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Nuclear Energy Policy

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SUMMARY

Nuclear energy policy issues facing Congress include whether to provide federal incentives for a new generation of commercial reactors, radioactive waste management, research and development priorities, power plant safety and regulation, terrorism, and the Price-Anderson Act nuclear liability system.

The Bush Administration has stressed the importance of nuclear power in the nation's energy policy. For nuclear energy research and development, the Administration is requesting $389.9 million for FY2006, about $14.7 million above the FY2005 appropriation. In addition to that funding, the Department of Energy (DOE) Office of Nuclear Energy, Science, and Technology would receive $120.9 million for defense-related management and security at the Idaho National Laboratory (INL). The Nuclear Energy office's total FY2006 funding request of $510.8 million is 5.2% above the comparable FY2005 level, according to DOE.

Nuclear provisions are included in energy legislation approved by the House April 21, 2005 (H.R. 6). The bill would extend Price-Anderson coverage for new commercial reactors and new DOE nuclear contracts through the end of 2025. The bill would also authorize a hydrogen-producing demonstration reactor at INL and five other nuclear hydrogen demonstration projects.

The September 11, 2001, terrorist attacks on the United States raised questions about nuclear power plant security. Reactor security provisions are in the energy bill approved by the House, including a presidential study of security threats to nuclear facilities, force-on-force security exercises at nuclear power plants, the establishment of federal security coordinators, and the fingerprinting of nuclear facility workers.

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

Upon releasing the civilian nuclear waste program's FY2006 budget request, program officials announced that the opening of DOE's planned nuclear waste repository at Yucca Mountain, Nevada, would be delayed at least two years from the previous goal of 2010. The waste program's funding request of $651.4 million is about 14% above the FY2005 level but only about half the amount that last year's budget justification said would have been needed to open the repository by 2010. DOE officials also announced that a Yucca Mountain license application to the Nuclear Regulatory Commission (NRC) will be delayed by at least a year, to the end of 2005.

Whether progress on nuclear waste disposal and other congressional action will revive the U.S. nuclear power industry's growth will depend primarily on economic considerations. Natural gas- and coal-fired power plants currently are favored over nuclear reactors for new generating capacity. However, some electric utilities are seeking approval of sites for possible new reactors.

MOST RECENT DEVELOPMENTS

Several nuclear provisions are included in energy legislation approved by the House April 21 (H.R. 6). The measure would extend Price-Anderson Act nuclear liability coverage for new commercial reactors and new Department of Energy (DOE) nuclear contracts through the end of 2025. The bill would also authorize a DOE hydrogen-producing demonstration reactor at the Idaho National Laboratory (INL) and five other nuclear hydrogen demonstration projects. A number of nuclear facility security provisions are included as well. The House bill's nuclear provisions are similar to those of the conference report on an omnibus energy bill in the 108th Congress (also H.R. 6).

The Bush Administration on February 7 released its FY2006 budget request for nuclear energy programs. For DOE nuclear research and development — including advanced reactors, fuel cycle technology, and nuclear hydrogen production — the Administration is requesting $389.9 million, about $14.7 million above the FY2005 appropriation. In addition to that funding, the DOE Office of Nuclear Energy, Science, and Technology would receive $120.9 million for defense-related management and security at the Idaho National Laboratory (INL), which has been transferred to the nuclear energy program from DOE's environmental management program. The Nuclear Energy office's total FY2006 funding request of $510.8 million is 5.2% above the comparable FY2005 level, according to DOE.

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A preliminary commitment to provide almost $5 billion in financial support for a proposed sale of four Westinghouse reactors to China was approved February 18 by the Export-Import Bank of the United States. The proposed deal, if approved by China, would be Westinghouse's first opportunity to construct its advanced AP-1000 reactor design, which received final design approval from NRC in September 2004. However, the Ex-Im financing decision has been criticized for potentially subsidizing the nuclear power industry and transferring U.S. nuclear technology to China.

DOE announced November 4, 2004, that it would award $13 million to help two industry consortia pursue combined construction and operating licenses for new nuclear power plants. The proposed license applications would be the first for new U.S. nuclear power plants in more than 25 years. However, the consortia are not committing to construct the plants if the licenses are granted.

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 long-term future. No nuclear plants have been ordered in the United States 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 (TVA's) Watts Bar 1 reactor, ordered in 1970 and licensed to operate in 1996, was the most recent 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 ranged from $2-$6 billion, averaging more than $3,000 per kilowatt of electric generating capacity (in 1997 dollars). The nuclear industry predicts that new plant designs could be built for less than half that amount if many identical plants were built in a series, but such economies of scale have yet to be demonstrated.

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. (That number excludes TVA's Browns Ferry 1, which has not operated since 1985; the TVA Board decided May 16, 2002, to spend about $1.8 billion to restart the reactor by 2007.) 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 more than half of U.S. electricity generation. Nuclear plants generate more than half the electricity in six states. The record 824 billion kilowatt-hours of nuclear electricity generated in the United States during 2004[1] was more than the nation's entire electrical output in the early 1960s, when the first large-scale commercial reactors were being ordered.

Average operating costs of U.S. nuclear plants dropped substantially during the past decade, and costly downtime has been steadily reduced. Licensed commercial reactors generated electricity at an average of 89.6% of their total capacity in 2004, according to industry statistics.[2]

Thirty commercial reactors have received 20-year license extensions from the Nuclear Regulatory Commission (NRC), giving them up to 60 years of operation. License extensions for 18 more reactors are currently under review, and many others are anticipated, according to NRC (see website at [http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html]).

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[1] Margaret L. Ryan, "World Nuclear Output, and U.S., Set Records in 2004," *Nucleonics Week*, February 10, 2005, p. 1.

[2] Ibid.

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 occurred, including the March 2001 sale of the Millstone plant in Connecticut to Dominion Energy for a record $1.28 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, headquartered in Chicago. Exelon and New Jersey-based Public Service Enterprise Group announced a merger on December 20, 2004, that would boost the combined firm's reactor fleet to 20.

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 competitive with those of fossil fuel technologies.[3] Although eight U.S. nuclear reactors were permanently shut down during the 1990s, none has been closed since 1998, and recent reactor sales could indicate greater industry interest in nuclear plants that previously had been considered marginal. Despite the shutdowns, annual U.S. nuclear electrical output increased by more than one-third from 1990 to 2004, according to the Energy Information Administration and industry statistics. The increase resulted primarily from reduced downtime at the remaining plants, the startup of five new units, and reactor modifications to boost capacity.

The good performance of existing reactors and the relatively high cost of natural gas — the favored fuel for new power plants for the past 15 years — have prompted renewed utility consideration of the feasibility of building new reactors. That apparently growing interest has helped intensify congressional debate about the federal role, if any, in encouraging the construction of new nuclear power plants.

Entergy, Dominion Resources, and Exelon have chosen sites in Mississippi, Virginia, and Illinois, respectively, for possible future nuclear units and filed early site permit applications with NRC (see [http://www.nrc.gov/reactors/new-licensing/esp.html]) in fall 2003. As discussed in the next section, the Department of Energy (DOE) is assisting the site-selection efforts and new reactor license applications as part of a program to encourage construction of new commercial reactors by 2010. However, none of the utilities participating in the DOE site selection and licensing program have committed to continuing to the construction stage. EIA projects that, without federal assistance, no new reactors will be built by 2025.[4]

A conference agreement on omnibus energy legislation in the 108th Congress (H.R. 6) would have provided tax credits for electricity produced from as much as 6,000 megawatts of new nuclear generating capacity and authorized about $1.1 billion for a demonstration reactor in Idaho to produce both electricity and hydrogen. The House approved the conference report November 18, 2003, but a Senate filibuster blocked further action.

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[3] Energy Information Administration, *Nuclear Power: 12 percent of America's Generating Capacity, 20 percent of the Electricity*, July 17, 2003, at [http://www.eia.doe.gov/cneaf/nuclear/page/analysis/nuclearpower.html].

[4] Energy Information Administration, *Annual Energy Outlook 2005*, DOE/EIA-0383(2005), February 2005, p. 6.

A DOE advisory group recommended in January 2005 that the federal government provide up to $4.2 billion in loan guarantees, power purchase agreements, accelerated depreciation, and investment and production tax credits to persuade the industry to build new U.S. nuclear plants.[5]

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. On May 19, 2003, New Hampshire became the first state to provide emissions credits for incremental nuclear generating capacity. But the large obstacles noted above must still be overcome before electric generating companies will risk ordering new nuclear units. (For more on the outlook for nuclear power, see CRS Report RL31064, *Nuclear Power: Prospects for New Commercial Reactors*.)

Nuclear Power Research and Development

For nuclear energy research and development — including advanced reactors, fuel cycle technology, and nuclear hydrogen production — the Administration is requesting $389.9 million for FY2006, about $14.7 million above the FY2005 appropriation. In addition to that funding, the DOE Office of Nuclear Energy, Science, and Technology would receive $120.9 million under Other Defense Activities for defense-related management and security at the Idaho National Laboratory (INL), which has been transferred to the nuclear energy program from DOE's environmental management program. The Nuclear Energy office's total FY2006 funding request of $510.8 million is 5.2% above the comparable FY2005 level, according to DOE.

"The benefits of nuclear power as an emissions free, reliable, and affordable source of energy are an essential element in the Nation's energy and environmental future," according to DOE's budget justification. However, opponents have criticized DOE's nuclear research program as providing wasteful subsidies to an industry that they believe should be phased out as unacceptably hazardous and economically uncompetitive.

President Bush's specific mention of "safe, clean nuclear energy" in his most recent State of the Union Address indicates the Administration's interest in encouraging construction of new commercial reactors. DOE's efforts to restart the nuclear construction pipeline are focused on the Nuclear Power 2010 Program, which will pay up to half of the nuclear industry's costs of seeking regulatory approval for new reactor sites, applying for new reactor licenses, and preparing detailed plant designs. The program is intended to provide assistance for advanced versions of existing commercial nuclear plants that could be ordered within the next few years.

The Nuclear Power 2010 Program is helping three utilities seek NRC approval for potential nuclear reactor sites in Illinois, Mississippi, and Virginia. In addition, three industry consortia in 2004 applied for a total of $650 million over the next several years to

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[5] Elaine Hiruo, "Special DOE Task Force Recommends $4.2-billion in New Reactor Aid," *Nucleonics Week*, January 13, 2005, p. 1.

design and license new nuclear power plants and conduct a feasibility study. The budget request includes $56.0 million for the program in FY2006, a 12.9% boost over FY2005.

The nuclear license applications under the Nuclear Power 2010 program would test the "one step" licensing process established by the Energy Policy Act of 1992 (P.L. 102-486). Successful applicants would receive combined construction permits and operating licenses (COLs), which would allow a completed reactor to operate if it were found to be properly constructed. Even if the COLs are granted by NRC, the three industry consortia have not committed to building new reactors.

- Dominion Resources is leading a consortium that is seeking $250 million over six years for a COL for an advanced General Electric reactor (after originally considering a Canadian design). The proposed reactor would be located at Dominion's existing North Anna plant in Virginia, where the company is seeking an NRC early site permit with DOE assistance. The $500 million total cost would include "first of a kind" design and engineering work, to the level of detail necessary for firm construction cost estimates.

- A consortium called NuStart Energy Development, which includes Exelon and several other major nuclear utilities, is requesting $400 million from DOE over seven years for a COL for "passively safe" Westinghouse or General Electric reactor designs. Various sites are under consideration, including two in the ESP program. First-of-a-kind design cost are included in the total $800 million estimate. NuStart member Duke Power announced in February 2005 that it was considering submitting its own application for a COL.

- TVA is leading a consortium that requested $2 million to study the feasibility of building a General Electric Advanced Boiling Water Reactor (ABWR) at the site of TVA's uncompleted Bellefonte nuclear plant in Alabama. Because the ABWR already has received NRC standard design certification and has been constructed in other countries, first-of-a-kind design work would not be needed.

According to news reports, the Dominion team will receive an initial DOE award of $9 million, NuStart will be granted $4 million, and, for the ABWR feasibility study, TVA will receive more than $2 million.[6]

The advanced Westinghouse reactor under consideration by NuStart, the AP-1000, is also competing for a contract in China. If Westinghouse were to prevail over designs being offered by France and Russia, the four-reactor contract could help demonstrate the commercial viability of the new design, which received final design approval from NRC in September 2004. A preliminary commitment to provide almost $5 billion in financial support for the proposed China reactor sale was approved February 18, 2005, by the Export-

[6] Tom Harrison, "Two Reactor Consortia Awarded DOE Funding," *NuclearFuel*, November 8, 2004, p. 1.

Import Bank of the United States. Critics contend that the tentative Ex-Im financing could provide unwarranted subsidies to the nuclear power industry and unwisely transfer U.S. nuclear technology to China.

Advanced commercial reactor technologies that are not yet close to deployment are the focus of DOE's Generation IV Nuclear Energy Systems Initiative, for which $45.0 million is being requested for FY2006, about 12.5% above FY2005.

The Generation IV program is focusing on six advanced designs that could be commercially available around 2020-2030: two gas-cooled, one water-cooled, two liquid-metal-cooled, and one molten-salt concept. Some of these reactors would use plutonium recovered through reprocessing of spent nuclear fuel. The Administration's May 2001 *National Energy Policy* report contends that plutonium recovery could reduce the long-term environmental impact of nuclear waste disposal and increase domestic energy supplies. However, opponents contend that the separation of plutonium from spent fuel poses unacceptable environmental risks and, because of plutonium's potential use in nuclear bombs, undermines U.S. policy on nuclear weapons proliferation.

The development of plutonium-fueled reactors in the Generation IV program is closely related to the nuclear energy program's Advanced Fuel Cycle Initiative (AFCI), for which the Administration is requesting $70.0 million — 3.8% above the FY2005 level. According to the budget justification, AFCI will develop and demonstrate nuclear fuel cycles that could reduce the long-term hazard of spent nuclear fuel and recover additional energy. Such technologies would involve separation of plutonium, uranium, and other long-lived radioactive materials from spent fuel for re-use in a nuclear reactor or for transmutation in a particle accelerator. The program includes longstanding DOE work on electrometallurgical treatment of spent fuel from the Experimental Breeder Reactor II (EBR-II) at INL.

In support of President Bush's program to develop hydrogen-fueled vehicles, DOE is requesting $20.0 million in FY2006 for the Nuclear Hydrogen Initiative, an increase of 124% from the FY2005 level. According to DOE's FY2005 budget justification, "preliminary estimates ... indicate that hydrogen produced using nuclear-driven thermochemical or high-temperature electrolysis processes would be only slightly more expensive than gasoline" and result in far less air pollution.

An advanced reactor that would demonstrate co-production of hydrogen and electricity — the Next Generation Nuclear Plant (NGNP) — was allocated $25.0 million from DOE's Generation IV program by the FY2005 omnibus appropriations conference report. "The conferees expect the Department to submit a budget in fiscal year 2006 that is consistent with the goal of demonstrating hydrogen production and electricity generation by 2015 at the Idaho National Laboratory," according to the statement of managers. DOE's FY2006 budget justification for Generation IV says the research to be undertaken by the program "will help inform a decision on whether to proceed with a demonstration of the Next Generation Nuclear Plant."

Nuclear hydrogen provisions are also included in energy legislation approved by the House on April 21, 2005 (H.R. 6). The bill would authorize $1.3 billion through FY2015 for a hydrogen-producing demonstration reactor at INL and five other nuclear hydrogen demonstration projects.

DOE is again seeking no new funding specifically for the Nuclear Energy Research Initiative (NERI), which provides grants for research on innovative nuclear energy technologies. Instead, according to the budget justification, NERI projects will be pursued at the discretion of individual nuclear R&D programs. NERI received an appropriation of $2.5 million for FY2005. New funding also is not being requested for the Nuclear Energy Plant Optimization program (NEPO), which received $2.5 million in FY2005. The program supports cost-shared research by the nuclear power industry on ways to improve the productivity of existing nuclear plants.

Nuclear Power Plant Safety and Regulation

Safety

Controversy over safety has dogged nuclear power throughout its development, particularly following the March 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 a relatively recent example, it was discovered in March 2002 that leaking boric acid had eaten a large cavity in the top of the reactor vessel in Ohio's Davis-Besse nuclear plant. The corrosion left only the vessel's quarter-inch-thick stainless steel inner liner to prevent a potentially catastrophic loss of reactor cooling water. Davis-Besse remained closed for repairs and other safety improvements until NRC allowed the reactor to restart in March 2004.

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 2,500 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. A study of 32,000 people living within 5 miles of the reactor when the accident occurred found no significant increase in cancer rates through 1998, although the authors note that some potential health effects "cannot be definitively excluded."[7]

The relatively small amounts of radioactivity released by nuclear plants during normal operation are not generally believed to pose significant hazards, although some groups

[7] Evelyn O. Talbott et al., "Long Term Follow-Up of the Residents of the Three Mile Island Accident Area: 1979-1998," Environmental Health Perspectives, published online October 30, 2002, at [http://ehp.niehs.nih.gov/docs/2003/5662/abstract.html].

contend that routine emissions are risky. 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 in World War II.

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. (For the current U.S. fleet of about 100 reactors, that rate would yield an average of one severe accident every 100 years.) 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 thousands of additional cancer deaths among the tens of millions of people exposed to radiation from the accident may occur during the next several decades.

According to a 2002 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 were 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 also rose measurably, the organization reported. The OECD report estimated that about 50,000 square miles of land in Belarus, Ukraine, and Russia were substantially contaminated with radioactive cesium from Chernobyl.[8]

Licensing and 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 required by NRC. The Energy Policy Act of 1992 (P.L. 102-486) largely implemented the industry's licensing goals, but no plants have been ordered.

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.

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[8] OECD Nuclear Energy Agency, *Chernobyl: Assessment of Radiological and Health Impacts*, 2002.

Over the vehement objections of nuclear opponents, the Energy Policy Act provides a clear statutory basis for one-step nuclear licenses, which would combine the construction permits and operating licenses and allow 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. DOE's Nuclear Power 2010 initiative (discussed above) proposes to pay up to half the cost of at least one combined construction and operating license for an advanced reactor.

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. 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 plant owners, who 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.

In response to congressional criticism, 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's risk-informed reactor oversight system, inaugurated April 2, 2000, relies on a series of performance indicators to determine the level of scrutiny that each reactor should receive.

Reactor Security

Nuclear power plants have long been recognized as potential targets of terrorist attacks, and critics have long questioned the adequacy of the measures required of nuclear plant operators to defend against such attacks. All commercial nuclear power plants licensed by NRC have a series of physical barriers to accessing the operating reactor area, and are required to maintain a trained security force to protect them. Following the terrorist attacks of September 11, 2001, NRC began a "top-to-bottom" review of its security requirements.

A key element in protecting nuclear plants is the requirement that simulated terrorist attack exercises, monitored by NRC, be carried out to test the ability of the plant operator to defend against them. The severity of attacks to be prepared for are specified in the form of a "design basis threat" (DBT). After more than a year's review, on April 29, 2003, NRC changed the DBT to "represent the largest reasonable threat against which a regulated private guard force should be expected to defend under existing law." The details of the revised DBT were not released to the public.

The energy bill passed by the House on April 13, 2005 (H.R. 6), includes several nuclear facility security proposals that are similar to those in the unpassed energy conference

report in the 108th Congress (also H.R. 6). Security provisions in the House bill include a presidential study of security threats to nuclear facilities, force-on-force security exercises at nuclear power plants, authorization of firearms use by nuclear security personnel, establishment of federal security coordinators, and fingerprinting of nuclear facility workers.

Senator Inhofe, Chairman of the Senate Environment and Public Works Committee, introduced a nuclear plant security bill on April 20, 2005 (S. 864). The measure includes similar provisions to those of the House-passed bill on firearms use, fingerprinting, and several other provisions, but does not require a presidential security study, force-on-force exercises, or federal security coordinators.

(For background on security issues, see CRS Report RS21131, *Nuclear Power Plants: Vulnerability to Terrorist Attack.*)

Decommissioning

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 radioactive material and contamination from reactor sites 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.

The tax treatment of decommissioning funds has been a continuing issue. An energy tax bill (H.R. 1541) approved by the House Ways and Means Committee April 13, 2005, would provide favorable tax treatment to nuclear decommissioning funds, subject to certain restrictions; similar provisions were included in the conference report on H.R. 6 in the 108th Congress.

Nuclear Accident Liability

Liability for damages to the general public from nuclear incidents is addressed by the Price-Anderson Act (primarily Section 170 of the Atomic Energy Act of 1954, 42 U.S.C. 2210). The act was up for reauthorization on August 1, 2002, and it was extended for commercial reactors through December 31, 2003, by the FY2003 omnibus continuing resolution (P.L. 108-7). Even without a further extension, existing reactors continue to operate under the current Price-Anderson liability system, but new reactors would not be covered. Price-Anderson coverage for DOE nuclear contractors was extended through December 31, 2004, by the National Defense Authorization Act for FY2003 (P.L. 107-314). A further two-year extension for DOE contractors was approved by Congress on October 9, 2004, as part of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (P.L. 108-375). The energy bill approved by the House on April 21, 2005, would extend Price-Anderson coverage for new commercial reactors and new DOE nuclear contracts through the end of 2025. A bill introduced by Senator Voinovich on April 20, 2005, would provide the same extension (S. 865).

Under Price-Anderson, the owners of commercial reactors must assume all liability for nuclear damages awarded to the public by the court system, and they must waive most of their legal defenses following a severe radioactive release ("extraordinary nuclear occurrence"). To pay any such damages, each licensed reactor must carry financial protection in the amount of the maximum liability insurance available, which was increased by the insurance industry from $200 million to $300 million on January 1, 2003. Any damages exceeding that amount are to be assessed equally against all covered commercial reactors, up to $95.8 million per reactor (most recently adjusted for inflation on August 20, 2003). 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. Including two that are not operating, 105 commercial reactors are currently covered by the Price-Anderson retrospective premium requirement.

For each nuclear incident, the Price-Anderson liability system currently would provide up to $10.9 billion in public compensation. That total includes the $300 million in insurance coverage carried by the reactor that suffered the incident, plus the $95.8 million in retrospective premiums from each of the 105 currently covered reactors, totaling $10.4 billion. On top of those payments, a 5% surcharge may also be imposed, raising the total per-reactor retrospective premium to $100.6 million and the total available compensation to about $10.9 billion. Under Price-Anderson, the nuclear industry's liability for an incident is capped at that amount, which varies depending on the number of covered 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 approval under special procedures in the act.

The Price-Anderson Act also covers contractors who operate hazardous DOE nuclear facilities. The liability limit for DOE contractors is the same as for commercial reactors, excluding the 5% surcharge, except when the limit for commercial reactors drops because of a decline in the number of covered reactors. Because the most recent adjustments have raised the commercial reactor liability limit to a record high, the liability limit for DOE contractors is currently the same as the commercial limit, minus the surcharge, or $10.4 billion. Price-Anderson authorizes DOE to indemnify its contractors for the entire amount, so that damage payments for nuclear incidents at DOE facilities would ultimately come from the Treasury. However, the law also allows DOE to fine its contractors for safety violations, and contractor employees and directors can face criminal penalties for "knowingly and willfully" violating nuclear safety rules.

Under the Price-Anderson extension approved by the House, the total retrospective premium for each reactor would be set at the current level of $95.8 million and the limit on per-reactor annual payments raised to $15 million, with both to be adjusted for inflation every five years. For the purposes of those payment limits, a nuclear plant consisting of multiple small reactors (100-300 megawatts, up to a total of 1,300 megawatts) would be considered a single reactor. Therefore, a power plant with six 120-megawatt pebble-bed modular reactors would be liable for retrospective premiums of up to $95.8 million, rather than $574.8 million. The liability limit on DOE contractors would be set at $10 billion per accident, also to be adjusted for inflation.

Although DOE is generally authorized to impose civil penalties on its contractors for violations of nuclear safety regulations, Atomic Energy Act §234A specifically exempts

seven non-profit DOE contractors and their subcontractors. Under the same section, DOE automatically remits any civil penalties imposed on non-profit educational institutions serving as DOE contractors. The House-passed bill would eliminate the civil penalty exemption for future contracts by the seven listed non-profit contractors and DOE's authority to automatically remit penalties imposed on all non-profit educational institutions serving as contractors. However, the bill would limit the civil penalties against a non-profit contractor to the amount of management fees paid under that contract. If a DOE for-profit nuclear contractor causes public injuries through intentional misconduct by a corporate officer or executive, the Attorney General may recover up to the amount of the profit derived from the contract. Except for the last provision, the Price-Anderson language in the House bill is nearly identical to the H.R. 6 conference report in the 108th Congress.

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.

Because no new U.S. reactors are currently planned, missing the deadline for extension has had little immediate effect on the nuclear power industry. However, any new DOE contracts signed during Price-Anderson expiration would have to use alternate indemnification authority.

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 large network of tunnels carved from rock that has remained geologically undisturbed for hundreds of thousands of years.

The Nuclear Waste Policy Act of 1982 (NWPA, P.L. 97-425) as amended, names Nevada's Yucca Mountain as the sole candidate site for a national geologic repository. Following the recommendation of Energy Secretary Abraham, President Bush on February 15, 2002, recommended to Congress that DOE submit an application to NRC to construct the Yucca Mountain repository. As allowed by NWPA, Nevada Governor Guinn submitted a "notice of disapproval" (or "state veto") to Congress April 8, 2002. The state veto would have blocked repository construction at Yucca Mountain if a congressional resolution approving the site had not been enacted within 90 days of continuous session. The House passed a Yucca Mountain approval resolution (H.J.Res. 87) on May 8, 2002, by a 306-117

vote. The Senate approved the resolution by voice vote July 9 (following a 60-39 vote to consider S.J.Res. 34, the Senate version of the resolution), and the President signed it July 24, 2002 (P.L. 107-200).

Upon releasing the civilian nuclear waste program's FY2006 budget request, program officials announced that the opening of the planned Yucca Mountain repository would be delayed at least two years from the previous goal of 2010. The waste program's funding request of $651.4 million is about 14% above the FY2005 level but only about half the amount that last year's budget justification said would have been needed to open the repository by 2010. DOE officials also announced that a Yucca Mountain license application to the Nuclear Regulatory Commission (NRC) will be delayed by at least a year, to the end of 2005.

Last year, the FY2005 budget request for the nuclear waste program had assumed that Congress would enact legislation to offset most of the program's spending with revenue from a longstanding fee on nuclear power, which currently is not available without appropriation. Because last year's net appropriations request was relatively small, congressional appropriators had to scramble to find funding for the nuclear waste program when the Administration's fee-offset proposal was not enacted. For FY2006, the Administration is again proposing that nuclear waste funding be offset by fees, but the budget request does not assume the proposal will be enacted and therefore includes full funding through appropriations.

The delays in the Yucca Mountain program follow a July 9, 2004, ruling by the U.S. Court of Appeals for the District of Columbia Circuit that overturned a key aspect of the Environmental Protection Agency's (EPA's) regulations for the planned repository. The three-judge panel ruled that the 10,000-year compliance period was too short, but it rejected several other challenges to the rules. EPA is currently revising the regulations to comply with the court decision.

The quality of scientific work at Yucca Mountain was called into question by DOE's March 16, 2005, disclosure of e-mails from geologists indicating that some quality assurance documentation had been falsified. DOE currently is determining whether the problems affect the completeness and accuracy of information submitted to NRC in support of the planned Yucca Mountain license application.

Further delays in the nuclear waste program could prove costly under a settlement announced August 10, 2004, between the Department of Justice and Exelon Corporation, which had filed a breach-of-contract suit over DOE's failure to begin accepting spent fuel by 1998 as required by NWPA. Under the settlement, Exelon is to be reimbursed from the federal Judgment Fund for its spent fuel storage costs caused by the waste program delays. Exelon estimates that it will receive $300 million if DOE begins accepting waste by 2010 as previously scheduled, and up to $600 million if waste acceptance does not begin until 2015. The waste program is run by DOE's Office of Civilian Radioactive Waste Management (OCRWM).

(For further details, see CRS Issue Brief IB92059, *Civilian Nuclear Waste Disposal*.)

Federal Funding for Nuclear Energy Programs

The following tables summarize current funding for DOE nuclear fission programs and 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 the nuclear programs. President Bush submitted his FY2006 funding request February 7, 2005. For the current fiscal year, Energy and Water funding was included in the Consolidated Appropriations Act for FY2005 (P.L. 108-447).

Funding for the Yucca Mountain program is provided under two appropriations accounts. The Administration is seeking $300.0 million from the Nuclear Waste Fund, which holds fees paid by nuclear utilities. An additional $351.5 million is being requested under the Defense Nuclear Waste Disposal account, which pays for disposal of high-level waste from the nuclear weapons program in the planned Yucca Mountain repository.

Table 1. Funding for the Nuclear Regulatory Commission

(budget authority* in millions of current dollars)

	FY2004 Approp.	FY2005 Approp.	FY2006 Request	
Nuclear Regulatory Commission				
Reactor Licensing	198.7	263.3	274.9	
Reactor Inspection	107.4	179.8	194.3	
Fuel Facility Licensing and Inspection	21.7	38.5	36.6	
Nuclear Materials Lic. and Insp.	45.3	63.6	65.9	
High-Level Waste Repository	32.9	68.5	69.1	
Decommission. and Low-Level Waste	19.4	24.1	28.1	
Spent Fuel Storage and Transportation	19.7	23.9	24.6	
Infrastructure and Support	173.2	—	—	
Inspector General	7.3	7.5	8.3	
TOTAL NRC BUDGET AUTHORITY	**625.6**	**669.3**	**701.7**	
Offsetting fees	**545.3**	**540.1**	**567.1**	
Net appropriation	**80.3**	**128.6**	**134.6**	

* For FY2005 and FY2006, management and support is divided among the functional program areas.

Table 2. DOE Funding for Nuclear Activities

(budget authority in millions of current dollars)

	FY2004 Approp	FY2005 Approp.	FY2006 Request	
Nuclear Energy				
University Reactor Assistance	23.1	23.8	24.0	
Nuclear Energy Plant Optimiz.	2.9	2.5	0	
Nuclear Energy Research Initiative	6.4	2.5	0	
Nuclear Power 2010	19.4	49.6	56.0	
Generation IV Nuclear Systems	27.0	39.7	45.0	
Nuclear Hydrogen Initiative	6.2	8.9	20.0	

	FY2004 Approp	FY2005 Approp.	FY2006 Request	
Advanced Fuel Cycle Initiative	65.8	67.5	70.0	
Nuclear R&D Infrastructure	195.6	249.0	144.9	
Program Direction	60.3	60.4	30.0	
Defense-Related Infrastructure*	111.6	113.4	123.9	
Total, Nuclear Energy	402.8	485.6	510.8	
Civilian Nuclear Waste Disposal**	576.6	572.4	651.4	

* Funded under "other defense activities."
** Funded by a 1-mill-per-kilowatt-hour fee on nuclear power, plus appropriations for defense waste disposal.

LEGISLATION

H.R. 6 (Barton)
Energy Policy Act of 2005. Omnibus energy legislation that extends Price-Anderson nuclear liability system, authorizes nuclear R&D programs, and requires security measures at nuclear facilities. Introduced April 18, 2005; referred to multiple committees. Passed House April 21 by vote of 249-183.

H.R. 526 (Berkley)
Redirect the Nuclear Waste Fund established under the Nuclear Waste Policy Act of 1982 into research, development, and utilization of risk-decreasing technologies for the onsite storage and eventual reduction of radiation levels of nuclear waste, and for other purposes. Introduced February 2, 2005; referred to Committees on Energy and Commerce; Science; Ways and Means.

H.R. 895 (Berkley)
Provide for interagency planning for preparing for, defending against, and responding to the consequences of terrorist attacks against the Yucca Mountain Project, and for other purposes. Introduced February 17, 2005; referred to Committees on Energy and Commerce and Homeland Security.

H.R. 966 (Saxton)
Require the Nuclear Regulatory Commission to consider certain criteria in relicensing nuclear facilities, and to provide for an independent assessment of the Oyster Creek Nuclear Generating Station by the National Academy of Sciences prior to any relicensing of that facility. Introduced February 17, 2005; referred to Committee on Energy and Commerce.

S. 387 (Hagel)
Amend the Internal Revenue Code of 1986 to provide tax incentives for investment in greenhouse gas intensity reduction projects, including a production tax credit for nuclear-generated electricity. Introduced February 15, 2005; referred to Committee on Finance.

S. 388 (Hagel)
Amend the Energy Policy Act of 1992 to direct the Secretary of Energy to carry out activities that promote the adoption of technologies that reduce greenhouse gas intensity, including advanced nuclear power plants, and to provide credit-based financial assistance and

investment protection for projects that employ advanced climate technologies or systems. Introduced February 15, 2005; referred to Committee on Energy and Natural Resources.

S. 858 (Voinovich)

Reauthorizes Nuclear Regulatory Commission user fees. Introduced April 20, 2005; referred to Committee on Environment and Public Works.

S. 864 (Inhofe)

Nuclear Safety and Security Act of 2005. Authorizes use of firearms by nuclear plant security personnel and requires fingerprinting of nuclear personnel for criminal background checks. Introduced April 20, 2005; referred to Committee on Environment and Public Works.

S. 865 (Voinovich)

Price-Anderson Amendments Act of 2005. Extends nuclear accident indemnification authority through 2025. Introduced April 20, 2005; referred to Committee on Environment and Public Works.