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Civilian Nuclear Waste Disposal

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SUMMARY

Management of civilian radioactive waste has posed difficult issues for Congress since the beginning of the nuclear power industry in the 1950s. Although federal policy is based on the premise that nuclear waste can be disposed of safely, new storage and disposal facilities for all types of radioactive waste have frequently been delayed or blocked by concerns about safety, health, and the environment.

Civilian radioactive waste ranges from the highly radioactive spent fuel from nuclear power plants to the far-less-radioactive uranium mill tailings that result from the processing of uranium ore. Most of the debate over civilian waste disposal focuses on spent fuel and on "low level" waste from nuclear power plants, medical institutions, civilian research facilities, and industry.

The Nuclear Waste Policy Act of 1982 (NWPA) calls for disposal of spent nuclear fuel in a repository in a deep geologic formation that is unlikely to be disturbed for thousands of years. 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 is studying numerous scientific issues in determining the suitability of Yucca Mountain for a nuclear waste repository, which must be licensed by the Nuclear Regulatory Commission (NRC). Questions about the site include the likelihood of earthquakes, volcanoes, groundwater contamination, and human intrusion.

NWPA's goal for loading waste into the repository was 1998, but DOE does not expect to open the facility until 2010 at the earliest. Energy Secretary Abraham recommended the site to the President on February 14, 2002. President Bush recommended the site to Congress the next day, and Nevada Governor Guinn exercised his right to "veto" the site April 8, 2002. The veto will block further development of the site unless Congress passes an approval resolution that is signed by the President within 90 days of continuous session, a deadline that is currently calculated to occur in early September. The House passed a Yucca Mountain approval resolution (H.J.Res. 87) May 8, 2002, by a vote of 306-117. The Senate Energy and Natural Resources Committee passed an approval resolution (S.J.Res. 34) on June 5, 2002, by 13-10.

If the Yucca Mountain approval resolution is enacted, DOE plans to submit a construction permit application to NRC in 2004. DOE is seeking $527 million for the program in FY2003, a 40% increase from FY2002.

Low-level waste sites are a state responsibility under the Low-Level Radioactive Waste Policy Act of 1980. Pursuant to that act, 10 regional compacts for disposal of low-level waste have been approved by Congress.

Only three commercial low-level waste sites are currently operating, in the states of South Carolina, Utah, and Washington. The Washington facility is accepting waste just from within the Northwest and Rocky Mountain regional compacts, and the Utah site accepts only the least-concentrated class of low-level waste, although it has received preliminary approval to accept the other major low-level waste classes as well.

MOST RECENT DEVELOPMENTS

President Bush recommended to Congress February 15 that a license application be submitted by the Department of Energy (DOE) to the Nuclear Regulatory Commission (NRC) to build a nuclear waste repository at Yucca Mountain in Nevada. As allowed by the Nuclear Waste Policy Act, Nevada Governor Guinn on April 8 sent Congress a notice of disapproval for the Yucca Mountain site. That so-called "state veto" will block further action at the site unless a congressional resolution to approve the site is enacted into law within 90 days of continuous session, a deadline that is currently calculated to occur in early September. Senator Bingaman introduced the approval resolution in the Senate April 9 (S.J.Res. 34), and Representative Barton introduced it in the House April 11 (H.J.Res. 87). The House Committee on Energy and Commerce approved H.J.Res. 87 (H.Rept. 107-425) on April 25 by a 41-6 vote, and the resolution was approved by the House, 306-117, on May 8. The Senate Committee on Energy and Natural Resources approved S.J.Res. 34 by a 13-10 vote June 5. (For details on the special congressional procedures for considering the approval resolution, see CRS Report RL31135, Nuclear Waste Repository Siting: Expedited Procedures for Congressional Approval.*)*

The Administration's FY2003 budget request, submitted to Congress February 4, seeks $527 million for the DOE civilian waste disposal program, a 40% boost over FY2002. The increased budget is intended to pay for preparation of a 10,000-page Yucca Mountain repository construction permit application, which DOE expects to submit to the Nuclear Regulatory Commission (NRC) in FY2004 – a one-year delay from the previous schedule. The additional funds are also needed for detailed repository design work, repository performance studies, and transportation planning, according to DOE. Despite the delay in submitting a construction permit application, DOE contends that it can still begin receiving waste at the site by 2010 as previously scheduled.

BACKGROUND AND ANALYSIS

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. As a result, progress on nuclear waste disposal is widely considered a prerequisite for any future growth of nuclear power.

Under the Nuclear Waste Policy Act of 1982 (NWPA) and 1987 amendments, the Department of Energy (DOE) is studying the suitability of Yucca Mountain, Nevada, for housing 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.

However, DOE contends that the evidence so far indicates that Yucca Mountain is likely to prove suitable and that studies of the site should continue. A "viability assessment" issued by the Department December 18, 1998, concluded that "no show stoppers have been identified to date at Yucca Mountain." A Draft Environmental Impact Statement completed by DOE in July 1999 reiterated those findings, recommending that the project proceed as planned [http://www.ymp.gov/timeline/eis/deis.htm]. The planned Yucca Mountain repository is not scheduled to open until 2010 at the earliest, more than a decade later than the 1998 goal specified by NWPA. (For more information on the Yucca Mountain scientific studies, see CRS Report RL30190, *Proposed High-Level Nuclear Waste Repository: Yucca Mountain Site Characterization Progress*.)

The safety of geologic disposal of highly radioactive waste, 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 no scientific or technical reason to think that a satisfactory geological repository cannot be built," according to the National Research Council.

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 groundwater flow 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 10,000-year period that nuclear waste is to be isolated. Opponents of geologic disposal have urged greater emphasis on new or alternative technologies that might allow entirely different approaches to high-level radioactive waste management.

Other Programs. Other types of civilian radioactive waste have also generated public controversy, particularly low-level radioactive 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, and the Washington facility does not accept waste from outside its region. The lowest-concentration class of low-level radioactive waste is also accepted by a commercial disposal facility in Utah, which is applying for a license to receive all major classes of low-level waste. Threats by states to close their disposal facilities led to congressional authorization of regional compacts for low-level waste disposal in 1985, although no new sites have been opened by any of the 10 authorized disposal compacts.

Nuclear Utility Lawsuits

Nuclear utilities, which pay for most of the high-level waste disposal program through a fee on nuclear power, have sued DOE for failing to begin the removal of spent nuclear fuel from storage at commercial reactors by January 31, 1998, the deadline established by the Nuclear Waste Policy Act.

In response to a utility lawsuit, the U.S. Court of Appeals for the District of Columbia Circuit ruled November 14, 1997, that DOE would be liable for unspecified damages to nuclear utilities if it missed the 1998 deadline. DOE was ordered to work out a remedy with the utilities under the procedures of the standard disposal contract signed by all nuclear utilities pursuant to NWPA.

In the first set of rulings on breach-of-contract suits filed by several utilities, the U.S. Court of Federal Claims decreed on October 29, 1998, that DOE must pay fuel storage costs for three closed commercial reactors. Those costs are to be determined by future trials; the three utilities are claiming damages of $2.4 billion. Damage claims were denied to Northern States Power by another Court of Federal Claims judge on April 6, 1999, but that ruling was reversed by the U.S. Court of Appeals for the Federal Circuit on August 31, 2000. The Appeals court decision cleared the way for nuclear power companies to proceed with lawsuits in the Court of Federal Claims against DOE. Industry officials contend that total damages for missing the 1998 disposal deadline could eventually reach tens of billions of dollars, assuming that no disposal ever takes place.

DOE has been negotiating with various reactor owners since 1999 on the missed nuclear waste deadline and reached its first settlement agreement with a nuclear utility, PECO Energy Co., on July 19, 2000. The agreement allows PECO to keep up to $80 million in nuclear waste fee revenues during the next 10 years and may result in DOE's taking title to waste and storage facilities at PECO's Peach Bottom plant in Pennsylvania. In return, PECO agreed not to sue DOE over the missed disposal deadline. Several utilities expressed opposition to the agreement, but DOE said others are considering similar settlements.

Although some of the delays have been blamed on poor program management, DOE contends that tight funding has been a major barrier. DOE cannot spend the nuclear industry's mandatory waste fees without congressional approval, and only about half the total fees collected have been appropriated to the program so far. However, some surplus in the fund may be necessary to pay future nuclear waste disposal costs after today's nuclear plants have ceased operation.

Nuclear Spent Fuel Legislation

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 will block further repository development at Yucca Mountain unless a resolution approving the site is passed by Congress and signed into law within 90 days of continuous session, a deadline that is currently calculated to occur in early September 2002.

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. 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. (For more about the special procedures

that will be used to consider the approval resolution, see CRS Report RL31135, *Nuclear Waste Repository Siting: Expedited Procedures for Congressional Approval*, September 28, 2001.)

The nuclear industry and its supporters have urged Congress to require DOE to build an interim storage facility that could begin receiving spent fuel from nuclear power plants as soon after the missed 1998 deadline as possible. Such a facility, consisting of storage casks on concrete pads or in surface-based bunkers, could reduce spent fuel storage costs, increase safety, and fulfill the federal government's legal obligations, supporters contend (see NEI perspective at [http://www.nei.org/index.asp?catnum=1&catid=14]).

But environmental, anti-nuclear power, and other groups warn that interim storage would result in earlier transportation of unprecedented quantities of nuclear waste; they contend it would be safer to leave the waste in place until a permanent solution can be found (see Nuclear Information and Resource Service perspective at [http://www.nirs.org/fctsht.htm]). (For more on the controversy over nuclear waste transportation, see CRS Report 97-403, *Transportation of Spent Nuclear Fuel*.)

Omnibus energy legislation introduced July 27, 2001 (H.R. 4) would have taken all expenditures and receipts of the Nuclear Waste Fund off-budget; however, the provision was struck by the rule for floor debate. In analyzing the same provision in a House Commerce Committee-passed nuclear waste bill in the 106th Congress (H.R. 45), the Congressional Budget Office concluded that it "could ease the way for increased federal spending by exempting such spending from budgetary controls." The nuclear industry and other program supporters have long contended that funding constraints have slowed the program's progress. Opponents of the program, particularly the State of Nevada, contend that increased spending should not be directed to the Yucca Mountain site, which they view as fundamentally flawed.

As passed by the House August 2, 2001, H.R. 4 would establish a spent nuclear fuel "recycling" research and development program, for which $10 million would be authorized for FY2002 and "such sums as necessary" for the following two years. The provision is based on language in an energy bill (H.R. 2460) ordered reported by the House Science Committee July 18, 2001. Supporters of such research contend that new technologies could reduce the volume and long-term toxicity of nuclear waste, particularly by destroying plutonium in the waste through nuclear fission. Opponents note that such treatment requires reprocessing of spent fuel to at least partially separate its major constituents, such as uranium and plutonium, and that separated plutonium could be used for nuclear explosives. Such a program, opponents contend, could undermine U.S. nuclear nonproliferation efforts aimed at discouraging other nations from separating plutonium from spent nuclear fuel. H.R. 4 specifies that technologies pursued by the program should be "proliferation-resistant."

Omnibus energy legislation being considered by the Senate (S. 517) also addresses some aspects of the nuclear waste issue. An amendment to S. 517 by Senator Domenici, approved March 13, 2002, would prevent "irreversible action relating to the disposal of spent nuclear fuel" until Congress had determined whether to permanently bury the spent fuel as waste or to extract plutonium and uranium from the spent fuel to make new nuclear fuel. The amendment also would establish a nuclear waste research program similar to that in H.R. 4. Similar provisions are included in a nuclear energy bill (S. 472) introduced by Senator

Domenici March 7, 2001, and an omnibus bill (S. 388) introduced by Senator Murkowski February 26, 2001.

In the 106th Congress, comprehensive legislation to rewrite NWPA and require construction of an interim storage facility near Yucca Mountain was approved by the House Commerce Committee April 21, 1999, by a vote of 40-6 (H.R. 45, H.Rept. 106-155). In addition to mandating interim storage, the bill would have modified the licensing standards for a permanent underground repository, revised the program's funding mechanism, and authorized DOE to take title to spent fuel stored at commercial reactor sites.

The Clinton Administration's primary stated objection to H.R. 45 and similar bills introduced in the previous two Congresses was that nuclear waste should not be stored temporarily near Yucca Mountain before the site had been found suitable for permanent underground disposal. Supporters of the interim storage legislation contend that the December 1998 viability assessment, which found "no show stoppers" at Yucca Mountain, should have been sufficient to overcome the Clinton Administration's major concerns. However, Administration officials subsequently indicated that more study was necessary before the veto threat would be lifted. The Clinton Administration also threatened a veto over provisions in the bills that would have given NRC sole authority to set radiation protection standards for the repository, eliminating EPA's role.

Faced with continued Clinton Administration opposition to interim storage at Yucca Mountain during the 106th Congress, the Senate Energy and Natural Resources Committee set aside a comprehensive nuclear waste bill that had been referred to the panel (S. 608) and instead reported an original measure (S. 1287, S.Rept. 106-98) that concentrated on storage at reactor sites. Under S. 1287 as approved by the Committee, DOE would have been authorized to take title to spent fuel at reactor sites and to begin receiving waste at Yucca Mountain as soon as possible after NRC granted a construction permit for a permanent underground repository. In addition, the Committee-passed bill included the elimination of EPA's authority to set environmental standards for the repository, drawing continued veto threats.

On the Senate floor, the provision authorizing DOE to take title to waste stored at reactor sites drew substantial opposition from a number of states with nuclear power plants. Opponents of the "take title" provision contended that once nuclear utilities had handed their waste over to DOE, the pressure to continue progress on a permanent repository would decrease, and the spent fuel could remain at reactor sites indefinitely. To ease those concerns, the provision was dropped from the bill before the final vote. Supporters of the legislation attempted to address the Clinton Administration's objections to the elimination of EPA's standard-setting authority by instead prohibiting EPA from issuing final standards for the repository before June 1, 2001, but the Administration responded with a further veto threat February 8, 2000. With those changes, the Senate passed S. 1287 February 10, 2000, by a vote of 64-34. The House passed S. 1287 without amendment on March 22, 2000, by a vote of 253-167, sending it to the President's desk.

As promised, President Clinton vetoed the bill April 25, 2000. The Senate attempted to override the veto on May 2, 2000, but fell three votes short of the necessary two-thirds majority (64-35).

Characteristics of Nuclear Waste

Radioactive waste is a term that encompasses a broad range of material with widely varying characteristics. Some is barely radioactive and 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 generally defined by DOE and the Nuclear Regulatory Commission (NRC) as follows:

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 uranium and other fissile elements) as well as long-lived radionuclides such as plutonium, which remains dangerously radioactive for tens of thousands of years.

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 remain, however, to require isolation for 10,000 years or more.

Transuranic 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.

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 and 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. High-level, low-level or TRU waste that contains hazardous non-radioactive waste. Such waste poses serious institutional problems, because the radioactive portion is regulated by DOE or NRC under the Atomic Energy Act, while 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 very 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 slightly enriched in the isotope U-235. But after nuclear fission has taken place in the reactor, many of the uranium atoms 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 large pools of water adjacent to the reactors to keep them from overheating and to protect workers from radiation.

The approximately 45,000 metric tons of spent fuel discharged from U.S. commercial nuclear reactors through 2001 is currently stored at about 70 power plant sites around the nation. (Some is also held at two small central storage facilities.) 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.

A typical large commercial nuclear reactor discharges an average of 20-30 metric tons of spent fuel per year — about 2,000 metric tons annually for the entire U.S. nuclear power industry. As a result, the total amount of spent fuel is expected to reach 60,000 metric tons by 2010, the earliest feasible date for opening the Yucca Mountain repository, and almost 80,000 metric tons by 2020.

New storage capacity at nuclear plant sites will obviously be required if DOE is unable to begin accepting waste into its disposal system for another 8 years. Most utilities are expected to construct new dry storage capacity for their older fuel. On-site dry storage facilities currently in operation or planned typically consist of metal casks or concrete modules. NRC has determined that spent fuel could be stored safely at reactor sites for up to 100 years.

The terrorist attacks of September 11, 2001, have heightened concerns about the vulnerability of stored spent fuel. Concerns have been raised that an aircraft crash into a reactor's pool area 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. Nuclear industry representatives contend that the several hours required for uncovered spent fuel to heat up enough to catch fire would allow ample time for alternative measures to cool the fuel.

Commercial Low-level Waste

Low-level waste disposed of in commercial sites makes up about a third of all accumulated low-level waste in the United States; the remaining two-thirds has been generated by DOE activities and sent to DOE-owned disposal sites. About 320,000 cubic feet of commercial low-level waste was shipped to disposal sites in 1997. The volume of

commercial low-level radioactive waste peaked in 1980 and fell sharply in the 1990s, primarily because of escalating disposal fees.

The vast majority of commercial low-level waste typically consists of the least hazardous "Class A" waste. In 1997, nuclear utilities generated nearly two-thirds of the volume of commercially disposed low-level waste, industrial activities accounted for about a fourth, government for less than 10%, academic activities for about 2%, and medical institutions for less than 1%, according to DOE. About 85% of the radioactivity came from utility waste. Nuclear utilities' share of total volume and radioactivity is expected to rise when current reactors are decommissioned, because significant numbers of components have become radioactive during operation and will be disposed of as low-level waste — some of it relatively long-lived.

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, consisting of 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 proves unsuitable, 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 repository be constructed (which is currently not scheduled to take place until FY2002) although the search for an MRS site may begin at any time. In addition, construction of an MRS facility may not begin until NRC has granted a construction license for the permanent repository, and construction or operation of the MRS must cease if repository construction is interrupted. No more than 10,000 metric tons of

waste may be stored at the MRS before the permanent repository begins operating, and no more than 15,000 metric tons thereafter.

Waste Facility Schedules. DOE's most recent nuclear waste program schedule calls for the repository to begin operating by 2010 — 12 years later than the law's target date. According to a draft Civilian Radioactive Waste Program Plan issued in May 1996, the 2010 opening can be achieved despite severe budget cuts imposed for FY1996.

The major activity at the Yucca Mountain site is the excavation 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 are being conducted at several side alcoves that have been excavated off the main tunnel.

DOE completed a "viability assessment" of Yucca Mountain in December 1998, which was followed by a draft environmental impact statement (EIS) for the project in July 1999, and the final EIS in February 2002. DOE issued a preliminary site suitability evaluation August 21, 2001, that found Yucca Mountain could meet EPA and NRC requirements.

Energy Secretary Abraham on February 14, 2002, recommended to the President that the Yucca Mountain project go forward. At the same time, the Secretary submitted a final EIS and other supporting materials (for details, see the Yucca Mountain Project home page at [http//www.ymp.gov]). As noted previously, President Bush recommended the Yucca Mountain site to Congress the day after the Secretary's recommendation, and Nevada Governor Guinn subsequently submitted a notice of disapproval, or "state veto," as allowed by NWPA. Congress is now considering an approval resolution to overturn the state veto under expedited procedures required by NWPA; the House passed its version of the resolution (H.J.Res. 87) May 8, 2002.

If the state veto is overturned, DOE plans to submit a license application to NRC in 2004 – a year later than previously scheduled. DOE then hopes to receive an NRC construction permit by 2006 and a license to begin receiving waste at the repository by 2010. The repository is to be permanently closed in 2116, according to the DOE viability assessment.

A December report by the General Accounting Office (GAO) had called on the Energy Secretary to delay recommending Yucca Mountain to the President until more of the research needed for a license application to NRC could be completed. The report noted that DOE's main contractor on the Yucca Mountain project does not expect the license application to be ready before January 2006. GAO concluded that "on the bases of a 4-year licensing period and a 5-year period for initial construction, the repository might not be ready to open until about 2015 if DOE does not apply for a license until January 2006."[1] However, GAO

[1] U.S. General Accounting Office. *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project.* GAO-02-191. December 2001.

recently noted that DOE has told its primary contractor "to prepare a new plan for submitting a license application to NRC by December 2004."[2]

The DOE Total System Life Cycle Cost Report, issued in May 2001, estimates that the entire program will cost $49.3 billion (in constant 2000 dollars) from 2001-2119. The report says the program spent $6.7 billion in year-of-expenditure dollars through FY2000.

Private Interim Storage. Delays in the federal nuclear waste program have prompted interest in a private interim storage facility. A utility consortium signed an agreement with a Utah Indian tribe 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 June 25, 1997. Project officials told NRC in March 1997 that the dry-cask storage facility would be located on 98 acres of the sparsely populated reservation of the Skull Valley Band of Goshute Indians, about 70 miles southwest of Salt Lake City. The initial lease for the site would run for 25 years, with possible renewal for another 25 years. The facility's capacity would be 40,000 metric tons, available to any U.S. nuclear utility in addition to the eight consortium members. The facility, strongly opposed by the State of Utah, would not require DOE assistance or congressional or state approval. PFS officials have projected that operations could begin as early as 2004.

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.

NRC's licensing requirements for Yucca Mountain, at 10 CFR 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.

DOE's repository siting guidelines, at 10 CFR 960, developed with NRC concurrence, establish the criteria that the Secretary of Energy used in determining the suitability of the Yucca Mountain site. DOE issued new siting guidelines November 14, 2001, that prompted the State of Nevada to file a court challenge on December 17, 2001. The new guidelines replace numerous individual disqualifying conditions, such as a high rate of water movement through the repository, with an analysis of "total system performance," in which previously unacceptable conditions could be mitigated by other factors. The Nevada lawsuit contends that the new guidelines allow too much reliance on waste packages and other engineered barriers, rather than natural geologic features, to prevent radioactive releases from the repository.

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[2] Prepared testimony of Gary Jones, Director, Natural Resources and Environment Team, U.S. General Accounting Office, to Subcommittee on Energy and Air Quality, House Committee on Energy and Commerce, April 18, 2002.

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 complained that some of EPA's general standards might be impossible or impractical to meet.

The new standards, which would limit the radiation dose that the repository could impose on individual members of the public, must be consistent with the findings of a study by the National Academy of Sciences (NAS), which was issued August 1, 1995. The NAS study recommends 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, 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 well after that period.

EPA issued its final Yucca Mountain standards on June 6, 2001. The final standards include most of the major provisions of the proposed version, including the 15 millirem overall exposure limit and the 4 millirem groundwater limit. The most significant changes in the final rules were to require that compliance be demonstrated about one mile closer to the repository and to double the amount of groundwater that would be analyzed. Despite the Department's opposition to the EPA standards, DOE's preliminary site suitability evaluation indicates 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.

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 concept of "burning" long-lived plutonium and other radionuclides in a special nuclear reactor or particle accelerator, converting them to faster-decaying fission products.

Funding. DOE is seeking $524.7 million for the civilian nuclear waste program in FY2003, a 40% increase over the program's comparable FY2002 appropriation of $375.0 million, according to the House Appropriations Committee.

The FY2003 budget request anticipates that sharply higher annual funding will continue as the project moves toward construction and operation. Continuation of site studies and preparation of the 10,000-page construction permit application are budgeted for most of the requested increase. A more than 400% boost in funding for transportation and waste acceptance will be required to help prepare for shipments in 2010, according to the DOE budget justification. One of the FY2003 goals of the waste transportation program is to develop final policies and procedures for providing technical assistance to states through which nuclear waste will be shipped.

Table 1. DOE Civilian Spent Fuel Management Funding
(in millions of current dollars)

Program	**FY2001 Approp.**	**FY2002 Approp.**	**FY2003 Request**	**--**	**--**
Yucca Mountain	313.0	296.9	424.9	--	--
Waste acceptance, storage, transportation	2.7	4.1	17.1	--	--
Program integration	12.1	18.0	19.7	--	--
Program direction	64.9	58.3	65.3	--	--
Total	**402.6***	**375.0**	**524.7**	**--**	**--**
Source of Funding					
Nuclear Waste Fund approp.	192.9	95.0	209.7	--	--
Defense waste appropriations	199.7	280.0	315.0	--	--

Sources: House Appropriations Committee, DOE FY2002 Congressional Budget Request, Appropriations reports, Congressional Record. Subcategories do add exactly to the total because of adjustments made after submission of the Administration budget request.

*includes $10 million transferred from interim storage fund

As Table 1 indicates, about 40% of the FY2003 funding request for the program would come from the Nuclear Waste Fund, with the rest coming from the defense waste account. 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 the end of FY2000, utility nuclear waste fees and interest totaled $15.2 billion, of which about $5.5 billion had been disbursed to the waste disposal program, according to DOE, leaving a balance of $9.6 billion in the Nuclear Waste Fund. Another $2.3 billion was owed by utilities for spent fuel generated before 1983. The nuclear waste program's appropriations for FY1983-FY2000 total about $6.7 billion, according to DOE, including $1.2 billion for defense waste disposal.

Low-level Radioactive Waste

Current Policy. Disposal of 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, while others are developing single-state disposal sites. 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 site is currently using that authority, leaving only one open to nationwide disposal of all major types of low-level waste. A third site, in Utah, has since become available nationwide for most Class A low-level waste. The Utah site's operator, Envirocare, applied to the State on November 1, 1999, for a license amendment to accept Class B and C waste as well. Utah regulators announced preliminary approval of the request January 2, 2001.

Despite the 1992 deadline, no new disposal sites have been opened. A facility in California's Ward Valley to serve California, Arizona, North Dakota, and South Dakota received a state operating permit in 1993. However, the site is on federal land, which the Department of the Interior would not transfer to the state as had originally been expected. As a result, California Governor Davis established an advisory committee in June 1999 to explore alternatives to the Ward Valley disposal site.

Texas is to develop a disposal site under a recently approved compact with Maine and Vermont. Legislation providing congressional consent to the compact was signed by President Clinton September 20, 1998 (P.L. 105-236). However, the future of the new compact's disposal program was thrown into uncertainty by the October 22, 1998, rejection of a proposed disposal site near Sierra Blanca, Texas, by the Texas Natural Resource Conservation Commission.

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. Most other regional disposal compacts and individual states that have not joined compacts are making little progress toward finding disposal sites, largely because of public opposition and the continued availability of the disposal facilities in South Carolina and, for most Class A waste, Utah. "Presently, no state or compact is trying to identify a site for a disposal facility," according to a September 1999 report by the General Accounting Office.

Only one disposal facility, at Barnwell, S.C., is currently accepting all Class A, B and C low-level waste from most states. The Barnwell facility had stopped accepting waste from outside the Southeast Compact at the end of June 1994. Then 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 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, a move that prompted a lawsuit from the Compact on July 10, 2000.

South Carolina joined the Atlantic Compact (formerly the Northeast Compact) with 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. A state law enacted in June 2000 phases out acceptance of non-compact waste through 2008.

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. States barred from access to existing disposal facilities are likely to require low-level waste generators to store their waste on site until new disposal sites are available, particularly for Class B and C waste. However, the Envirocare site in Utah could provide nationwide disposal if its Class B and C license is approved.

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, California, and Utah are "agreement states" — states authorized by NRC to license the handling of low-level waste and certain other radioactive materials. Most states, both agreement and non-agreement, have established substantially stricter technical requirements for low-level waste disposal than NRC's, such as banning shallow land burial and requiring concrete bunkers and other engineered barriers. NRC would issue the licenses in non-agreement states.

LEGISLATION

P.L. 107-66, H.R. 2311

Energy and Water Development Appropriations for FY2002. Provides funding for DOE civilian nuclear waste program. Introduced June 26, 2001, as an original measure from the Committee on Appropriations (H.Rept. 107-112). Passed Senate July 19, 2001 (S.Rept. 107-39). Conference Report passed by both Houses November 1, 2001 (H.Rept. 107-258). Signed into law November 12, 2001.

H.R. 4 (Tauzin)

Securing America's Future Energy Act of 2001. Omnibus energy bill includes provisions establishing nuclear waste research program. Introduced July 27, 2001; referred to multiple committees. Passed by House August 2, 2001, by vote of 240-189. Senate version passed April 25, 2002, by vote of 88-11. Conference began June 27, 2002.

H.R. 2072 (Berkley)

Redirects the Nuclear Waste Fund into research, development, and utilization of technologies for on-site nuclear waste storage and reduction of radiation levels. Introduced

June 6, 2001; referred to the Committee on Energy and Commerce, and in addition to the Committees on Science, and Ways and Means.

H.R. 2460 (Boehlert)

Comprehensive Energy Research and Technology Act of 2001. Includes provisions to establish a nuclear waste research program. Introduced July 11, 2001; referred to Committee on Science. Ordered reported July 18, 2001. Most provisions included in omnibus energy legislation, H.R. 4.

H.R. 2587 (Tauzin)

Energy Advancement and Conservation Act of 2001. Includes provision to take the Nuclear Waste Fund off-budget. Committee print adopted July 19, 2001; measure introduced July 23, 2001; referred to Committee on Energy and Commerce and other committees, which were discharged. Reported by Energy and Commerce July 25, 2001. Most provisions included in omnibus energy legislation, H.R. 4, but Nuclear Waste Fund section dropped.

H.R. 3289 (Berkley)

Nuclear Waste Terrorist Threat Assessment and Protection Act. Prohibits Secretary of Energy from recommending construction of the Yucca Mountain repository until interagency plans to protect against terrorism are implemented. Introduced November 14, 2001; referred to Committees on Energy and Commerce and Transportation and Infrastructure.

H.J.Res. 87 (Barton)/S.J.Res. 34 (Bingaman)

Joint Resolution to approve further development of a permanent nuclear waste repository at Yucca Mountain, Nevada. House version introduced April 11, 2002; referred to Committee on Energy and Commerce. Approved by Subcommittee on Energy and Air Quality April 23 by vote of 24-2. Approved by Energy and Commerce Committee April 25 by vote of 41-6 (H. Rept. 107-425). Passed House May 8, 2002, by vote of 306-117. Senate version introduced April 9, 2002; approved by Committee on Energy and Natural Resources June 5, 2002, by vote of 13-10.

S. 388 (Murkowski)

National Energy Security Act of 2001. Includes provisions on nuclear waste strategy and research. Introduced February 26, 2001; referred to Committee on Energy and Natural Resources.

S. 472 (Domenici)

Nuclear Energy Electricity Supply Assurance Act of 2001. Includes provisions on nuclear waste strategy and research. Introduced March 7, 2001; referred to Committee on Energy and Natural Resources.

S. 517 (Bingaman)

Floor vehicle for omnibus energy legislation. Amended to include provisions on nuclear waste strategy and research. Introduced March 12, 2001; referred to Energy and Natural Resources Committee. Reported by Committee June 5, 2001. Amended energy provisions of S. 517 substituted for H.R. 4 and passed by Senate April 25, 2002. Conference began June 27, 2002.

CONGRESSIONAL HEARINGS, REPORTS, AND DOCUMENTS

U.S. Congress. House. Committee on Commerce. Subcommittee on Energy and Power. *Status of the Department of Energy Program to Develop a Permanent Geologic Repository at Yucca Mountain, Nevada*. Hearing, 106th Congress, 2nd session. June 23, 2000. Washington, U.S. Govt. Print. Off., 2000. 165 p.
"Serial no. 106-151"

---- *Nuclear Waste Policy Act of 1999*. Hearings, 106th Congress, 1st session. February 10 and March 12, 1999. Washington, U.S. Govt. Print. Off., 1999. 245 p.
"Serial no. 106-17"

U.S. Congress. Senate. Committee on Energy and Natural Resources. *Nuclear Waste Litigation.* Hearing, 106th Congress, 2nd session. September 28, 2000. Washington, U.S. Govt. Print. Off., 2001. 58 p.
S. Hrg. 106-918

---- *Nuclear Waste Storage and Disposal Policy*. Hearing, 106th Congress, 1st session. March 24, 1999. Washington, U.S. Govt. Print. Off., 1999. 99 p.
S. Hrg. 106-105

U.S. Congress. Senate. Committee on Environment and Public Works. *Disposal of Low-Level Radioactive Waste.* Hearing, 106th Congress, 2nd session. July 25, 2000. Washington, U.S. Govt. Print. Off., 2001. 166 p.

FOR ADDITIONAL READING

League of Women Voters Education Fund. *The Nuclear Waste Primer*. Washington, D.C., 1993. 170 p.

Nuclear Waste Technical Review Board. *Report to the U.S. Congress and the U.S. Secretary of Energy.* April 2001. 118 p.

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.rw.doe.gov]

U.S. General Accounting Office. *Nuclear Waste: Impediments to Completing the Yucca Mountain Repository Project.* GAO/RCED-97-30. January 1997. 56 p.

U.S. Geological Survey. *Yucca Mountain as a Radioactive-Waste Repository*. Circular 1184. 1999. 19 p.