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Nuclear Energy Policy

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SUMMARY

Nuclear energy policy issues facing Congress include questions about radioactive waste management, research and development priorities, power plant safety and regulation, nuclear weapons proliferation, nuclear weapons facilities cleanup, and technology for producing nuclear fuel.

Federal funding for nuclear energy research and development has been substantially reduced by the Clinton Administration, which places a higher priority on energy efficiency and alternative energy technologies. However, the FY2001 budget request by the Department of Energy (DOE) seeks $35 million for the Administration's Nuclear Energy Research Initiative, which focuses on advanced nuclear technology research.

Disposal of highly radioactive waste has been one of the most controversial aspects of nuclear power. The Nuclear Waste Policy Act of 1982 (P.L. 97-425), as amended in 1987, requires DOE to begin detailed physical characterization of Yucca Mountain in Nevada as a permanent underground repository for high-level waste.

Legislation was introduced in the 106th Congress (H.R. 45, S. 608) to establish an interim storage facility for nuclear waste at Yucca Mountain. But the Clinton Administration opposes temporary storage at the site. In response, the Senate approved an alternative measure February 10, 2000, to authorize DOE to store waste at Yucca Mountain only after receiving a construction permit for a permanent repository (S. 1287). The House passed the bill without amendment March 22, 2000, sending it to the President, who vetoed it April 25, 2000. A Senate effort to override the veto fell short on May 2, 2000, by a vote of 64-35.

Whether progress on nuclear waste disposal and other congressional action will revive the U.S. nuclear power industry's growth will depend on economic considerations. Natural gas- and coal-fired powerplants currently are favored over nuclear reactors for new generating capacity. However, the nuclear industry believes that simpler, safer versions of today's commercial reactors could eventually be built in the United States.

Concern about the spread, or proliferation, of nuclear weapons throughout the world has risen sharply since longtime rivals India and Pakistan conducted competing nuclear weapons tests in May 1998. The heightened tensions in Southeast Asia have focused attention on the effectiveness of the international nuclear nonproliferation regime. Potential nuclear weapons development by North Korea and Iran have also recently raised considerable U.S. concern.

Cleaning up severe environmental problems at U.S. nuclear weapons production facilities, owned by DOE, is expected to cost about $150 billion over the next several decades. After sharp growth in the early 1990s, DOE environmental cleanup funding under the Clinton Administration has been nearly flat. DOE is requesting about $6.3 billion for the program in FY2001, including $515 million for "privatized" waste treatment projects.

The enrichment of natural uranium to make nuclear fuel, formerly a government activity, now is carried out by the newly privatized U.S. Enrichment Corporation (USEC). USEC was privatized in a $1.9 billion initial public stock offering that was completed July 28, 1998.

MOST RECENT DEVELOPMENTS

The Senate voted May 2 not to override President Clinton's veto of a bill that would advance the schedule for receiving nuclear waste at a planned permanent repository at Yucca Mountain, Nevada (S. 1287). The 64-35 vote was three votes short of the two-thirds of the Senate needed for a veto override. The legislation would authorize the Department of Energy (DOE) to begin storing waste at the site as early as 2007, if the repository received a construction permit from the Nuclear Regulatory Commission (NRC). The Environmental Protection Agency (EPA) would be barred from issuing final environmental standards for the repository until June 1, 2001. In vetoing the bill April 25, the President contended that it would hinder EPA's rulemaking authority and reduce public confidence in the repository program. The 35 senators voting against the override included Senator Lott, who switched his vote so that he could enter a motion to reconsider, keeping the door open for another override attempt before the 106th Congress adjourns.

Most Department of Energy (DOE) nuclear-related programs would receive increased funding under the Clinton Administration's budget request that was submitted to Congress February 7. Nuclear energy programs would rise about 7%, to $306.1 million, and DOE's civilian nuclear waste disposal program would receive a 26% boost, to $437.5 million. Funding for environmental restoration and waste management would total $6.3 billion, an increase of $440 million; most of the increase is for "privatized" waste treatment projects, such as a high-level waste vitrification plant at Hanford, Washington.

BACKGROUND AND ANALYSIS

Overview of Nuclear Power in the United States

The U.S. nuclear power industry, while currently generating about 20% of the nation's electricity, faces an uncertain future. No nuclear plants have been ordered since 1978 and more than 100 reactors have been canceled, including all ordered after 1973. No units are currently under active construction; the Tennessee Valley Authority's Watts Bar 1 reactor, ordered in 1970 and licensed to operate in 1996, was the last U.S. nuclear unit to be completed. The nuclear power industry's troubles include a slowdown in the rate of growth of electricity demand, high nuclear power plant construction costs, relatively low costs for competing fuels, public concern about nuclear safety and waste disposal, and regulatory compliance costs.

High construction costs are perhaps the most serious obstacle to nuclear power expansion. Construction costs for reactors completed since the mid-1980s have ranged from $2-$6 billion, averaging about $3,000 per kilowatt of electric generating capacity (in 1995 dollars). The nuclear industry predicts that new plant designs could be built for about half that amount, but their total generating costs would still exceed currently projected costs for new coal- and gas-fired plants.

Of more immediate concern to the nuclear power industry is the outlook for existing nuclear reactors in a deregulated electricity market. Electric utility restructuring, which is

currently underway in several states, could increase the competition faced by existing nuclear plants. High operating costs and the need for costly improvements and equipment replacements have resulted during the past decade in the permanent shutdown of 11 U.S. commercial reactors before completion of their 40-year licensed operating periods.

Nevertheless, all is not bleak for the U.S. nuclear power industry, which currently comprises 103 licensed reactors at 65 plant sites in 31 states (NRC data on each site, by state, is available at [http://www.nrc.gov./AEOD/pib/pib.html]). Electricity production from U.S. nuclear power plants is greater than that from oil, natural gas, and hydropower, and behind only coal, which accounts for 55% of U.S. electricity generation. Nuclear plants generate more than half the electricity in six states.

Average operating costs of U.S. nuclear plants dropped substantially during the 1990s, and costly downtime has been steadily reduced. Licensed commercial reactors generated electricity at a record-high average of nearly 85% of their total capacity in 1999, according to industry statistics. The Calvert Cliffs nuclear plant received the first 20-year license extension from the Nuclear Regulatory Commission (NRC) in March 2000, and several more extensions are pending. Industry consolidation could also help existing nuclear power plants, as larger nuclear operators purchase plants from utilities that run only one or two reactors. Several such sales have been announced, including the planned sale of two New York Power Authority reactors to Entergy Nuclear for the record price of $967 million. The planned merger of two of the nation's largest nuclear utilities, PECO Energy and Unicom, announced September 23, 1999, would consolidate the operation of 14 reactors under a single corporate entity.

Global warming that may be caused by fossil fuels — the "greenhouse effect" — is cited by nuclear power supporters as an important reason to develop a new generation of reactors. But the large obstacles noted above must still be overcome before electric utilities will risk ordering new nuclear units. Reactor manufacturers are working on designs for safer, less expensive nuclear plants, and the Nuclear Regulatory Commission (NRC) has approved new regulations intended to speed up the nuclear licensing process, consistent with the Energy Policy Act of 1992 (P.L. 102-486). Even so, the Energy Information Administration forecasts that no new U.S. reactors will become operational before 2010, at the earliest.

Nuclear Power Research and Development

For the Clinton Administration, "nuclear power is not high priority," according to a FY1995 DOE budget summary, but "the option should be kept open." That ambivalence is reflected in DOE's nuclear R&D budget under the Clinton Administration, which has proposed to continue research on existing commercial nuclear plants while terminating development of advanced reactors.

Termination of DOE research on advanced reactors began in FY1995, when Congress accepted the Administration's plan to halt development of the advanced liquid metal reactor (ALMR), also called the Integral Fast Reactor (IFR). For FY1996, Congress agreed to terminate research on the gas turbine modular helium reactor (GT-MHR), although $5 million was provided in FY1999 for a joint U.S.-Russian program to develop the GT-MHR for destruction of surplus weapons plutonium. Congress and the Administration continued

funding for improved versions of today's light water reactors (LWRs) through FY1997. But the Administration's FY1998 request declared the program completed and provided only $5.5 million in termination costs for advanced LWR development.

The Clinton Administration's FY2001 budget request includes $40 million for two new LWR programs in DOE, which started in FY1999 and FY2000. The "nuclear energy plant optimization" (NEPO) program, for which $5 million is requested, is intended to improve the economic competitiveness of existing nuclear power plants. The "nuclear energy research initiative" (NERI), to be funded at $35 million, is designed to support innovative nuclear energy research projects. Congress provided $22 million for NERI and $5 million for NEPO for FY2000.

DOE justifies its efforts to encourage the continued operation of commercial U.S. nuclear plants as an important element in meeting national goals for reducing carbon dioxide emissions. Because nuclear plants directly emit no carbon dioxide, the continued operation of existing U.S. reactors avoids more than 620 million tons of carbon dioxide emissions each year, according to the FY2000 DOE budget justification. Opponents have criticized the nuclear energy research proposals as providing wasteful subsidies to a failing industry.

Shutting down the ALMR program and its associated research facilities, particularly the Experimental Breeder Reactor II (EBR-II) in Idaho, is expected to take several years. Some ALMR facilities are being used for electrometallurgical treatment of EBR-II fuel, for which $45 million was appropriated in FY1999. Opponents of the program have expressed concern that such activities could help keep the ALMR/IFR program alive and have called for Congress to halt further funding. Supporters contend that the technology could convert unstable fuel elements into safer forms for storage and disposal. According to DOE's FY2001 budget justification, a National Research Council report to be completed in early 2000 will help determine whether the electrometallurgical process should be used for full-scale treatment of spent fuel at the Idaho site.

Light Water Reactors

Funding for a program to develop improved versions of today's commercial LWRs ended in FY1997. The effort resulted in NRC certification of advanced light water reactor (ALWR) designs that are intended to be simpler, safer, and less expensive to build and operate than existing plants. Opponents called such funding an unjustified subsidy to the nuclear industry, which they contend will be uncompetitive with future electricity generation alternatives. The DOE effort comprised two major elements:

Standard Design Certification. DOE helped major U.S. nuclear reactor manufacturers obtain NRC standard design certification for advanced LWR power plants. Once a standard design is certified by NRC, a utility can order the design for the next 15 years with a minimum of further NRC design review. Two designs, from General Electric (GE) and Asea Brown Boveri/ Combustion Engineering (ABB/CE), received NRC standard design certification December 6, 1996; final rules to implement the certifications were issued May 21, 1997, for the GE design and May 21, 1997, for the ABB/CE reactor. A more advanced design, by Westinghouse, received NRC approval for standard design certification December 15, 1999.

First-of-a-kind Engineering. First-of-a-kind engineering (FOAKE) for advanced LWR power plants is the design stage in which most of the engineering and construction details are completed — details not needed for NRC-certified standard designs. Such additional detail is considered necessary to develop the cost estimates that utilities would require before ordering one of the new nuclear plants, even if it already had NRC certification. The cost of the FOAKE program was shared by DOE, electric utilities, and reactor manufacturers. The FY1997 nuclear energy funding was "the final Federal contribution to the light water reactor program," according to the conference report on that year's Energy and Water Development Appropriations bill (H.Rept. 104-782).

Although the Energy Information Administration does not expect advanced nuclear reactors to be built in the United States within the next decade, overseas sales remain a possibility, particularly in Asia. For example, two reactors using GE's recently certified advanced design have already been completed in Japan, and another two-unit plant has been ordered by Taiwan. Implementation of a U.S.-China nuclear cooperation agreement in March 1998 allows U.S. reactor sales to China for the first time.

Nuclear Power Plant Safety and Regulation

Safety

Controversy over safety has dogged nuclear power throughout its development, particularly following the 1979 Three Mile Island accident in Pennsylvania and the April 1986 Chernobyl disaster in the former Soviet Union. In the United States, safety-related shortcomings have been identified in the construction quality of some plants, plant operation and maintenance, equipment reliability, emergency planning, and other areas. In addition, mishaps have occurred in which key safety systems have been disabled. NRC's oversight of the nuclear industry is an ongoing issue; nuclear utilities often complain that they are subject to overly rigorous and inflexible regulation, but nuclear critics charge that NRC frequently relaxes safety standards when compliance may prove difficult or costly to the industry.

Domestic Reactor Safety. In terms of public health consequences, the safety record of the U.S. nuclear power industry in comparison with other major commercial energy technologies has been excellent. In more than 2,250 reactor-years of operation in the United States, the only incident at a commercial power plant that might lead to any deaths or injuries to the public has been the Three Mile Island accident, in which more than half the reactor core melted. Public exposure to radioactive materials released during that accident is expected to cause fewer than five deaths (and perhaps none) from cancer over the following 30 years. An independent study released in September 1990 found no "convincing evidence" that the TMI accident had affected cancer rates in the area around the plant. However, a study released in February 1997 concluded that much higher levels of radiation may have been released during the TMI accident than previously believed.

The relatively small amounts of radioactivity released by nuclear plants during normal operation are not generally believed to pose significant hazards. Documented public exposure to radioactivity from nuclear power plant waste has also been minimal, although the potential long-term hazard of waste disposal remains controversial. There is substantial scientific

uncertainty about the level of risk posed by low levels of radiation exposure; as with many carcinogens and other hazardous substances, health effects can be clearly measured only at relatively high exposure levels. In the case of radiation, the assumed risk of low-level exposure has been extrapolated mostly from health effects documented among persons exposed to high levels of radiation, particularly Japanese survivors of nuclear bombing.

The consensus among most safety experts is that a severe nuclear power plant accident in the United States is likely to occur less frequently than once every 10,000 reactor-years of operation. These experts believe that most severe accidents would have small public health impacts, and that accidents causing as many as 100 deaths would be much rarer than once every 10,000 reactor-years. On the other hand, some experts challenge the complex calculations that go into predicting such accident frequencies, contending that accidents with serious public health consequences may be more frequent.

Reactor Safety in the Former Soviet Bloc. The Chernobyl accident was by far the worst nuclear power plant accident to have occurred anywhere in the world. At least 31 persons died quickly from acute radiation exposure or other injuries, and between 5,000 and 45,000 fatal cancers may result over the next 40 years from radiation released during the accident. Those cancers would represent an increase in the cancer rate of about half a percent among the 75 million people in the western part of the former Soviet Union and a smaller increase in non-Soviet Europe, with a higher increase possible in the contaminated region around the plant.

The 10-year anniversary of the Chernobyl accident prompted renewed interest in the disaster's long-term consequences. According to a November 1995 report by the Organization for Economic Cooperation and Development (OECD), the primary observable health consequence of the accident has been a dramatic increase in childhood thyroid cancer. About 1,000 cases of childhood thyroid cancer have been reported in certain regions surrounding the destroyed reactor — a rate that is as much as a hundred times the pre-accident level, according to OECD. The death rate for accident cleanup workers has also risen measurably, the organization reported. Other recent studies have found increased genetic mutations among children born in contaminated regions.

Environmental contamination from the accident was widespread. The OECD report estimated that about 50,000 square miles of land in Belarus, Ukraine, and Russia were substantially contaminated with radioactive cesium. Significant levels of radioactive strontium, plutonium, and other isotopes were also deposited. Although radiation levels have declined during the past decade, land-use restrictions in the most contaminated areas may remain indefinitely, according to OECD.

World concern in recent years has focused on the safety of 14 other Chernobyl-type reactors (called RBMKs) that are still operating in the former Soviet Union, including one reactor at the Chernobyl site (a second operating reactor at the site was shut down November 30, 1996). Despite safety improvements made after the Chernobyl disaster, the RBMKs remain inherently unstable and dangerous, according to many Western experts. Also still operating in the former Soviet bloc are 10 early-model Soviet light water reactors (LWRs), which are similar to most Western reactors but suffer from major safety deficiencies, such as the lack of Western-style emergency cooling systems. More than two dozen newer Soviet-

designed LWRs that are currently operating are substantially safer than the earlier models but still do not meet all Western standards.

Immediate shutdown of the Soviet-designed reactors appears impractical because of the ex-Soviet bloc's critical need for electricity. Western help has been proposed for developing replacement power sources, allowing shutdown of the riskiest nuclear units, as well as funding for short- and long-term safety improvements. Russian leaders have estimated that total costs of the effort could range as high as $40 billion.

The United States is providing direct assistance for upgrading the safety of Soviet-designed reactors, a program being coordinated by DOE, NRC, the Agency for International Development (AID), and the Department of State. DOE was appropriated $45 million in FY1997 for improving the operation and physical condition of Soviet-designed nuclear power plants. The program was appropriated $35 million in FY1999, and Congress provided $15 million for FY2000.

The General Accounting Office estimates that $1.93 billion has been provided through November 1999 by the United States and other industrialized nations to improve the safety of Soviet-designed reactors. Of that amount, $753 was contributed by the European Union, $532 by the United States, $43 million by the International Atomic Energy Agency (which receives much of its funding from the United States), and the remainder from 14 other countries.

Regulation

For many years a top priority of the nuclear industry was to modify the process for licensing new nuclear plants. No electric utility would consider ordering a nuclear power plant, according to the industry, unless licensing became quicker and more predictable, and designs were less subject to mid-construction safety-related changes ordered by NRC. The Energy Policy Act of 1992 largely implemented the industry's licensing goals.

Nuclear plant licensing under the Atomic Energy Act of 1954 (P.L. 83-703; U.S.C. 2011-2282) had historically been a two-stage process. NRC first issued a construction permit to build a plant, and then, after construction was finished, an operating permit to run it. Each stage of the licensing process involved complicated proceedings. Environmental impact statements also are required under the National Environmental Policy Act.

Over the vehement objections of nuclear opponents, the Energy Policy Act (P.L. 102-486) provides a clear statutory basis for one-step nuclear licenses, allowing completed plants to operate without delay if construction criteria are met. NRC would hold preoperational hearings on the adequacy of plant construction only in specified circumstances.

A fundamental concern in the nuclear regulatory debate is the performance of NRC in issuing and enforcing nuclear safety regulations. The nuclear industry and its supporters have regularly complained that unnecessarily stringent and inflexibly enforced nuclear safety regulations have burdened nuclear utilities and their customers with excessive costs. Moreover, the nuclear industry is concerned about the size of NRC's own budget, because the agency is required to cover most of its costs through annual fees imposed on commercial reactors. But many environmentalists, nuclear opponents, and other groups charge NRC with

being too close to the nuclear industry, a situation that they say has resulted in lax oversight of nuclear power plants and routine exemptions from safety requirements.

That controversy was illustrated by a March 4, 1996, *Time* magazine cover article about regulatory violations at the three-reactor Millstone nuclear plant in Connecticut. The article described the efforts of two Millstone engineers to stop the routine placement of greater amounts of hot nuclear fuel in the plant's storage pools than the pools were qualified to hold. NRC had been aware of the problem, but the article focused national attention on the situation and prompted closer NRC scrutiny of the Millstone plant and its own procedures. Because of the storage pool situation and numerous other problems, all three Millstone reactors were shut down and not allowed to restart until NRC was satisfied with the plant's safety compliance. The newest Millstone unit was restarted in June 1998 after being out of service more than 2 years, and the oldest of the three units is being permanently closed. The remaining unit restarted in 1999.

In a speech on April 9, 1996, NRC Chairman Shirley Ann Jackson said that the Millstone problems "can and should be considered a wake-up call to both the regulated industry and the NRC." However, she contended that overall safety of commercial nuclear power plants had steadily improved during the past decade, with the number of automatic reactor shutdowns and safety system actuations dropping dramatically.

Primary responsibility for nuclear safety compliance lies with nuclear utilities, which are required to find any problems with their plants and report them to NRC. Compliance is also monitored directly by NRC, which maintains at least two resident inspectors at each nuclear power plant. The resident inspectors routinely examine plant systems, observe the performance of reactor personnel, and prepare regular inspection reports. For serious safety violations, NRC often dispatches special inspection teams to plant sites. NRC Chairman Jackson testified September 5, 1996, to the Subcommittee on Energy and Power of the House Commerce Committee that each nuclear power plant has averaged about 10 safety violations per year since 1989.

In a May 1997 report on nuclear reactor regulation (RCED 97-145), the General Accounting Office (GAO) concluded, "While we are not making judgments on the safety of plants, the many safety problems identified in some plants raises questions about whether NRC's regulatory program is working as it should." The report also found, "For some plants, NRC has not taken aggressive enforcement action to force the licensees to fix their long-standing safety problems on a timely basis. As a result, the plants' conditions have worsened, making safety margins smaller."

However, the opposite trend was identified by the House and Senate Appropriations Committees in considering NRC's FY1999 budget request. The Senate Committee report on the FY1999 Energy and Water Development Appropriations Bill strongly criticized NRC for allegedly failing to streamline its regulatory system in line with improvements in nuclear industry safety. The Committee contended, among other problems, that NRC's regional offices were inconsistent with one another, that NRC was inappropriately interfering with nuclear plant management, and that numerous NRC review processes were outdated and unnecessary. The House panel directed NRC to "reduce its workforce, reduce the regulatory burdens on licensees, and streamline its adjudicatory process."

In response, NRC has begun reorganizing and overhauling many of its procedures. The Commission is moving toward "risk-informed regulation," in which safety enforcement is guided by the relative risks identified by detailed individual plant studies. NRC began implementing a new reactor oversight system April 2, 2000, that relies on a series of performance indicators to determine the level of scrutiny that each reactor should receive. The House and Senate Appropriations committees expressed general satisfaction with the NRC response to last year's criticism, and Congress approved nearly the full NRC FY2000 funding request, except for a $1 million cut for the NRC Inspector General.

Decommissioning and Life Extension

When nuclear power plants end their useful lives, they must be safely removed from service, a process called decommissioning. NRC requires nuclear utilities to make regular contributions to special trust funds to ensure that money is available to remove all radioactive material from reactors after they are closed. Because no full-sized U.S. commercial reactor has yet been completely decommissioned, which can take several decades, the cost of the process can only be estimated. Decommissioning cost estimates cited by a 1996 DOE report, for one full-sized commercial reactor, ranged from about $150 million to $600 million in 1995 dollars. Disposal of low-level waste is expected to account for much of those costs.

For planning purposes, it is generally assumed that U.S. commercial reactors could be decommissioned at the end of their 40-year operating licenses, although several plants have been retired before their licenses expired and others could seek license renewals to operate longer. NRC rules that took effect June 13, 1992, allow plants to apply for a 20-year license extension, for a total operating life of 60 years. On March 23, 2000, the Calvert Cliffs nuclear plant in Maryland became the first U.S. plant to receive a license extension. Several other license-extension applications are pending, and more are expected to be filed. Assuming a 40-year lifespan, without life extension, more than half of today's 103 licensed reactors could be decommissioned by the year 2016.

Nuclear Waste Management

One of the most controversial aspects of nuclear power is the disposal of radioactive waste, which can remain hazardous for thousands of years. Each nuclear reactor produces an annual average of about 20 tons of highly radioactive spent nuclear fuel and 50-200 cubic meters of low-level radioactive waste.

The federal government is responsible for permanent disposal of commercial spent fuel (paid for with a fee on nuclear power) and federally generated radioactive waste, while states have the authority to develop disposal facilities for commercial low-level waste. Spent fuel and other highly radioactive waste is to be isolated in a deep underground repository, consisting of a vast network of chambers carved from rock that has remained geologically undisturbed for hundreds of thousands of years.

DOE is studying Nevada's Yucca Mountain as the site for such a geologic repository, as required by the Nuclear Waste Policy Act of 1982 (NWPA, P.L. 97-425) as amended. DOE issued a "viability assessment" in December 1998 that found no insurmountable

problems with the site, but a final recommendation on the site's suitability is not expected until 2001. DOE contends that it will need its full FY2001 budget request of $437.5 million to keep the program on schedule.

As originally enacted, the 1982 nuclear waste law established procedures and timetables for DOE to examine candidate sites for at least one deep repository for commercial spent fuel (with the option of also taking government high-level waste), to begin operating by January 31, 1998. Nuclear utilities were required to sign a contract with DOE for disposal services. The Nuclear Waste Fund, consisting of revenues from a fee on nuclear power, was created to pay for the disposal program. However, DOE could not spend money from the fund without annual congressional appropriations. The waste repository was required to meet Environmental Protection Agency (EPA) standards and be licensed by the Nuclear Regulatory Commission (NRC).

Controversy over implementation of the waste law led to fundamental revisions included in the Omnibus Budget Reconciliation Act of 1987 (P.L. 100-203). The revised waste law singled out Yucca Mountain as the only candidate site for a permanent waste repository.

With no federal storage or disposal facility available by the nuclear waste law's 1998 deadline, nuclear power plants must continue storing their waste at reactor sites much longer than originally anticipated. Most are expected to build additional on-site storage facilities, a move that has drawn strong state and local opposition in several recent cases. A federal appeals court ruled July 23, 1996, that DOE was required to meet the 1998 deadline, although the court did not specify a remedy for missing it. The same panel on November 14, 1997, refused to order DOE to begin taking waste from nuclear plant sites, but ruled that the Department would be liable for damages under its contract with utilities. (For more background, see CRS Report 96-212, *Civilian Nuclear Spent Fuel Temporary Storage Options*.)

Interim Storage Legislation

DOE's current goal for opening the Yucca Mountain waste repository is 2010 — 12 years later than required by NWPA. The nuclear industry and state utility regulators are urging Congress to authorize waste to be stored at an interim facility near Yucca Mountain until the permanent repository is ready.

Legislation to establish a Yucca Mountain nuclear waste interim storage facility was introduced in both Houses in the 106th Congress (H.R. 45, S. 608), but Administration veto threats appear to have stalled the idea. In an effort to reach a compromise, an alternative bill was developed in the Senate (S. 1287) that would allow waste to be shipped to Yucca Mountain after NRC granted a repository construction permit – as early as 2007, under the bill's schedule. The Senate approved S. 1287 by a vote of 64-34 on February 10, 2000, and the House passed the same bill without amendment March 22, 2000, by 253-167, sending it to the President's desk. In addition to authorizing expedited waste shipments, the bill would bar EPA from issuing final environmental standards for the repository until June 1, 2001.

H.R. 45 was approved by the House Commerce Committee's Subcommittee on Energy and Power on April 14, 1999, by a vote of 25-0, with full Committee approval following on April 21, 1999, by a 40-6 vote. The Committee-passed version would require an interim

storage facility at Yucca Mountain to open by June 2003 and require work on a permanent repository to move forward at the same time. To pay for both activities, the bill would exempt the program's spending from budget ceilings while maintaining utility fees at the current level. Several key Commerce Committee leaders spoke out against the move to bring S. 1287 to the House floor rather than H.R. 45.

The Clinton Administration opposes the siting of an interim storage facility at Yucca Mountain before more technical study of the site's suitability for a permanent repository can be completed. Administration veto threats blocked the proposal in the 104th and 105th Congresses. Before the Energy and Power Subcommittee markup of H.R. 45, Energy Secretary Richardson reiterated the Administration's opposition.

The Senate Energy Committee marked up S. 1287 on June 16, 1999, including provisions that would have authorized DOE to take title to spent fuel at commercial reactor sites and pay for storage costs, and eliminated EPA's role in setting repository standards, in addition to authorizing early waste shipments to the repository site (S. 1287, S. Rept. 106-98). Environmental and anti-nuclear groups staunchly oppose any proposal that would hasten waste shipments to Yucca Mountain, charging that the risks of transporting unprecedented amounts of high-level radioactive waste across the country are unwarranted. Supporters of the various nuclear waste bills contend that minimal transportation risks would be outweighed by the margin of safety gained by removing spent fuel from multiple reactor sites. (For more on the transportation issue, see CRS Report 97-403 ENR, *Transportation of Spent Nuclear Fuel*).

Supporters of S. 1287 made further changes on the Senate floor in an effort to win enough votes to override a presidential veto. The EPA role in setting environmental standards for the repository was restored, but the agency was barred from issuing final standards until June 1, 2001, after a new Administration would be in place. The provision allowing DOE to take title to nuclear waste at reactor sites was dropped, in response to concerns that DOE might keep the waste at reactor sites indefinitely.

Despite the changes, President Clinton vetoed S. 1287 on April 25, 2000, contending that it would interfere with EPA rulemaking and undermine public confidence in the repository program. An effort in the Senate to override the veto fell short of the necessary two-thirds majority, 64-35, on May 2, 2000. The 35 senators voting against the override included Senator Lott, who switched his vote so that he could enter a motion to reconsider, keeping the door open for another override attempt before the 106th Congress adjourns.

Low-level Waste Facilities

Disposal facilities for commercially generated low-level radioactive waste — from nuclear power plants, hospitals, universities and industry — are a state responsibility. The Low-Level Radioactive Waste Policy Amendments Act of 1985 (P.L. 99-240) gave states and regions until the beginning of 1993 to begin operating their own low-level waste disposal facilities before potentially losing access to outside waste sites.

Only two commercial low-level sites, in South Carolina and Washington, are currently operating. Certain types of low-activity waste are also accepted by a Utah disposal facility, which has applied for a license to receive all three major classes of low-level waste. Access

to the Washington site is allowed only to states in the Pacific Northwest and Rocky Mountain regions. A planned disposal facility at Ward Valley, California, for use by the Southwestern disposal region received a state license in 1993, but the facility's operation has been blocked by the federal government's refusal to transfer the federally owned site to the State of California. California Governor Davis established an advisory panel in June 1999 to study alternative waste management strategies.

Congress approved a disposal compact among Texas, Maine, and Vermont September 2, 1998 (P.L. 105-236), which allows waste from the three states to go to a site to be developed in Texas and the exclusion of waste from other states. Controversy over the measure had focused on a candidate disposal site chosen by Texas low-level waste authorities. However, the proposed site, located in a predominantly Hispanic area, was rejected by the Texas Natural Resource Conservation Commission October 22 because of concerns about potential earthquakes and socioeconomic effects. (For further details, see CRS Issue Brief IB92059, *Civilian Nuclear Waste Disposal*.)

Nuclear Weapons Proliferation

Nuclear technology was first used to make nuclear weapons, initially by the United States, and subsequently in Russia, England, France, and China. Peaceful nuclear energy followed the development of nuclear weapons. The nuclear tests carried out by India and Pakistan in May 1998, combined with proliferation problems in Iraq, North Korea, Iran, and Russia, intensified longstanding concerns about worldwide efforts to prevent the spread, or proliferation, of nuclear weapons. Both the international nonproliferation regime and U.S. policy are receiving attention from many directions.

The discovery following the Gulf War in 1991 that Iraq had been near success in developing nuclear weapons led to efforts to strengthen inspection and enforcement of the Nuclear Nonproliferation Treaty (NPT). The NPT is nearly universal, with 187 members. The International Atomic Energy Agency (IAEA) operates a global safeguards system that monitors nuclear technology and materials to deter and detect diversions from peaceful to military uses. Detection by the IAEA of undeclared nuclear activities in North Korea — like Iraq, a member of the NPT — triggered efforts to halt nuclear weapons development in that nation as well.

The United States continues to be a leading proponent of the international non-proliferation regime. It also has a system of export control and licensing laws covering transfers of nuclear technology or materials. There are also laws requiring sanctions against countries that obtain or test nuclear weapons, which were applied against India and Pakistan.

In addition to broad questions about the effectiveness of international nonproliferation efforts, Congress is sometimes faced with the repercussions of nonproliferation policy in specific instances, particularly with respect to sanctions and controls that do not solve proliferation problems, but still have negative effects on bilateral relations and trade.

South Asia. The sanctions imposed on India and Pakistan included a prohibition on export credits, including export credits for agricultural products. The 105th Congress passed separate legislation exempting credits, guarantees, and financial assistance to support

purchase of food or agricultural commodities from the mandated sanctions. In addition, the Omnibus FY1999 Appropriations Act (P.L. 105-277) gave the President authority to waive some sanctions for a year. President Clinton used the new authority by lifting some of the sanctions on India and Pakistan November 6, 1998, to encourage the two countries to halt further testing, establish effective export controls, and begin bilateral discussions on nuclear weapons. There has since been little progress or restraint, despite further lifting of sanctions and the President's visit to India and Pakistan in March 2000. Restrictions on transfers of nuclear technology, however, remain in place.

The Middle East. The ongoing confrontation between certain Arab Middle East countries and Israel has long had a nuclear undercurrent. Israel has made no official acknowledgment of a weapons program, but is widely considered to have developed nuclear weapons. Israel's weapons program has led to calls in Arab states for development of an "Islamic bomb." Iraq, before its defeat in the Gulf War in 1991, actively pursued nuclear weapons development. Iran declares it has no nuclear weapons program, but the United States claims that it does. The Clinton Administration has not succeeded in efforts to dissuade Russia from selling nuclear reactors to Iran. It is feared that such assistance could be a cover for weapons-related activities. (See *Weapons of Mass Destruction in the Middle East,* CRS Report RL30408.)

China. China has long been a nonproliferation concern. It was the major supplier to Pakistan's nuclear weapons program in the 1980s and early 1990s, and also supplied technology to Iran and Algeria. However, China has gradually taken steps to join international nonproliferation agreements, and the 105th Congress approved a U.S. agreement for nuclear cooperation with China. However, the projected demand for U.S. nuclear technology sales to China has not materialized.

North Korea. North Korea had an active nuclear weapons program in the early 1990's. In October 1994, the United States signed an agreement with North Korea to exchange its existing nuclear reactors and reprocessing equipment for light water reactor technology that is less suited to making bombs. The agreement has had a difficult history, with funding being a continuing issue. A House amendment to the Foreign Operations Appropriations Bill for FY2000 (H.R. 2606) put new conditions on aid to the Korea Peninsula Energy Development Organization (KEDO), which is building the nuclear power plant in North Korea. Conditions include a new certification for U.S.-North Korean nuclear cooperation. The Clinton Administration waived parts of the certification when it was submitted February 24, 2000. (For more details see CRS Issue Brief IB91141, *North Korea's Nuclear Weapons Program*.)

Russia. Maintaining control over the storage and disposal of Russian nuclear materials is also a nonproliferation issue. The Departments of Energy, Defense, and State are involved in the Cooperative Threat Reduction (Nunn-Lugar) program to improve the security of Russian nuclear material, technology, and expertise. In February 1993 the United States agreed to buy 500 metric tons of highly enriched uranium (HEU) from dismantled Russian weapons to use in commercial nuclear power reactors. Implementation of the purchase by the newly privatized U.S. Enrichment Corporation has faced numerous hurdles, however. Disposal of plutonium from weapons is a more difficult problem; President Clinton and Russian President Boris Yeltsin signed a joint statement September 2, 1998, calling for the elimination of 50 metric tons of weapons plutonium by each nation. The Department of Energy plans to "burn" part of the excess plutonium as fuel in existing civilian power reactors,

but the plan is expensive and controversial. (For more information, see CRS Report RL30170, *Nuclear Weapons: Disposal of Surplus Weapons-Usable Plutonium*.)

The Clinton Administration requested $973.6 million for its Expanded Threat Reduction Initiative (ETRI) for FY2001. Congress allocated $890 million for ETRI when it was first introduced in FY2000, and both the House and Senate approved an additional $1 billion in May 2000 in separate defense authorization bills for FY2001. The ETRI includes Defense Department, State Department, and Energy Department programs to assist Russia and other countries of the Former Soviet Union (FSU) to secure nuclear, chemical and biological weapons, materials, and expertise. However, Congress also passed legislation that would cut assistance to Russia if it continues to assist Iran to build nuclear plants and missiles. (For more information on nonproliferation, see CRS Issue Brief IB98039, *Nuclear Nonproliferation Policy*.)

Environmental Problems at Nuclear Weapons Facilities

The aging U.S. nuclear weapons production complex, managed by the Department of Energy, faces long-term problems with environmental contamination, radioactive waste disposal, and other environmental risks. DOE's Environmental Management Program, which is responsible for cleaning up the nuclear weapons complex, has grown into DOE's largest activity since its formal establishment in 1989. For FY2000, DOE was appropriated $5.9 billion for the program, including nearly $200 million for the "privatization" of future cleanup and waste management projects. DOE requested $6.3 billion for the program for FY2001, including more than $500 million for privatized projects.

A DOE proposal for accelerating the cleanup program, issued in June 1998, estimated that total costs could reach about $150 billion through 2070, with cleanup completed at 41 of 53 major sites by 2006. DOE managers contend that substantial long-term savings can be gained by focusing on completing work at those sites, allowing the earliest possible termination of infrastructure costs.

The bulk of the EM privatization funding was intended to go toward the Hanford Tank Waste Remediation System, consisting of a "vitrification" plant that would turn liquid high-level waste into radioactive glass for eventual disposal. However, high costs estimates prompted DOE to decide in May 2000 to switch the project to traditional contracting methods. Other major privatized projects include a project to treat "mixed" radioactive and hazardous waste at the Idaho National Engineering and Environmental Laboratory, and waste treatment, storage, and disposal facilities at Oak Ridge, Tennessee.

The EM privatization effort is intended to reduce costs by increasing competition for cleanup work and shifting a portion of project risks from the federal government to contractors. Profits to contractors would depend on their success in meeting project schedules and holding down costs; potentially, profits could be substantially higher than under traditional DOE contracting arrangements.

Uranium Enrichment

Only 0.7% of the uranium found in nature is the fissile isotope uranium-235 (U-235). The remaining 99.3% is U-238. Before uranium can be used in most nuclear reactors, the amount of U-235 must be increased (enriched) to 3-5%. Uranium is enriched in the United States for commercial reactors at plants originally built for the nuclear weapons program. Until July 1, 1993, the enrichment program was run by DOE.

The Energy Policy Act of 1992 (EPACT) established the U.S. Enrichment Corporation (USEC), a wholly owned government corporation that took over operation of DOE's uranium enrichment facilities and enrichment marketing activities. EPACT authorized the sale of USEC to the private sector and required the corporation to prepare a privatization plan by July 1, 1995. Legislation to facilitate USEC privatization was included in an omnibus continuing appropriations bill for FY1996 signed by the President April 26, 1996 (P.L. 104-134).

The USEC privatization was completed July 28, 1998, with an initial public offering of stock that raised an estimated $1.9 billion for the federal government. Controversy over the privatized corporation has focused on whether USEC will continue purchasing highly enriched uranium (HEU) from dismantled Russian nuclear weapons (under an agreement negotiated in 1993), and future sales of USEC's large inventories of natural uranium. Under the HEU agreement, USEC receives enriched uranium from Russian nuclear weapons and, in addition to its payment for the material, returns an equivalent amount of natural (unenriched) uranium to Russia to sell on the world market.

One of assets transferred from DOE to USEC was the right to commercialize a new enrichment technology called "atomic vapor laser isotope separation (AVLIS). As a government corporation, USEC continued funding to develop the technology. After privatization, however, the company's board of directors decided on June 9, 1999, that further investment in AVLIS was unlikely to pay off and canceled the program. Energy Secretary Richardson, concerned about the abandonment of a technology for which DOE and USEC had spent nearly $2 billion during the past 25 years, announced the same day that the Clinton Administration would review the national security implications of the AVLIS decision.

Federal Funding for Nuclear Energy Programs

The following tables summarize current funding for DOE nuclear fission programs and uranium activities, and for the NRC. The sources for the funding figures are Administration budget requests and committee reports on the Energy and Water Development Appropriations Acts, which fund all nuclear programs. President Clinton's funding request for FY2001 was submitted to Congress February 7, 2000. FY2000 funding reflects a rescission of 0.38% imposed on each federal agency's discretionary funding after enactment of the Energy and Water Development Appropriations Act (P.L. 106-60). Subsequently, a by the FY2000 Consolidated Appropriations Act (H.R. 3194). In allocating the rescission, agencies may not reduce any program, project, or activity by more than 15%, and reductions in defense-related accounts must be applied in equal proportion.

Table 1. Funding for the Nuclear Regulatory Commission
(budget authority in millions of current dollars)

	FY1999 Approp.	FY2000 Approp.	FY2001 Request	—	—
Nuclear Regulatory Commission					
Reactor Safety	210.6	210.7	217.2	—	—
Nuclear Materials Safety	51.9	53.3	57.4	—	—
Nuclear Waste Safety	58.4	52.4	57.8	—	—
Defense and International	4.0	4.7	4.8	—	—
Management and Support	149.1	143.8	144.7	—	—
Inspector General	4.8	5.0	6.2	—	—
TOTAL NRC BUDGET AUTHORITY	**468.8***	**469.9***	**488.1**	**—**	**—**

* Entirely offset by fees on NRC licensees, plus payments from the Nuclear Waste Fund for repository licensing. Subtotals in House and Senate bills not specified.

Table 2. DOE Funding for Nuclear Activities
(budget authority in millions of current dollars)

	FY1999 Approp.	FY2000 Approp.	FY2001 Request		
Nuclear Energy (selected programs)					
Termination Costs	84.5	91.4	92.2	—	—
Fast Flux Test Facility	30.0	78.8	74.0	—	—
Advanced Radioisotope Power Systems	36.8	34.1	31.2	—	—
Program Direction	24.7	24.7	27.6	—	—
University Reactor Assistance	11.0	12.0	12.0	—	—
Nuclear Energy Plant Optimization	0	5.0	5.0	—	—
Nuclear Energy Research Initiative	18.5	22.4	35.0	—	—
Uranium Programs	50.8	41.9	53.4	—	—
Isotope Support	21.5	20.5	17.2	—	—
Accelerator Transmutation of Waste	0	9.0	0	—	—
International Nuclear Safety*	80.0	15.0	20.0	—	—
Total, Nuclear Energy	279.1	285.1	306.1	—	—
Nuclear Waste Activities					
Environmental Management, Defense	4,322.4	4,465.5	4,551.5	—	—
Environmental Mgmt. Privatization	228.4	188.3	515.0	—	—
Env. Management, Non-Defense	405.4	307.2	286.0	—	—
Uranium Enrichment D&D Fund	220.2	249.2	303.0	—	—
Nuclear Waste Fund Activities**	353.5	347.2	437.5	—	—

* Funded under "Other Nuclear Security Activities."
** Funded by a 1-mill-per-kilowatt-hour fee on nuclear power, plus appropriations for defense waste disposal. FY2000 request excludes $39 million in previous appropriations for interim storage.

LEGISLATION

H.R. 45 (Upton)/S. 608 (Murkowski)

Rewrites Nuclear Waste Policy Act of 1982 and mandates construction of an interim storage site for spent nuclear fuel at Yucca Mountain, Nevada. House bill introduced January 6, 1999; referred to Commerce Committee, with sequential referrals to the Committees on Resources and Transportation and Infrastructure. Approved 25-0 by Energy and Power Subcommittee on April 14, 1999. Senate bill introduced March 15, 1999; referred to Committee on Energy and Natural Resources.

H.R. 2605 (Packard)

Energy and Water Development Appropriations Bill for FY2000. Provides funding for DOE nuclear-related programs. Approved by Senate Appropriations Committee May 27, 1999 (S. 1186, S.Rept. 106-58), and by the Senate June 16, 1999. House Appropriations Committee reported July 23, 1999, and House approved July 27, 1999. Senate passed House bill in lieu of S. 1186 on July 28, 1999. Conference report approved by House September 27, 1999, and by Senate September 28, 1999. Signed by President September 29, 1999 (P.L. 106-60).

H.R. 2531 (Barton)/S. 1627 (Inhofe)

Nuclear Regulatory Commission Authorization for Fiscal Year 2000. Authorizes NRC funding and extends authority for NRC to collect fees sufficient to offset 100% of agency funding. House bill introduced July 15, 1999; referred to Committee on Commerce. Ordered reported September 29, 1999 (H.Rept. 106-415). Senate measure introduced September 23; referred to Committee on Environment and Public Works. Ordered reported September 29, 1999, with provisions to eliminate fees for NRC activities that do not directly benefit licensees (S.Rept. 106-220).

S. 1287 (Murkowski)

Nuclear Waste Policy Amendments Act of 2000. Authorizes DOE to receive spent fuel at Yucca Mountain site after NRC issues a construction permit for a permanent repository. Reported as an original bill by Senate Energy and Natural Resources Committee (S.Rept. 106-98) June 24, 1999. Approved by the Senate February 10, 2000, by vote of 64-34. Approved by the House, 253-167, on March 22, 2000. Vetoed by the President April 25, 2000. Senate defeated veto override May 2, 2000, by vote of 64-35.