.

[104] U.S. Department of Energy, Management Information Manifest System, http://mims.doe.gov/GeneratorData.aspx. Most recent year reported. A curie is a unit of radioactivity equal to 3.7×10^{10} nuclear transformations per second.

2016 was 1.7 million cubic feet. 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. Class A waste constitutes most of the annual volume of low-level waste, while classes B and C generally contain most of the 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.

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 halted development of the Yucca Mountain repository after FY2010, although Yucca Mountain remains the sole candidate site for civilian highly radioactive waste disposal under current law. The Trump Administration is proposing to revive the program in FY2019, requesting $110 million for Yucca Mountain and $10 million for interim nuclear waste storage at DOE, and an additional $47.7 million for NRC. A similar request for FY2018 was not enacted.

Under the Obama Administration, DOE issued an alternative waste management strategy in January 2013 that called for a pilot facility for spent fuel storage to open at a voluntary site by 2021 and a new repository at a volunteer location by 2048. New legislation would have been required to carry out the Obama strategy.

Spent Nuclear Fuel

Current Program and Proposed Policy Changes

The Nuclear Waste Policy Act of 1982 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 NWPA, the act was substantially modified by the Nuclear Waste Policy Amendments Act of 1987 (Title IV, Subtitle A of P.L. 100-203, the Omnibus Budget Reconciliation Act of 1987). Under the amendments, the only candidate site DOE may consider for a permanent high-level waste repository is at Yucca Mountain, Nevada. If that site cannot be licensed, DOE must return to Congress for further instructions.

The 1987 amendments also authorized construction of a monitored retrievable storage 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.[105]

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 Mexico, which, after many years of controversy, began receiving transuranic defense waste in 1999 with state and local government approval (although WIPP disposal was suspended for nearly three years after a release of radioactivity in February 2014, resuming in January 2017).

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 appropriations 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 disposal 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.[106] 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 NWPA restrictions on the MRS are so rigid that the MRS cannot currently be built. Without describing specific provisions, the DOE strategy

[105] BRC Final Report, op. cit.

[106] 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 consult with Congress and interest groups on "defining consent, deciding how that consent is codified, and determining whether or how it is ratified by Congress." As discussed above, DOE issued its "Draft Consent-Based Siting Process" on January 12, 2017.

The Obama Administration's proposed waste program was to 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 in the 114th Congress by Senator Alexander (S. 854), discussed under "Congressional Action," would have modified the waste program along the lines of the Obama Administration's waste strategy. Other proposals have called for privatization of waste management services.[107]

DOE issued a report in October 2014 that recommended testing the consent-based approach by siting and developing a repository solely for defense and research waste. According to the report, a separate repository for such waste would not be subject to the Yucca Mountain siting requirement that applies to a civilian nuclear waste repository under NWPA. The idea would reverse long-standing federal policy, established by the Reagan Administration, that a single repository would hold both civilian and defense high-level waste and spent fuel. DOE's 2014 report concluded that a separate repository for the nation's relatively small volumes of defense and research waste (compared to civilian waste) could be developed more quickly, "within existing legislative authority," than a repository for all highly radioactive waste. The report also recommended that disposal in deep boreholes be considered for the most compact types of defense and research waste.[108]

President Obama authorized DOE on March 24, 2015, to begin planning a separate underground repository for high-level radioactive waste generated by nuclear defense activities. However, as noted above, GAO criticized DOE's analysis of the defense-only repository in January 2017, and bills have been introduced to delay the plan.

President Obama blocked DOE's previously preferred rail route to Yucca Mountain on July 10, 2015, by establishing the Basin and Range National Monument in southeastern Nevada. However, an Obama Administration fact sheet said that other potential rail routes would still be available.[109]

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[107] Spencer, Jack, "Nuclear Waste Management: Minimum Requirements for Reforms and Legislation," Heritage Foundation, March 28, 2013, http://www.heritage.org/research/reports/2013/03/nuclear-waste-management-minimum-requirements-for-reforms-and-legislation.

[108] DOE, *Assessment of Disposal Options for DOE-Managed High-Level Radioactive Waste and Spent Nuclear Fuel*, October 2014, http://www.energy.gov/ne/downloads/assessment-disposal-options-doe-managed-high-level-radioactive-waste-and-spent-nuclear.

[109] Bureau of Land Management, "Basin and Range National Monument Q&A," undated fact sheet, http://www.blm.gov/style/medialib/blm/nv/special_areas/basin_and_range_monument.Par.77668.File.dat/Basin%20and%20Range%20National%20Monument%20Q&A.pdf.

Private Interim Storage

The waste management company Waste Control Specialists (WCS) filed an application on April 28, 2016, for an NRC license to develop a consolidated interim storage facility for spent nuclear fuel in Texas. WCS asked NRC to suspend consideration of the license application until April 18, 2017, citing estimated licensing costs that were "significantly higher than we originally estimated."[110] However, WCS subsequently formed a joint venture with Orano USA called Waste Control Partners, which submitted a renewed application for the Texas facility on June 11, 2018.[111]

The proposed WCS spent fuel storage facility would be built at a 14,000-acre WCS site near Andrews, TX, where the company currently operates two low-level radioactive waste storage facilities with local support. The facility was proposed to consist of dry casks on concrete pads. Construction would take place in eight phases, with each phase capable of holding 5,000 metric tons of spent fuel, for a total capacity of 40,000 metric tons.[112]

Under the WCS proposal, DOE would take title to spent fuel at nuclear plant sites, ship it to the Texas site, and pay WCS for storage for up to 40 years with possible extensions, according to the company. DOE's costs would be covered through appropriations from the Nuclear Waste Fund, as were most costs for the Yucca Mountain project. WCS contends that a privately developed spent fuel storage facility would not be bound by NWPA restrictions that prohibit DOE from building a storage facility without making progress on Yucca Mountain.[113]

An NRC license application for a spent fuel storage facility in New Mexico was filed March 30, 2017, by Holtec International, a manufacturer of spent fuel storage systems.[114] The facility would be located on land provided by a local government consortium near the Waste Isolation Pilot Plant in New Mexico, the Eddy-Lea Energy Alliance (ELEA).

Local officials near the WIPP facility have long supported the development of additional waste facilities at that 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.[115]

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[110] NRC, "Joint Request to Withdraw the *Federal Register* Notice Providing an Opportunity to Submit Hearing Requests" (including WCS letter of April 18, 2017), April 19, 2017, https://www.nrc.gov/docs/ML1710/ML17109A480.pdf.

[111] Orano USA, "Interim Storage Partners Submits Renewed NRC License Application for Used Nuclear Fuel Consolidated Interim Storage Facility in West Texas," press release, June 11, 2018, http://us.areva.com/EN/home-4216/orano-orano-usa—interim-storage-partners-submits-renewed-nrc-license-application-for-used-nuclear-fuel-consolidated-interim-storage-facility-in-west-texas.html.

[112] Waste Control Specialists, "WCS Files License Application with Nuclear Regulatory Commission (NRC) to Operate a Consolidated Interim Storage Facility (CISF) for Used Nuclear Fuel," April 28, 2016, news release, http://www.wcstexas.com/wp-content/uploads/2016/04/4_28_16.WCS_Release.pdf; Valhi, Inc., "Valhi's Waste Control Specialists Subsidiary to Apply for License to Store Used Nuclear Fuel," February 7, 2015, http://www.valhi.net/phoenix.zhtml?c=103380&p=irol-newsArticle&ID=2014598; Waste Control Specialists LLC, *License Application*, Docket 72-1050, https://www.nrc.gov/docs/ML1613/ML16133A100.pdf.

[113] Beattie, Jeff, "Waste Control Specialists Sets 2020 Date to Open Spent Fuel Storage Facility," *IHS The Energy Daily*, February 10, 2015, p. 1; Hiruo, Elaine, "Texas Company Seeks License for Spent Fuel Storage," *Nucleonics Week*, February 12, 2015, p. 1.

[114] Letter from Holtec International to NRC, March 30, 2017, https://www.nrc.gov/docs/ML1711/ML17115A418.pdf.

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

New Mexico Governor Susana Martinez expressed support for ELEA's efforts in an April 10, 2015, letter to Energy Secretary Ernest Moniz, but the state's U.S. senators, Tom Udall and Martin Heinrich, said in a joint statement that they would oppose an interim storage facility without a plan for permanent disposal.[116] Moreover, a February 2014 radioactive release from WIPP, which led to the suspension of disposal operations, could also affect public support in the state for expanded waste activities.

Interest in hosting nuclear waste sites has also been expressed by groups in Mississippi and Loving County, Texas, although whether they would be developed by the private sector or the government has not been specified.[117]

As noted above, a bill to explicitly authorize DOE to enter into contracts with privately owned spent fuel storage facilities (H.R. 474) was introduced on January 12, 2017, by Representative Issa. The Interim Consolidated Storage Act of 2017 is similar to legislation introduced by Representative Conaway in the 114th Congress (H.R. 3643). Under the bill, DOE would take title to all spent nuclear fuel from commercial reactors delivered to the private storage facility. Annual interest earned by the Nuclear Waste Fund could be used by DOE without further congressional appropriation to pay for private interim storage. As of August 31, 2018, the bill's 33 cosponsors included 14 from Texas. Provisions for a private-sector MRS facility are included in a bill (H.R. 3053), described above, approved by the House Energy and Commerce Committee June 28, 2017.

An earlier effort to develop a private spent fuel storage facility was undertaken after 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 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. However, 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.[118] 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.[119]

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.[120] A federal district court

[116] "New Mexico Pursues Interim Storage," *Nuclear News*, June 2015, p. 60. "Udall, Heinrich Statements on Proposed Interim Nuclear Waste Facility in New Mexico," news release, April 30, 2015, http://www.tomudall.senate.gov/?p=press_release&id=1947.

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

[118] 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.

[119] 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.

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

judge on July 26, 2010, ordered the Department of the Interior to reconsider its decisions on the PFS permits.[121] However, PFS asked NRC to terminate its license on December 20, 2012.[122]

Regulatory Requirements for Yucca Mountain

Although the Obama Administration tried to redirect the high-level nuclear waste program, current law still focuses on Yucca Mountain for civilian waste. 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 must receive a construction authorization to build the Yucca Mountain repository before being issued a license to bring nuclear waste to the site and emplace it underground. Among NRC substantive regulatory requirements is a mandatory DOE 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.[123] The Yucca Mountain 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.[124] 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

[121] 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.

[122] Palmberg, Robert M., Chairman of the Board, Private Fuel Storage LLC, letter to Nuclear Regulatory Commission, December 20, 2012, http://pbadupws.nrc.gov/docs/ML1235/ML12356A063.pdf.

[123] 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.

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

groups contended that the 10,000-year standard proposed by EPA was too short, because DOE had projected that radioactive releases from the repository would peak after about 400,000 years.

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

A three-judge U.S. Court of Appeals panel on July 9, 2004, struck down the 10,000-year regulatory compliance period in the EPA and NRC Yucca Mountain standards.[125] 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.[126] Nevada state officials called EPA's proposed standard far too lenient and charged that it was "unlawful and arbitrary."[127]

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.[128] NRC revised its repository licensing regulations to conform to the new EPA standards on April 13, 2009.[129] 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."[130]

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

[126] 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.

[127] 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.

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

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

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

Alternative Technologies

DOE's Fuel Cycle Research and Development Program conducts research on a wide variety of technologies for improving the management of spent nuclear fuel. This had included research related to the implementation of the Obama Administration's integrated waste strategy, according to the FY2017 DOE budget justification. The Trump Administration's FY2018 Fuel Cycle R&D budget proposal included $88.5 million for nuclear waste processing and related technologies but would have eliminated funding for the Obama Administration's integrated waste strategy. The Consolidated Appropriations Act for FY2018 included $63.9 million for generic nuclear waste R&D and $22.5 million for integrated waste management activities. The Trump Administration's FY2019 request includes $10 million for waste disposal R&D and zero for integrated waste management.

A major focus of the Fuel Cycle R&D program is technology related to 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.

Program Costs

Nuclear utilities had paid fees to the Nuclear Waste Fund to cover the disposal costs of civilian nuclear spent fuel until halted by a court order in May 2014, but DOE cannot spend the money in the fund until it is appropriated by Congress. At the end of FY2017, the Waste Fund balance stood at $37.2 billion, according to the FY2019 Administration budget request.[131] Before the Obama Administration halted the Yucca Mountain project after FY2010, $7.41 billion had been disbursed from the Waste Fund, according to DOE's program summary report.[132] 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.[133] 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

[131] Office of Management and Budget, *Fiscal Year 2019 Budget Appendix*, p. 393, https://www.whitehouse.gov/omb/appendix.

[132] 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.

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

prohibit waste from outside their regional compacts. Another site, in Utah, has since become available nationwide for most Class A low-level waste, but class B and C waste generally must be stored at the sites where it is generated.

The startup of a new disposal facility for Class A, B, and C low-level waste near Andrews, TX, in 2012 may alleviate the class B and C storage problem. Although the facility is intended to serve primarily Texas and Vermont, up to 30% of its 2.3 million cubic feet of disposal capacity may be allocated to waste from other states.[134] The Texas site received its first shipment of waste, from a company in Vermont, on April 27, 2012.[135]

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 Rick Perry signed legislation June 20, 2003, authorizing the Texas Commission on Environmental Quality (TCEQ) to license adjoining disposal facilities for commercial and federally generated low-level waste. Pursuant to that statute, an application to build 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.[136]

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 noncompact 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.[137]

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.

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

[134] Waste Control Specialists, "Our Facilities: Compact Waste Facility," http://www.wcstexas.com/facilities/compact-waste-facility/.

[135] 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.

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

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

governing low-level waste licenses[138] 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.

NRC proposed a significant modification of its low-level waste disposal regulations on March 26, 2015.[139] The NRC staff submitted a final version of the regulations for commission approval on September 15, 2016.[140] The commission issued further revisions on September 8, 2017, which would have to be incorporated before it could be published as a supplemental proposed rule. As drafted by the NRC staff, the regulations would for the first time establish time periods for technical analyses of low-level waste sites to ensure protection of the general population. Technical analysis would have to be conducted for a 1,000-year compliance period if no significant quantities of long-lived radioactive material are present at a disposal site, and for a 10,000-year compliance period if significant quantities are present. A post-10,000-year analysis would be required in certain cases, and a new technical analysis would be required to protect inadvertent intruders at a low-level waste site. NRC's current low-level waste regulations were adopted in 1982.

Concluding Discussion

Disposal of radioactive waste will be a key issue in the continuing nuclear power debate. Without a national waste management 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.

Under current law, the federal government's nuclear waste disposal policy is focused on the Yucca Mountain site. However, President Obama's actions to terminate the Yucca Mountain project and develop a new waste strategy through the Blue Ribbon Commission on America's Nuclear Future brought most activities in the DOE waste program to a halt. Congress is continuing to debate the project's future, particularly through the appropriations process. The NRC staff's finding in October 2014 that the Yucca Mountain site would meet NRC standards after the repository was filled and sealed has been cited as evidence of the project's continued viability.[141]

The Trump Administration's proposal to restart Yucca Mountain licensing and the retirement of Senator Reid, who as Democratic Leader had strongly opposed the Yucca Mountain project, may affect legislative action on nuclear waste in the 115th Congress. In requesting $120 million in FY2018 for Yucca Mountain licensing and spent fuel storage, the Trump Administration said, "These investments would accelerate progress on fulfilling the Federal Government's obligations to address nuclear waste, enhance national security, and reduce future taxpayer burden."[142] The

[138] 10 C.F.R. Part 61, Licensing Requirements for Land Disposal of Radioactive Waste.

[139] NRC, "Low-Level Radioactive Waste Disposal; Proposed Rule," 80 *Federal Register* 16082, March 26, 2015.

[140] NRC, "Final Rule: Low-Level Radioactive Waste Disposal," SECY-16-0106, September 15, 2016, https://www.nrc.gov/docs/ML1618/ML16188A290.html. For more details, see NRC, "Low-Level Radioactive Waste Disposal Rulemaking," September 25, 2017, https://www.nrc.gov/waste/llw-disposal/llw-pa/uw-streams.html.

[141] Northey, Hannah, "Yucca Mountain: Boosters Hope NRC Report Ends Safety Debate, Draws Supporters," *E&E Daily*, Friday, January 30, 2015, https://www.eenews.net/eedaily/2015/01/30/stories/1060012593.

[142] Office of Management and Budget, *op. cit.*

Yucca Mountain funding was not approved for FY2018, but the Trump Administration has repeated the request for FY2019.

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. For example, 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. DOE estimates that its potential liabilities for waste program delays could total as much as $34.1 billion, including the $6.9 billion already paid to Exelon and other utilities in settlements and final judgments. The nuclear industry has predicted that future damages could rise by tens of billions of dollars more 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.[143] 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.

The "consent based" nuclear waste siting process recommended by the Blue Ribbon Commission, and which would be authorized by the Senate Appropriations Committee's FY2018 Energy and Water Development Appropriations bill and other legislation, has attracted serious interest from localities in New Mexico and Texas. However, previous voluntary siting efforts, such as those by the U.S. Nuclear Waste Negotiator established by the 1987 NWPA amendments, also attracted serious local interest but were ultimately blocked by the governments of the potential host states. Therefore, the cooperation of states is likely to be crucial to the success of any renewed "consent based" siting effort.

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