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CRS Issue Brief for Congress

Nuclear Energy Policy

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Mark Holt and Carl E. Behrens
Resources, Science, and Industry Division

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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 was substantially reduced by the Clinton Administration, which placed a higher priority on energy efficiency and alternative energy technologies. However, the Department of Energy (DOE) sought, and Congress provided, $35 million in FY2001 for the 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 opposed 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, but President Clinton 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. Congress approved about $6.4 billion for the program in FY2001.

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. USEC announced June 21, 2000, that it would close one of its enrichment plants by June 2001.

MOST RECENT DEVELOPMENTS

Most Department of Energy (DOE) nuclear-related programs will receive steady or increased funding under the FY2001 Energy and Water Appropriations bill (P.L. 106-377) signed by President Clinton October 27. Nuclear energy programs will receive about $260 million (plus $53 million transferred into a new uranium remediation fund), and DOE's civilian nuclear waste disposal program receive a $50 million boost over FY2000, to as much as $401 million. Funding for environmental restoration and waste management totals about $6.4 billion.

The Senate voted May 2, 2000, not to override President Clinton's veto of a bill to 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 have authorized 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 have been barred from issuing final environmental standards for the repository until June 1, 2001. In vetoing the bill April 25, President Clinton contended that it would hinder EPA's rulemaking authority and reduce public confidence in the repository program.

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 high nuclear power plant construction costs, 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.

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 the Millstone plant in Connecticut to Dominion Energy for a record $1.2 billion. The merger of two of the nation's largest nuclear utilities, PECO Energy and Unicom, completed in October 2000, consolidated the operation of 17 reactors under a single corporate entity, Exelon Corporation.

Existing nuclear power plants appear to hold a strong position in the ongoing restructuring of the electricity industry. In most cases, nuclear utilities have received favorable regulatory treatment of past construction costs, and average nuclear operating costs are currently estimated to be lower than those of competing technologies.[1] Although eight U.S. nuclear reactors have permanently shut down since 1990, recent reactor sales could indicate greater industry interest in nuclear plants that previously had been considered marginal. Despite the shutdowns, total U.S. nuclear electrical output increased nearly 25% from 1990 to 1999, according to the Energy Information Administration. The increase resulted primarily from reduced downtime at the remaining plants, the startup of five new units, and reactor modifications to boost capacity.

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. The Energy Information Administration forecasts that no new U.S. reactors will become operational before 2010, at the earliest.

Nuclear Power Research and Development

Under the Clinton Administration, development of advanced reactors has largely ended, although some research is continuing. In FY1995, 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.

[1] "Production Costs Made Nuclear Cheapest Fuel in 1999, NEI Says," *Nucleonics Week*, January 11, 2001, p. 3.

The Clinton Administration's FY2001 budget request included $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 was requested, is intended to improve the economic competitiveness of existing nuclear power plants. The "nuclear energy research initiative" (NERI), with a $35 million funding request, is designed to support innovative nuclear energy research projects. The FY2001 Energy and Water Development Appropriations bill (P.L. 106-377) provides the full request for both programs, plus $7.5 million for studies of advanced nuclear power technologies.

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 an industry that they believe should be phased out.

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. DOE issued a Record of Decision September 19, 2000, to use the electrometallurgical process for full-scale treatment of spent fuel at the Idaho site.

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 13 other Chernobyl-type reactors (called RBMKs) that are still operating in the former Soviet Union (the last operating Chernobyl unit was permanently closed at the end of 2000). 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. For FY2001, the Energy and Water Development Appropriations bill provides $20 million for the program.

The General Accounting Office estimates that $1.93 billion had 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.

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.

The House and Senate Appropriations Committees have been strongly urging NRC to reduce the cost of nuclear regulation. The Senate Committee report on the FY1999 Energy and Water Development Appropriations Bill sharply 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. However, the Union of Concerned Scientists issued a report August 17, 2000, that questioned the validity of the individual plant studies on which risk-informed regulation is based.

The House and Senate Appropriations committees have expressed general satisfaction with the NRC's new regulatory program, and Congress approved nearly the full NRC FY2000 funding request, except for a $1 million cut for the NRC Inspector General. For FY2001, the final Energy and Water appropriation provides the full NRC request, with a $700,000 reduction in the Inspector General's request.

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 large amounts of low-level waste, consisting of contaminated reactor components, concrete, and other materials, 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 Accident Liability

Liability for damages to the general public from nuclear accidents is controlled by the Price-Anderson Act (Section 170 of the Atomic Energy Act of 1954, 42 U.S.C. 2210). The act is up for reauthorization on August 1, 2002, but existing nuclear plants will continue to operate under the current Price-Anderson liability system if no extension is enacted.

Under Price-Anderson, the owners of commercial reactors must assume all liability for accident damages to the public. To pay any such damages, each licensed reactor must carry the maximum liability insurance available, currently $200 million. Any damages exceeding that amount are to be assessed equally against all operating commercial reactors, up to $83.9 million per reactor. Those assessments – called "retrospective premiums" – would be paid at an annual rate of no more than $10 million per reactor, to limit the potential financial burden on reactor owners following a major accident.

For each accident, therefore, the Price-Anderson liability system currently would provide up to $8.84 billion in public compensation. That total includes the $200 million in insurance coverage carried by the reactor that had the accident, plus the $83.9 million in retrospective premiums from each of the 103 currently licensed reactors. On top of those payments, a 5% surcharge may also be imposed. Under Price-Anderson, the nuclear industry's liability for an accident is capped at that amount, which varies depending on the number of licensed reactors, the amount of available insurance, and an inflation adjustment that is made every five years. Payment of any damages above that liability limit would require congressional action.

The same total liability limit (whatever it may be at any given time) also applies to contractors who operate hazardous DOE nuclear facilities. Price-Anderson authorizes DOE to indemnify its contractors for the entire amount, so that damage payments for accidents at DOE facilities would ultimately come from the Treasury. However, the law also allows DOE to fine its contractors for safety violations.

The mechanism for imposing fines on DOE contractors has become controversial since the 2000 startup of the National Nuclear Security Administration (NNSA) within DOE to administer the Department's nuclear defense programs. In approving legislation to clarify the situation (H.R. 4446), the House Commerce Committee recommended that the DOE Assistant Secretary for Environment, Safety, and Health continue to directly impose Price-

Anderson fines on DOE contractors who are now managed by NNSA (H.Rept. 106-694, Part 1), while the House Armed Services Committee recommended that such fines be imposed only through the NNSA Administrator (H.Rept. 106-694, Part 2).

The Price-Anderson Act's limits on liability were crucial in establishing the commercial nuclear power industry in the 1950s. Supporters of the Price-Anderson system contend that it has worked well since that time in ensuring that nuclear accident victims would have a secure source of compensation, at little cost to the taxpayer. However, opponents contend that Price-Anderson subsidizes the nuclear power industry by protecting it from some of the financial consequences of the most severe conceivable accidents.

Two bills were introduced in the 106th Congress to extend the Price-Anderson Act (S. 2162 and S. 2292), although no further action was taken. Without an extension, any commercial nuclear reactor licensed after August 1, 2002, could not be covered by the Price-Anderson system, although existing reactors would continue to be covered. Because no new U.S. reactors are currently planned, the lack of an extension would have little short-term effect on the nuclear power industry. However, if Price-Anderson expired, DOE would have to use alternate indemnification authority for hazardous nuclear contracts signed after that time. NRC issued a report to Congress in October 1998 recommending that Price-Anderson be extended for another 10 years and that the annual per-reactor limit on retrospective premiums be doubled to $20 million. A DOE report on Price-Anderson extension is available at [http://www.gc.doe.gov].

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. Upon decommissioning, contaminated reactor components are also disposed of as low-level 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. The final FY2001 Energy and Water Appropriations bill provides $391 million for the program, plus another $10 million that DOE can use upon written certification that it is necessary to complete the site suitability recommendation by 2001. The extra $10 million comes from $85 million in FY1996 appropriations for interim

storage, which was contingent on enactment of legislation that was vetoed by President Clinton. The remaining $75 million would be rescinded.

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 August 31, 2000, that nuclear power plant owners could sue DOE for damages resulting from the missed 1998 disposal deadline. (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 Clinton Administration veto threats 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. In addition to authorizing expedited waste shipments, the bill would bar EPA from issuing final environmental standards for the repository until June 1, 2001. 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, but President Clinton vetoed it.

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 have required an interim storage facility at Yucca Mountain to open by June 2003 and required work on a permanent repository to move forward at the same time. To pay for both activities, the bill would have exempted 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 opposed the siting of an interim storage facility at Yucca Mountain before more technical study of the site's suitability for a permanent repository was 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.

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. The South Carolina site is currently open nationwide, but South Carolina joined a compact with Connecticut and New Jersey on July 1, 2000, that will allow access outside those three states to be phased out. (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 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*.)

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 $6 billion for the program, excluding the Uranium Enrichment Decontamination and Decommissioning Fund. The FY2001 Energy and Water Development Appropriations bill provides about $6.4 billion for the program.

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 President Clinton 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. The privatized USEC leases its enrichment plants at Portsmouth, Ohio, and Paducah, Kentucky, from DOE. 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.

USEC's board of directors voted June 21, 2000, to close the Portsmouth enrichment plant by June 2001, leaving the company with only the Paducah plant. The USEC privatization agreement requires the company to operate both plants until 2004, unless certain financial problems arise. USEC says it is facing such problems, making a plant shutdown necessary. Opponents of the shutdown contend that it will leave the United States vulnerable to foreign suppliers.

DOE, which retains ownership of the Portsmouth plant, announced a plan October 6, 2000, to maintain part of the facility in standby condition for possible restart. The plan also calls for construction of a new enrichment plant at the site to demonstrate advanced gas centrifuge enrichment technology. Maintaining the Portsmouth plant in cold standby and building a centrifuge demonstration plant are estimated by DOE to cost $468 million over the next five years, with funding coming from a Treasury account for USEC privatization expenses. At the same time, DOE plans to accelerate the cleanup of the parts of the Portsmouth plant that will not be kept in standby condition.

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, and the House passed the FY2001 Energy and Water measure June 27, 2000. The Senate approved its version of the FY2001 spending bill September 7, 2000. The conference report was passed by the House September 28, 2000, and by the Senate October 2, 2000. President Clinton vetoed the measure October 7, 2000, primarily over a waterway management provision.

Table 1. Funding for the Nuclear Regulatory Commission

(budget authority in millions of current dollars)

	FY2000 Approp.	FY2001 Request	FY2001 House	FY2001 Senate	FY2001 Conf.
Nuclear Regulatory Commission					
Reactor Safety	210.7	217.2	—	—	–
Nuclear Materials Safety	53.3	57.4	—	—	–
Nuclear Waste Safety	52.4	57.8	—	—	–
Defense and International	4.7	4.8	—	—	–
Management and Support	143.8	144.7	—	—	–
Inspector General	5.0	6.2	5.5	5.5	5.5
TOTAL NRC BUDGET AUTHORITY*	**469.9**	**488.1**	**487.4**	**487.4**	**487.4**

* Entirely offset by fees on NRC licensees through FY2000, plus payments from the Nuclear Waste Fund for repository licensing. FY2001 conference total is offset 98%. Subtotals in House and Senate bills not specified.

Table 2. DOE Funding for Nuclear Activities

(budget authority in millions of current dollars)

	FY2000 Approp.	FY2001 Request	FY2001 House	FY2001 Senate	FY2001 Conf.
Nuclear Energy (selected programs)					
Advanced Radioisotope Power Systems	34.5	30.9	29.2	34.2	32.2
Program Direction	24.7	27.6	25.9	24.7	22.0
University Reactor Assistance	12.0	12.0	12.0	12.0	12.0
Nuclear Energy Plant Optimization	5.0	5.0	5.0	5.0	5.0
Nuclear Energy Research Initiative	22.5	34.9	22.5	41.5	35.0
Nuclear Energy Technologies	–	–	–	–	7.5
Uranium Programs	41.9	53.4	–	–	–
Isotope Support	20.5	16.7	15.2	21.2	19.2
Accelerator Transmutation of Waste	9.0	0	—	5.0	3.0*
International Nuclear Safety**	15.0	20.0	20.0	20.0	20.0
Total, Nuclear Energy	288.7	288.2	231.8	262.1	259.9
Uranium Facilities Maintenance and Remediation			301.4		393.4
Nuclear Waste Activities					
Environmental Management, Defense	5,716.0	6,159.7	5,864.0	6,042.1	6,122.2
Env. Management, Non-Defense	332.4	282.8	281.0	309.1	277.8
Uranium Enrichment D&D Fund	249.2	294.6	—	297.8	–
Nuclear Waste Fund Activities***	347.2	437.5	413.0	351.2	401.1

*Funded under "Advanced Accelerator Applications" under "Other Defense Activities."
** Funded under "Defense Nuclear Nonproliferation."
*** 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 (106th Congress)

P.L. 106-377 H.R. 5483

Energy and Water Development Appropriations Bill for FY2001. Introduced October 18, 2000, as successor to the vetoed H.R. 4733. Incorporated by reference in conference report on the appropriations bill for the Departments of Veterans Affairs and Housing and Urban Development and other agencies (H.R. 4635, H. Rept. 106-988). H.R. 4635 approved by House and Senate October 19, 2000. Signed into law October 27, 2000.

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. 4377 (Packard)

Energy and Water Development Appropriations Bill for FY2001. Provides funding for DOE nuclear-related programs. House Appropriations Committee reported June 23, 2000, and House approved June 27, 2000 (H.Rept. 106-693). Approved by Senate Appropriations Committee July 18, 2000 (S.Rept. 106-395), and by the Senate September 7, 2000. Conference report passed by the House September 28, 2000, and by the Senate October 2, 2000. Vetoed October 7, 2000. Superseded by H.R. 5483.

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 April 25, 2000. Senate defeated veto override May 2, 2000, by vote of 64-35.

S. 2162 (Bingaman)

Extends authority under the Price-Anderson Act for DOE to indemnify its contractors and for NRC to indemnify commercial nuclear plants, and amends DOE authority to impose fines on nonprofit contractors. Introduced March 2, 2000; referred to Senate Committee on Energy and Natural Resources.

S. 2292 (Inhofe)

Extends authority for NRC to indemnify commercial nuclear plants under the Price-Anderson Act. Introduced March 23, 2000; referred to Senate Committee on Environment and Public Works.