Civilian Nuclear Waste Disposal

Mark Holt
Specialist in Energy Policy

September 4, 2009

Congressional Research Service
7-5700
www.crs.gov
RL33461

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

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

The Obama Administration has decided to "terminate the Yucca Mountain program while developing nuclear waste disposal alternatives," according to the DOE FY2010 budget justification. Alternatives to Yucca Mountain are to be evaluated by a "blue ribbon" panel of experts convened by the Administration. At the same time, according to the justification, the NRC licensing process for the Yucca Mountain repository is to continue, "consistent with the provisions of the Nuclear Waste Policy Act."

The FY2010 budget request of $198.6 million for DOE's Office of Civilian Radioactive Waste Management would provide only enough funding to continue the Yucca Mountain licensing process and to evaluate alternative policies, according to DOE. The request is about $90 million below the FY2009 funding level, which was nearly $100 million below the FY2008 level. All work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted, according to the DOE budget justification.

The House-passed version of the FY2010 Energy and Water Development Appropriations Bill (H.R. 3183) approves the Administration's funding cuts but includes a requirement that Yucca Mountain be one of the options considered by the "blue ribbon" nuclear waste panel. The Senate version of the bill also approves the DOE nuclear waste funding cut but does not include the House requirement on the blue-ribbon panel; in addition, the Senate bill would reduce funding for NRC's Yucca Mountain licensing activities. Senator Reid of Nevada, a long-time opponent of the proposed Yucca Mountain repository, announced on July 29, 2009, that the Administration had agreed to terminate the Yucca Mountain licensing effort in the FY2011 budget request.

Contents

Figures

Tables

Contacts

Most Recent Developments

The Obama Administration has decided to "terminate the Yucca Mountain program while developing nuclear waste disposal alternatives," according to the Department of Energy (DOE) FY2010 budget justification, submitted to Congress May 7, 2009. Under the Nuclear Waste Policy Act, the Yucca Mountain site in Nevada is 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 proposed repository to the Nuclear Regulatory Commission (NRC) on June 3, 2008.

President Obama's FY2010 budget calls for a "blue ribbon" panel of experts to evaluate alternatives to the Yucca Mountain repository. At the same time, according to the DOE budget justification, the NRC licensing process for the Yucca Mountain repository is to continue, "consistent with the provisions of the Nuclear Waste Policy Act."

The FY2010 budget request of $198.6 million for DOE's Office of Civilian Radioactive Waste Management, which runs the nuclear waste program, would provide only enough funding to continue the Yucca Mountain licensing process and to evaluate alternative policies, according to DOE. The request is about $90 million below the FY2009 funding level, which was nearly $100 million below the FY2008 level. All work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted, according to the DOE budget justification.

The House version of the FY2010 Energy and Water Development Appropriations Bill (H.R. 3183, H.Rept. 111-203), passed July 17, 2009, approves the Administration's funding cuts but includes a requirement that Yucca Mountain be one of the options considered by the "blue ribbon" nuclear waste panel. The Senate version of the bill, passed July 29, 2009 (S.Rept. 111-45), also approves the DOE nuclear waste funding cut but does not include the House requirement on the blue-ribbon panel; in addition, the Senate bill would reduce funding for NRC's Yucca Mountain licensing activities. Senator Reid of Nevada, a long-time opponent of the proposed Yucca Mountain repository, announced on the same day as Senate passage that the Administration had agreed to terminate the Yucca Mountain licensing effort in the FY2011 budget request.

Introduction

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

Spent Nuclear Fuel Program

Under the Nuclear Waste Policy Act of 1982 (NWPA) and 1987 amendments, the Department of Energy (DOE) is focusing on Yucca Mountain, Nevada, to house a deep underground repository for spent nuclear fuel and other highly radioactive waste. The State of Nevada has strongly

opposed DOE's efforts on the grounds that the site is unsafe, pointing to potential volcanic activity, earthquakes, water infiltration, underground flooding, nuclear chain reactions, and fossil fuel and mineral deposits that might encourage future human intrusion.

Under the Bush Administration, DOE determined that Yucca Mountain was suitable for a repository and that licensing of the site by the Nuclear Regulatory Commission (NRC) should proceed. DOE submitted a license application for the repository to NRC on June 3, 2008, and projected that the repository could begin receiving waste in 2020, about 22 years later than the 1998 goal specified by NWPA.[1]

However, the Obama Administration decided that the Yucca Mountain repository should not be opened, although it requested FY2010 funding to continue the NRC licensing process. The Administration announced plans to convene a "blue ribbon" panel to develop alternative waste disposal strategies. (For a discussion of policy options, see CRS Report R40202, *Nuclear Waste Disposal: Alternatives to Yucca Mountain*, by Mark Holt.)

The safety of geologic disposal of spent nuclear fuel and high-level waste (HLW), as planned in the United States, depends largely on the characteristics of the rock formations from which a repository would be excavated. Because many geologic formations are believed to have remained undisturbed for millions of years, it appeared technically feasible to isolate radioactive materials 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.[2]

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

President Obama's FY2010 budget calls for long-term research on technologies that could reduce the volume and toxicity of nuclear waste. The Bush Administration had proposed to develop large-scale facilities to reprocess and recycle spent nuclear fuel by separating long-lived elements, such as plutonium, that could be made into new fuel and "transmuted" into shorter-lived radioactive isotopes. Spent fuel reprocessing, however, has long been controversial because of the potential weapons use of separated plutonium and cost concerns. The Obama Administration proposes to refocus DOE's nuclear waste research on fundamental science and away from the design and development of reprocessing facilities.

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

[2] 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.

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 South Carolina and Washington state. 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 is accepted from any waste generator by a Utah commercial disposal facility.

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

Nuclear Utility Lawsuits

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.[3] As required by NWPA, the contracts specified that DOE would begin disposing of nuclear waste no later than January 31, 1998.

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

The Department of Justice has since negotiated settlements with four utilities: Exelon, Scana, Duke, and the Omaha Public Power District, plus an additional tentative settlement. All five settlements would involve 36 of the 118 reactors (operating and closed) that are covered by DOE waste disposal contracts under NWPA. Under the settlements, utilities submit annual reimbursement claims to DOE for any delay-related nuclear waste storage costs they incurred during that year. Any disagreements over reimbursable claims between DOE and a utility would go to arbitration. Through the end of calendar year 2008, $406 million had been paid under the

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

settlements. The payments are made from the U.S. Treasury's Judgment Fund, a permanent account that is used to cover damage claims against the U.S. government.[4]

Other nuclear utilities have not reached settlements, but have continued pursuing their damage claims through the U.S. Court of Federal Claims. Unlike the settlements, which cover all past and future damages resulting from DOE's nuclear waste delays, awards by the Court of Claims can cover only damages that have already been incurred; therefore, utilities must continue filing claims as they accrue additional delay-related costs. About 20 cases involving initial damage claims have been tried in the Court of Claims so far, and about 30 more are pending. In addition, about half a dozen second-round suits have been filed by utilities that had already filed initial claims.

In the cases that have been tried so far, the Court of Claims has awarded judgments to the plaintiffs totaling $790 million. Of that amount, only $34.9 million has been paid—for one case filed by the Tennessee Valley Authority (TVA). The remaining cases are under appeal. Added to the $406 million in settlement payments, the $34.9 million TVA award brings the federal government's total nuclear waste damage payments so far to $440.9 million.

Future Liability Estimates

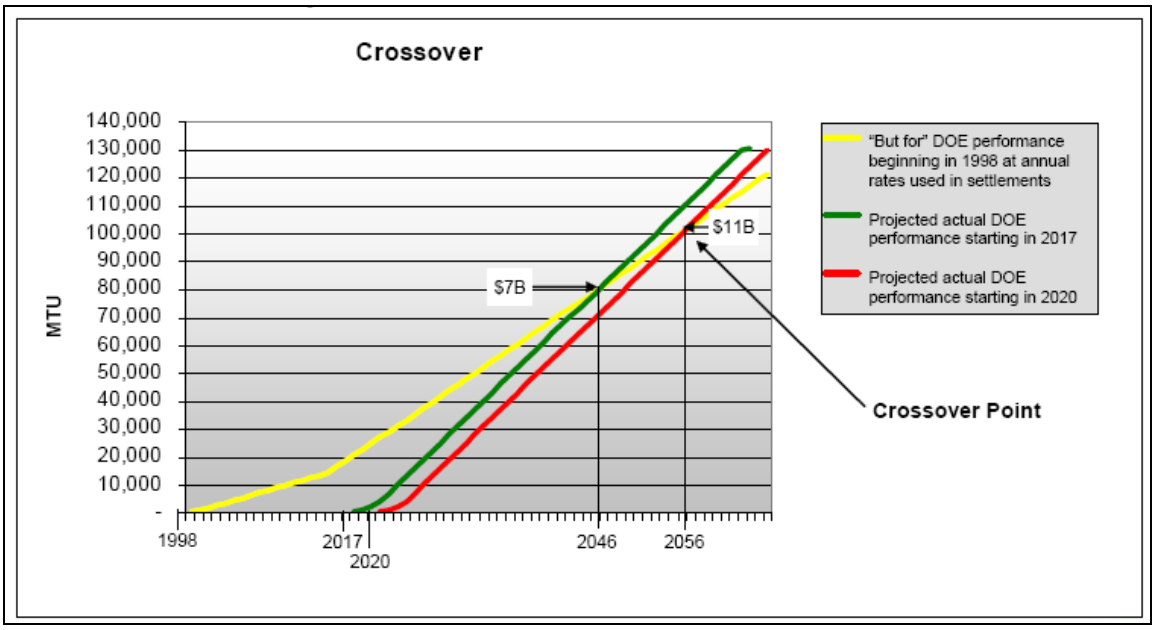
DOE estimates that its potential liabilities for waste program delays will total $11 billion through 2056 (in current dollars) if the Department is able to begin taking spent nuclear fuel from plant sites by 2020, which had been the Bush Administration's most recent goal. DOE's methodology for this estimate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

The green and red lines in **Figure 1** show DOE's planned waste acceptance rate if waste shipments begin by 2017 or 2020. Under those scenarios, DOE would take away 400 metric tons the first year, 600 the second year, 1,200 the third year, 2,000 the fourth year, and 3,000 per year thereafter. This is the rate assumed by DOE's Total System Life Cycle Cost Report.[5] At that higher acceptance rate, DOE would be able to eventually catch up with the amount of waste that it was assumed to take under the settlements (the yellow line). If waste acceptance began by 2017 (the green line), the backlog would be eliminated by 2046, and if acceptance began by 2020 (the red line) the backlog would be gone by 2056. Under the settlements, therefore, there would be no further annual damage payments after those years, if DOE were able to achieve the 2017 or 2020 acceptance scenario.

[4] Information in this section about nuclear waste settlements, court judgments, and liability estimates is based on a telephone conversation with David K. Zabransky, Nuclear Utility Specialist, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, March 25, 2009.

[5] U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, Fiscal year 2007*, DOE/RW-0591, Washington, DC, July 2008, p. 20, http://ocrwm.doe.gov/about/budget/pdf/TSLCC_2007_8_05_08.pdf.

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



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

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

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

DOE filed a license application with the Nuclear Regulatory Commission (NRC) for the proposed Yucca Mountain repository in June 2008, and has estimated that annual program spending would have to increase to nearly $2 billion (from around $300 million in FY2009) to allow waste shipments to begin by 2020 if the license were approved.[6] However, President Obama's FY2010 budget request would sharply reduce Yucca Mountain funding, as noted above.

The House and Senate have both accepted the Administration's FY2010 nuclear waste budget cuts, so it appears unlikely that spent nuclear fuel shipments to Yucca Mountain could begin by 2020, even if full funding for the project were to be restored in the future. Waste acceptance by 2020 might be possible if Congress authorizes one or more temporary storage sites within the next few years, although previous efforts to develop such facilities have been blocked by state and local opposition.

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

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

Congressional Action

President Obama's proposal to terminate the Yucca Mountain project and search for disposal alternatives has prompted considerable congressional response. The Senate Energy and Natural Resources Committee approved a comprehensive energy bill on June 17, 2009, that would establish a federal advisory commission to study nuclear waste options and submit recommendations to Congress (S. 1492, S.Rept. 111-48). President Obama's FY2010 budget request for $5 million for a blue-ribbon panel to study nuclear waste alternatives has been approved by the House and Senate and is awaiting conference action, with the primary difference being the House's requirement that Yucca Mountain be one of the alternatives considered.

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

Delays in nuclear waste disposal could affect the approximately 30 new U.S. reactors currently being proposed, because new reactors cannot be licensed without an NRC determination that sufficient waste disposal capacity will be available. Several bills have been introduced (see Legislation section) to prohibit NRC from denying a reactor license because of a lack of disposal capacity. Several recent bills would also encourage nuclear waste reprocessing and recycling, and would place the Nuclear Waste Fund "off budget" so that appropriations from the Waste Fund would no longer be subject to budget caps.

The Bush Administration proposed legislation in the 109th Congress (H.R. 5360, S. 2589) that was designed to speed the development of the Yucca Mountain repository. The bill would have reduced the scope of environmental reviews for the repository, changed the budget scoring of waste fee receipts so that program funding could be increased more easily, exempted nuclear waste sent to Yucca Mountain from disposal requirements under the Resource Conservation and Recovery Act (RCRA), allowed preemption of state and local transportation requirements, and permanently withdrawn the site from public lands use.

In addition, the Bush Administration bill would have required NRC to assume that sufficient disposal capacity would be available for waste produced by new reactors (known as the "waste confidence" determination). It also would have repealed the 70,000 metric ton limit on the amount of waste that could be emplaced at Yucca Mountain, a limit that is expected to be exceeded by currently operating reactors during their lifetimes.

The State of Nevada strongly opposed the Administration's Yucca Mountain legislation. As an alternative approach, Senator Reid introduced legislation on March 6, 2007, to require

commercial nuclear reactor operators to place their spent nuclear fuel into on-site dry storage casks, which would then become the permanent responsibility of DOE (S. 784). Opponents of the proposal contend that it would leave spent fuel at reactor sites indefinitely and undermine the Nuclear Waste Policy Act. However, supporters argue that the waste would be safer in dry storage at reactor sites than if it were shipped across the country to Yucca Mountain.

Because of delays in the Yucca Mountain project, the Senate Appropriations Committee included statutory authorization for the Secretary of Energy to designate interim storage sites for spent nuclear fuel as part of the FY2007 Energy and Water Development Appropriations bill (H.R. 5427, Sec. 313). However, the 109th Congress adjourned without enacting the measure. The Senate Committee's provisions would have required the Secretary, after consultation with the governor, to designate a storage site in each state with a nuclear power plant, if feasible, or to designate regional storage facilities.

President Bush 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).[7]

Characteristics of Nuclear Waste

Radioactive waste is a term that encompasses a broad range of material with widely varying characteristics. Some waste has relatively slight radioactivity and is safe to handle, 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:[8]

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

[7] 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.

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

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

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

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

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

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

Spent Nuclear Fuel

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

A fresh fuel rod, which emits relatively little radioactivity, contains uranium that has been enriched in the isotope U-235 (usually 3%-5%). But after nuclear fission has taken place in the reactor, many of the uranium nuclei in the fuel rods have been split into a variety of highly radioactive fission products; others have absorbed neutrons to become radioactive plutonium, some of which has also split into fission products. Radioactive gases are also contained in the spent fuel rods. Newly withdrawn spent fuel assemblies are stored in deep pools of water adjacent to the reactors to keep them from overheating and to protect workers from radiation.

Spent fuel discharged from U.S. commercial nuclear reactors is currently stored at 72 power plant sites around the nation, plus two small central storage facilities. A typical large commercial nuclear reactor discharges an average of 20-30 metric tons of spent fuel per year—an average of about 2,150 metric tons annually for the entire U.S. nuclear power industry. The nuclear industry

estimated that the total amount of commercial spent fuel was 56,586 metric tons by January 2008,[9] an amount projected to reach 62,000 metric tons by 2010. Including 7,000 metric tons of DOE spent fuel and high-level waste that is also planned for disposal at Yucca Mountain, the total amount would nearly reach NWPA's 70,000-metric-ton limit by 2010.

As long as nuclear power continues to be generated, the amounts stored at plant sites will continue to grow until an interim storage facility or a permanent repository can be opened—or until alternative treatment and disposal technology is developed. DOE recently updated its estimate of the total amount of U.S. commercial spent fuel that may eventually require disposal from 105,000 metric tons[10] to 130,000 metric tons.[11]

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 until 2020 or later. Most utilities are expected to construct new dry storage capacity for their older, cooler fuel. On-site dry storage facilities currently in operation or planned typically consist of metal casks or concrete modules. Forty-seven licensed dry storage facilities are currently operating in the United States.[12] NRC has determined that spent fuel could be stored safely at reactor sites for up to 100 years.[13]

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 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.[14] NRC has agreed to consider some of the recommendations, although it contends that current security measures would prevent successful attacks. The nuclear industry contends that the several hours required for uncovered spent fuel to heat up enough to catch fire would allow ample time for alternative measures to cool the fuel. The FY2006 Energy and Water appropriations bill (P.L. 109-103) gave NRC an additional $21 million to implement the NAS recommendations.

[9] "Spent Fuel Inventory at 56,586 Metric Tons," NuclearFuel, January 28, 2008, p. 10.

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

[11] DOE Office of Civilian Radioactive Waste Management, *Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*, Summary, DOE/EIS-0250F-S1D, October 2007, p. S-47.

[12] ACI Nuclear Energy Solutions, *U.S. Commercial Reactor Dry Storage Summary*, July 20, 2009.

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

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

Commercial Low-Level Waste

Nearly 2.1 million cubic feet of low-level waste with about 800,000 curies of radioactivity was shipped to commercial disposal sites in 2008, according to DOE.[15] Volumes and radioactivity can vary widely from year to year, based on the status of nuclear decommissioning projects and cleanup activities that can generate especially large quantities.

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

Current Policy and Regulation

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

Spent Nuclear Fuel

Current Program

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

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

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

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

President Obama has proposed that OCRWM and the DOE Office of Nuclear Energy (NE) be headed by the same person, leading to speculation that the two offices will be functionally combined. Much of NE's FY2010 funding request is focused on nuclear waste research. The President's nominee, Warren F. "Pete" Miller Jr., has been confirmed by the Senate for the NE post but not for OCRWM.

Waste Facility Schedules

In proposing to terminate the Yucca Mountain project, the Obama Administration has not announced a new schedule for the DOE nuclear waste program. The Administration has proposed that a blue-ribbon panel be convened in FY2010 to study waste disposal options, but no other details have been announced. The Administration currently is continuing the Yucca Mountain licensing process, which, under NWPA, is supposed to take no more than four years after the license submission, which was June 3, 2008. However, Senator Reid has announced that the Administration will seek no further repository licensing funding in FY2011.

Over the objections of the State of Nevada, NRC formally accepted the Yucca Mountain license application for docketing and review on September 8, 2008. At the same time, NRC staff recommended that the Commission adopt DOE's environmental impact statement for the project, but with a stipulation that supplemental groundwater analysis be conducted.[16]

The major activity at the Yucca Mountain site so far has been the construction and operation of an "exploratory studies facility" (ESF) with a 25-foot-diameter tunnel boring machine. The ESF consists primarily of a five-mile tunnel with ramps leading to the surface at its north and south ends. The tunnel boring machine began excavating the north ramp in October 1994 and broke through to the surface at the south entrance April 25, 1997. Underground studies have been conducted at several side alcoves that were excavated off the main tunnel. Budget cuts in FY2009 have halted most activity at the Yucca Mountain site.

Private Interim Storage

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

On September 7, 2006, the Department of the Interior issued two decisions against the PFS project. The Bureau of Indian Affairs disapproved a proposed lease of tribal trust lands to PFS, concluding there was too much risk that the waste could remain at the site indefinitely.[17] The

[16] Licensing documents are posted at http://www.rw.doe.gov/.

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

Bureau of Land Management rejected the necessary rights-of-way to transport waste to the facility, concluding that a proposed rail line would be incompatible with the Cedar Mountain Wilderness Area and that existing roads would be inadequate.[18]

In reaction to the Interior Department decisions, Senator Hatch, a staunch opponent of the PFS proposal, declared the project "stone cold dead."[19] However, the Skull Valley Band of Goshutes and PFS filed a federal lawsuit July 17, 2007, to overturn the Interior decisions on the grounds that they were politically motivated.[20]

Regulatory Requirements

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

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

The Energy Policy Act of 1992 (P.L. 102-486) made a number of changes in the nuclear waste regulatory system, particularly that EPA must issue new environmental standards specifically for the Yucca Mountain repository site. General EPA repository standards previously issued and subsequently revised no longer apply to Yucca Mountain. DOE and NRC had raised concern that some of EPA's general standards might be impossible or impractical to meet at Yucca Mountain.[21]

The new standards, which limit the radiation dose that the repository could impose on individual members of the public, were required to be consistent with the findings of a study by the National Academy of Sciences (NAS), which was issued August 1, 1995.[22] 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.

---

[18] 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.

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

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

[21] 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.

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

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

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

A three-judge U.S. Court of Appeals panel on July 9, 2004, struck down the 10,000-year regulatory compliance period in the EPA and NRC Yucca Mountain standards.[23] 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.[24] Nevada state officials called EPA's proposed standard far too lenient and charged that it was "unlawful and arbitrary."[25]

EPA issued its final rule to amend the Yucca Mountain standards on September 30, 2008. The final rule reduces the annual dose limit during the period of 10,000 through 1 million years from the proposed 350 millirems to 100 millirems, which the agency contended was consistent with international standards. Under the final rule, compliance with the post-10,000-year standard will be based on the arithmetic mean of projected doses, rather than the median as proposed. The 4 millirem groundwater standard will continue to apply only to the first 10,000 years.[26] NRC will have to revise its repository licensing regulations to conform to the new EPA standards. (For more

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

[24] 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.

[25] 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.

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

information, see CRS Report RL34698, *EPA's Final Health and Safety Standard for Yucca Mountain*, by Bonnie C. Gitlin.)

DOE estimated in its June 2008 Final Supplemental Environmental Impact Statement (FSEIS) for the Yucca Mountain repository that the maximum mean annual individual dose after 10,000 years would be 2 millirems. That is substantially below the level estimated by the 2002 Final Environmental Impact Statement, which calculated that the peak doses—occurring after 400,000 years—would be about 150 millirems (Volume 1, Chapter 5). The FSEIS attributed the reduction to changes in DOE's computer model and in the assumptions used, noting that "various elements of DOE's modeling approach may be challenged as part of the NRC licensing process."[27]

Alternative Technologies

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

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

Funding

The FY2010 OCRWM budget request of $198.6 million would provide only enough funding to continue the Yucca Mountain licensing process and to evaluate alternative policies, according to DOE. The request is about $90 million below the FY2009 funding level, which was nearly $100 million below the FY2008 level. More than 2,000 waste program contract employees will be terminated by the end of FY2009, according to the budget justification. Most of the program's remaining work is to be taken over by federal staff.

All work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted, according to the DOE budget justification. Such activities include development of repository infrastructure, waste transportation preparations, and system engineering and analysis.

The House agreed with the Administration's plans to provide funding solely for Yucca Mountain licensing activities and for a blue-ribbon panel to review waste management options. The House approved the Administration budget request, including $5 million for the blue ribbon review. However, the House-passed bill specifies that the review must include Yucca Mountain as one of the alternatives, despite the Administration's contention that the site should no longer be considered. According to the House Appropriations Committee report, "It might well be the case that an alternative to Yucca Mountain better meets the requirements of the future strategy, but the

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

review does not have scientific integrity without considering Yucca Mountain." The House panel also recommended that at least $70 million of the program's funding be devoted to maintaining expertise by the Yucca Mountain Project management contractor to support the licensing effort, rather than relying entirely on federal staff. The Senate also recommended approval of the Administration request, but without any restrictions on the blue ribbon panel.

Funding for the nuclear waste program is provided under two appropriations accounts, as shown in **Table 1**. The Administration's FY2010 request is divided evenly between an appropriation from the Nuclear Waste Fund, which holds fees paid by nuclear utilities, and the Defense Nuclear Waste Disposal account, which pays for disposal of high-level waste from the nuclear weapons program. The Senate Appropriations Committee report calls for the Secretary of Energy to suspend fee collections, "given the Administration's decision to terminate the Yucca Mountain repository program while developing disposal alternatives."

Additional funding from the Nuclear Waste Fund for the Yucca Mountain licensing process is included in the NRC budget request. The House provided the full $56 million requested, while the Senate voted to cut the request to $29 million. Senator Reid, a long-time opponent of the proposed Yucca Mountain repository, announced on July 29, 2009, that the Administration had agreed to terminate the Yucca Mountain licensing effort in the FY2011 budget request.

Although nuclear utilities pay fees to the Nuclear Waste Fund to cover the disposal costs of civilian nuclear spent fuel, DOE cannot spend the money in the fund until it is appropriated by Congress. Through June 30, 2009, utility nuclear waste fees and interest totaled $30.48 billion, of which $7.295 billion had been disbursed to the waste disposal program, according to DOE's program summary report, leaving a balance of $23.185 billion in the Nuclear Waste Fund. In addition to the disbursements from the Nuclear Waste Fund, the waste disposal program received defense waste disposal appropriations totaling $3.49 billion through FY2008, according to DOE.[28]

DOE's latest update of its *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* was released on August 5, 2008.[29] According to that estimate, the Yucca Mountain program would cost $96.2 billion in 2007 dollars from the beginning of the program in 1983 to repository closure in 2133. DOE's previous estimate, issued in 2001, was $57.5 billion in 2000 dollars. Major factors in the increase are inflation and a higher estimate of spent fuel to be generated by existing reactors. Spent fuel from proposed new reactors is not included in the cost estimate.

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

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

Table 1. DOE Civilian Spent Fuel Management Funding

(in millions of current dollars)

Program	FY2007 Approp.	FY2008 Approp.	FY2009 Approp.	FY2010 Request	FY2010 House	FY2010 Senate
Yucca Mountain	298.1	267.1	—[a]	—	—	—
Transportation	35.3	18.3	—	—	—	—
Management and Integration	46.7	26.4	—	—	—	—
Program Direction	64.4	74.7	74.9	70.0	70.0	70.0
Total	**445.7**	**386.4**	**288.4**	**196.8**	**196.8**	**196.8**
Source of Funding						
Nuclear Waste Fund appropriations	99.2	187.3	145.4	98.4	98.4	98.4
Defense waste appropriations	346.5	199.2	143.0	98.4	98.4	98.4

Sources: DOE FY2010 Congressional Budget Request, H.Rept. 111-203, S.Rept. 111-45.

a. Subcategories not specified.

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

Despite the 1992 deadline, no new disposal sites have been opened under the Low-Level Waste Act. Legislation providing congressional consent to a disposal compact among Texas, Maine, and Vermont was signed by President Clinton September 20, 1998 (P.L. 105-236). However, on October 22, 1998, a proposed disposal site near Sierra Blanca, Texas, was rejected by the Texas Natural Resource Conservation Commission, and Maine has since withdrawn. Texas Governor Perry signed legislation June 20, 2003, authorizing the Texas Commission on Environmental Quality (TCEQ) to license adjoining disposal facilities for commercial and federally generated low-level waste. Pursuant to that statute, an application to build a disposal facility for commercial and federal low-level waste in Andrews County, Texas, was filed August 2, 2004, by Waste Control Specialists LLC. TCEQ voted January 14, 2009, to issue the license after the necessary

land and mineral rights have been acquired.[30] Waste Control Specialists has predicted that the facility could start receiving waste by mid-2010.[31]

The Midwestern Compact voted June 26, 1997, to halt development of a disposal facility in Ohio. Nebraska regulators rejected a proposed waste site for the Central Compact December 21, 1998, drawing a lawsuit from five utilities in the region. A U.S. district court judge ruled September 30, 2002, that Nebraska had exercised bad faith in disapproving the site and ordered the state to pay $151 million to the compact. A settlement was reached August 9, 2004, resulting in a payment of $145.8 million,[32] and the compact is seeking access to the planned Texas disposal facility. Most other regional disposal compacts and individual states that have not joined compacts are making little progress toward finding disposal sites.

The disposal facility at Barnwell, South Carolina, is currently accepting all Class A, B, and C low-level waste from the Atlantic Compact (formerly the Northeast Compact), in which South Carolina joined original members Connecticut and New Jersey on July 1, 2000. Under the compact, South Carolina can limit the use of the Barnwell facility to the three compact members, and a state law enacted in June 2000 phased out acceptance of non-compact waste through June 30, 2008. The Barnwell facility previously had stopped accepting waste from outside the Southeast Compact at the end of June 1994. The Southeast Compact Commission in May 1995 twice rejected a South Carolina proposal to open the Barnwell site to waste generators outside the Southeast and to bar access to North Carolina until that state opened a new regional disposal facility, as required by the compact. The rejection of those proposals led the South Carolina General Assembly to vote in 1995 to withdraw from the Southeast Compact and begin accepting waste at Barnwell from all states but North Carolina. North Carolina withdrew from the Southeast Compact July 26, 1999.

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

Regulatory Requirements

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

Most states considering new or expanded low-level waste disposal facilities, including Texas and Utah, are agreement states. Most states, both agreement and non-agreement, have established substantially stricter technical requirements for low-level waste disposal than NRC's, such as

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

[31] Weil, Jenny, "Texas Regulators Approve License for LLW Disposal," *Inside NRC*, January 19, 2009, p. 3.

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

banning shallow land burial and requiring concrete bunkers and other engineered barriers. NRC would issue the licenses in non-agreement states.

Concluding Discussion

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

Under current law, the federal government's nuclear waste disposal policy is focused on the planned Yucca Mountain repository. However, deep funding reductions and uncertainty that have accompanied President Obama's plan to terminate the Yucca Mountain project have brought most activities in the DOE waste program to a halt. Although licensing of the Yucca Mountain repository is to continue through FY2010, DOE will face relentless opposition from the State of Nevada and a possible funding cutoff in FY2011.

Because of their waste-disposal contracts with DOE, owners of existing reactors are likely to continue seeking damages from the federal government if disposal delays continue. DOE's 2004 settlement with the nation's largest nuclear operator, Exelon, could require payments of up to $600 million from the federal judgment fund, and DOE estimates that payments could rise to $11 billion if Yucca Mountain does not open before 2020. The nuclear industry has predicted that future damages could reach tens of billions of dollars if the federal disposal program fails altogether.

Lack of a nuclear waste disposal system could also affect the licensing of proposed new nuclear plants, both because of NRC licensing guidelines and various state laws.[33] In addition, further repository delays could force DOE to miss compliance deadlines for defense waste disposal.

Problems being created by nuclear waste disposal delays would presumably be addressed by the President's proposed "blue ribbon" panel of experts on nuclear waste management alternatives. Major options include centralized interim storage, continued storage at existing nuclear sites, reprocessing and waste treatment technology, alternative repository sites, or a combination. Given the delays resulting from the current budget cuts, longer on-site storage is almost a certainty under any option. Any of the options would also face intense controversy, especially among states and regions that might be potential hosts for future waste facilities. As a result, substantial debate would be expected over any proposals to change the Nuclear Waste Policy Act.

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

Legislation

H.R. 513 (Forbes)

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

H.R. 2250 (Burton)

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

H.R. 2300 (Bishop)

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

H.R. 2539 (Thornberry)

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

H.R. 3183 (Pastor)

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

H.R. 3385 (Barton)

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

S. 591 (Reid)

National Commission on High-Level Radioactive Waste and Spent Nuclear Fuel Establishment Act of 2009. Would establish a national commission to study nuclear waste management improvements. Introduced March 12, 2009; referred to Committee on Environment and Public Works.

S. 807 (Nelson of Nebraska)

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

S. 861 (Graham)

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

S. 1333 (Barrasso)

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

S. 1462 (Bingaman)

American Clean Energy Leadership Act of 2009. Includes provision to establish a federal commission to study nuclear waste management alternatives and make recommendations to Congress. Approved by Energy and Natural Resources Committee June 17, 2009, and reported as an original bill July 16, 2009 (S.Rept. 111-48).

Congressional Hearings, Reports, and Documents

U.S. Congress. House. Committee on Energy and Commerce. Subcommittee on Energy and Air Quality. *A Review of the President's Recommendation to Develop a Nuclear Waste Repository at Yucca Mountain, Nevada*. Hearing, 107th Congress, 2nd session. April 18, 2002. Washington: GPO, 2002. 294 p. Serial no. 107-99.

U.S. Congress. Senate. Committee on Energy and Natural Resources. *Low-Level Radioactive Waste*. Hearing, 108th Congress, 2nd session. September 30, 2004. Washington: GPO, 2005. 62 p.

U.S. Congress. Senate. *Yucca Mountain Repository Development*. Hearings, 107th Congress, 1st session. May 16, 22, and 23, 2002. Washington: GPO, 2002. 240 p. S.Hrg. 107-483.

For Additional Reading

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

Nuclear Waste Technical Review Board. *Report to the U.S. Congress and the U.S. Secretary of Energy.* September 2008.
http://www.nwtrb.gov/reports/reports.html

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

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

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

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

Author Contact Information

Mark Holt
Specialist in Energy Policy
mholt@crs.loc.gov, 7-1704