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Nuclear Energy Policy

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Nuclear Energy Policy

SUMMARY

Nuclear energy policy issues facing Congress include questions about 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. The Administration's FY2005 budget request includes $35 million for a Department of Energy (DOE) effort to develop a new generation of commercial reactors and $9 million for the Nuclear Hydrogen Initiative, a DOE program in which nuclear reactors would produce hydrogen to fuel motor vehicles. Total funding for DOE's Office of Nuclear Energy, Science, and Technology would be $412.6 million, about the same as the FY2004 level. The House-passed Energy and Water Development Appropriations bill for FY2005 (H.R. 4614, H.Rept. 108-554) would provide $463.8 million for the nuclear energy office.

A conference agreement reached November 17, 2003, on omnibus energy legislation (H.R. 6) would provide tax credits for electricity generated by new nuclear power plants and authorize funding for a demonstration reactor in Idaho to produce hydrogen. The conference agreement also would extend Price-Anderson coverage for new commercial reactors and new DOE nuclear contracts through the end of 2023. The House approved the conference report November 18, 2003, but a Senate filibuster has made the bill's outlook doubtful.

The September 11, 2001, terrorist attacks on the United States raised questions about nuclear power plant security. Reactor security provisions are included in the conference agreement on H.R. 6, as well as in a bill (S. 1043) approved by the Senate Environment and Public Works Committee on May 15, 2003.

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. A resolution to allow work at Yucca Mountain to proceed despite state objections was signed by the President on July 23, 2002 (P.L. 107-200).

DOE received $580 million for the waste program for FY2004, and the Administration is requesting $880 million for the program for FY2005, a 50% increase. The Administration also is proposing that $749 million of the FY2005 request be offset by an existing fee on nuclear power, so that the net appropriation would be only $131 million. Because legislation to enact the proposed offset has not been passed, the House voted to provide only the requested $131 million net appropriation in the FY2005 Energy and Water Development appropriations bill (H.R. 4614). Disagreement over nuclear waste funding has stymied Senate action on the appropriations measure.

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

The House on June 25 passed an FY2005 Energy and Water Development Appropriations bill (H.R. 4614, H.Rept. 108-554) that would provide $463.8 million for Department of Energy (DOE) nuclear energy research and development — including advanced reactors, fuel cycle technology, nuclear hydrogen production, and facility management. The House-passed level is about $50 million above the Bush Administration request and the FY2004 appropriation.

The Administration requested $880 million for DOE's civilian nuclear waste program for FY2005, a 50% increase, with all but $131 million to be offset by an existing fee on nuclear power. Because legislation to enact the proposed offset has not been passed, the House voted to provide only the requested $131 million net appropriation for FY2005, a cut that DOE contends would severely disrupt the program. The House Energy and Commerce Committee on June 24 approved a bill (H.R. 3981) that would provide most of the requested funding offset, but no further action on the bill has been taken. Disagreement over nuclear waste funding has stymied Senate action on the Energy and Water appropriations measure.

A key aspect of the Environmental Protection Agency's regulations for the planned Yucca Mountain, Nevada, nuclear waste repository was overturned July 9 by the U.S. Court of Appeals for the District of Columbia Circuit. The three-judge panel ruled that the 10,000-year compliance period was too short, but it rejected several other challenges to the rules. The ruling could delay DOE's planned license application for the Yucca Mountain project.

Three nuclear industry consortia applied to the Department of Energy (DOE) during March and April for grants to pay half the costs of pursuing 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.

A conference agreement reached November 17, 2003, on omnibus energy legislation (H.R. 6) would provide tax credits for electricity generated by new nuclear power plants and authorize funding for a demonstration reactor in Idaho to produce both electricity and hydrogen. The conference agreement also would extend Price-Anderson coverage for new commercial reactors and new DOE nuclear contracts through the end of 2023. Reactor security provisions are included as well. The House approved the conference report November 18, 2003, but a Senate filibuster has left the bill's outlook doubtful. A two-year extension of Price-Anderson coverage for DOE contractors was included in the FY2005 defense authorization bill (H.R. 4200) approved by Congress October 9.

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 797 billion kilowatt-hours of nuclear electricity generated in the United States during 2003 was more than the nation's entire electrical output in 1963, when the first of today's 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 more than 87% of their total capacity in 2003, according to industry statistics.[1]

Twenty-six 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 20 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]).

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.

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

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[1] "2003 Nuclear Generation Would Have Been Record — in 2000," *Nucleonics Week*, February 12, 2004, p. 1.

favorable regulatory treatment of past construction costs, and average nuclear operating costs are currently estimated to be lower than those of competing fossil fuel technologies.[2] 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, annual U.S. nuclear electrical output increased by about one-third from 1990 to 2003, 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.

A spike in fossil fuel prices and shortages of electricity during 2000-2001 helped encourage at least three nuclear operating companies to consider building new commercial nuclear reactors. 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/license-reviews/esp.html]) in fall 2003. The Department of Energy (DOE) is assisting the site-selection efforts as part of a program to encourage construction of new commercial reactors by 2010.

A conference agreement reached November 17, 2003, on omnibus energy legislation (H.R. 6) would provide tax credits for electricity produced from as much as 6,000 megawatts of new nuclear generating capacity and authorize about $1.1 billion for a demonstration reactor in Idaho to produce both electricity and hydrogen. The Secretary of Energy would be required to study the feasibility of locating a commercial nuclear power plant at a DOE site. The House approved the conference report November 18, 2003, but a Senate filibuster has left the bill's future doubtful. The nuclear energy tax credits were excluded from a modified energy bill introduced February 12, 2004 (S. 2095).

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. An air pollution bill introduced April 9, 2003, by Senator Carper (S. 843) would provide potentially valuable emissions allowances to owners of incremental nuclear power capacity. 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 $299.7 million for FY2005. An additional $112.8 million is being sought for defense-related activities at the Idaho National Engineering and Environmental Laboratory (INEEL), which is being transferred to the nuclear energy program from DOE's environmental management

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

program, for a total of $412.6 million. The House on June 25, 2004, passed an FY2005 Energy and Water Development Appropriations bill (H.R. 4614, H.Rept. 108-554) that would provide $463.8 million for nuclear energy research and development — including $114.3 million for defense-related activities.

"The benefits of nuclear power as a clean, reliable, and affordable source of energy are a key to economic and environmental underpinnings of the U.S.," 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.

Within the nuclear energy budget, the Administration is seeking $10.2 million for the nuclear energy technologies program. Nearly all of that funding would be for the Nuclear Power 2010 program, which "is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by 2010," according to the DOE budget justification. The budget request for Nuclear Power 2010 is about half the FY2004 appropriation and a third of the FY2003 level. However, funding for the Generation IV Nuclear Energy Systems Initiative, which focuses on more-advanced reactors that could be deployed in the longer term, would rise about 10% to $30.5 million. The House voted to cut the Nuclear Power 2010 program to $5 million — contending that new nuclear plants should not be licensed without an operating waste repository — but boosted the Generation IV request by $10 million.

According to the DOE budget justification, the Nuclear Power 2010 program "will enable an industry decision by 2005 to deploy at least one new advanced nuclear power plant in the U.S." To meet the 2010 goal for possible deployment, the program is expected to focus primarily on advanced versions of existing commercial reactors. The initiative includes funding for site approval, reactor design certification, license applications, detailed design work, and development of improved construction techniques. DOE will pay up to half the cost of these activities. The program is already helping three utilities seek NRC approval for potential nuclear reactor sites in Illinois, Mississippi, and Virginia.

The next stage of the Nuclear Power 2010 program will test the "one step" licensing process for new nuclear power plants established by the Energy Policy Act of 1992. Under the new licensing process, NRC would issue a combined construction and operating license (COL) for a new nuclear power plant before construction began, rather issuing only a construction permit first and then an operating license after the plant had been built. As discussed in the next section, the legislation establishing COLs drew strong opposition from nuclear critics. Three industry consortia applied to DOE in March and April of 2004 for funding of 50% of their COL costs:

- Dominion Resources is leading a consortium that is seeking $250 million over six years for a COL for an advanced Canadian-designed ACR-700 reactor. 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 (ESP) 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 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 $800 million estimate.

- 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 and NuStart groups will split an initial DOE award of $11 million, and TVA will receive more than $2 million for the ABWR feasibility study.[3] However, members of the various consortia have stressed that they are not making a commitment to construct a new reactor, even if they receive a COL. The program's $10 million FY2005 budget request, drawn up before the three funding applications were submitted, would provide only a fraction of the annual costs anticipated by the three consortia, but DOE has not determined how much future funding may be requested.[4]

DOE's Generation IV program is focusing on six advanced designs that could be deployed after 2010: 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 $46.3 million is being requested for FY2005 — about $20 million below the FY2004 appropriation. The House voted to boost the program's funding to $68.0 million. According to the budget justification, AFCI will "develop advanced, proliferation-resistant nuclear fuel cycle technologies" 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

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[3] Beattie, Jeff. "DOE Giving Nuke Consortia $11 million for Licensing Projects." *Energy Daily*. October 25, 2004. p. 1; Weil, Jenny. "Potential Nuclear Construction in U.S. Gets Administration's Attention." *Nucleonics Week*. September 30, 2004. p. 1.

[4] Weil, Jenny, *et al.* "TVA, Duke join efforts to get funding for nuclear development." *Nucleonics Week*. April 29, 2004. p. 1.

electrometallurgical treatment of spent fuel from the Experimental Breeder Reactor II (EBR-II) at INEEL.

In support of President Bush's program to develop hydrogen-fueled vehicles, DOE is requesting $9.0 million in FY2005 for the Nuclear Hydrogen Initiative, nearly a 50% increase from the FY2004 level. The House endorsed the full request. According to DOE's budget justification, the program would investigate the use of high-temperature nuclear reactors to make hydrogen from water in a thermochemical process. According to DOE, "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. Even if the technology is successful, however, DOE officials have predicted that significant quantities of nuclear-produced hydrogen would not become available until 2020-2030.[5]

DOE is 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 $11 million for FY2004. No new funding is also being requested for the Nuclear Energy Plant Optimization program (NEPO), which received $2.9 million in FY2004. The program supports cost-shared research by the nuclear power industry on ways to improve the productivity of existing nuclear plants. The House agreed to provide no new funding for NERI or NEPO.

The conference report on the omnibus energy bill, H.R. 6, includes funding authorizations for DOE nuclear energy programs that are similar to the Administration funding request.

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

[5] EnergyWashington.com Daily Updates, February 5, 2003.

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."[6]

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

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[6] Talbott, Evelyn O., *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. [http://ehp.niehs.nih.gov/docs/2003/5662/abstract.html]

estimated that about 50,000 square miles of land in Belarus, Ukraine, and Russia were substantially contaminated with radioactive cesium from Chernobyl.[7]

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.

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 began implementing a new reactor oversight system April 2, 2000, that

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

relies on a series of performance indicators to determine the level of scrutiny that each reactor should receive. However, the Union of Concerned Scientists has questioned the validity of the individual plant studies on which risk-informed regulation is based.

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 September 11, 2001, terrorist attacks NRC activated its Emergency Response Center and advised all plant operators to go to the highest level of security alert. It also 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.

Several legislative proposals have been introduced in the 108th Congress, and one, the Nuclear Infrastructure Security Act of 2003 (S. 1043) was reported out on May 15, 2003, by the Senate Environment and Public Works Committee. The conference report on omnibus energy legislation, H.R. 6, would require a presidential study of security threats to nuclear facilities and periodic "force on force" security exercises. (For details 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.

Consolidation of the nuclear industry has raised questions about the tax treatment of decommissioning funds when a commercial reactor is sold. The conference report on H.R. 6 specifies that dedicated nuclear decommissioning funds can be transferred to new reactor owners without incurring additional tax liabilities. The provision was also included in a foreign sales tax bill (S. 1637) approved by the Senate May 11, 2004, but was dropped from the final version.

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 an extension, existing reactors would 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 (H.R. 4200).

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.

Extending the Price-Anderson Act is a key provision in the current omnibus energy bill, H.R. 6. The conferees on H.R. 6 approved a Price-Anderson extension for commercial reactors and DOE contractors through December 31, 2023. 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, under the conference agreement.

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 conference agreement on H.R. 6 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.

The House-passed version of H.R. 6 would have authorized the federal government to sue DOE contractors to recover at least some of the compensation that the government had paid for any accident caused by intentional DOE contractor management misconduct. Such cost recovery would have been limited to the amount of the contractor's profit under the contract involved, and no recovery would be allowed from nonprofit contractors. However, the conference agreement does not include that provision. The conferees did include a House provision to prohibit Price-Anderson indemnification of contracts related to nuclear facilities in countries found to sponsor terrorism.

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 will have little short-term 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).

The Bush Administration's FY2005 budget request, released February 2, 2004, includes $880 million for the DOE civilian nuclear waste disposal program, a 50% boost over FY2004. The Administration also is proposing that $749 million of the FY2005 request be offset by the existing nuclear waste fee, so that the net appropriation would be only $131 million. The House Energy and Commerce Committee approved a bill (H.R. 3981) on June 24, 2004, to provide most of the Administration's proposed funding offset. A bill introduced November 4, 2003, by Representative Shimkus (H.R. 3429) would also change the budget treatment of payments to the Nuclear Waste Fund so that they would offset appropriations to the waste program.

Because legislation to enact the proposed nuclear waste funding offset has not been passed, the House voted to provide only the requested $131 million net appropriation in the FY2005 Energy and Water Development Appropriations Bill (H.R. 4614). Disagreement over nuclear waste funding has stymied Senate action on the funding measure.

DOE contends that funding for the waste program must average $1.3 billion per year between FY2005 and FY2010 to meet the current 2010 target date for shipping nuclear waste to Yucca Mountain. According to a May 24, 2004, letter from DOE to the House Appropriations Committee, a funding level of $131 million would force layoffs of 70% of the program's 2,400-person workforce and cause "an indefinite delay" in opening the Yucca Mountain repository.

Delays in the Yucca Mountain project could also be created by a recent court decision. A three-judge panel of the U.S. Court of Appeals for the District of Columbia Circuit ruled on July 9, 2004, that EPA's 10,000-year regulatory compliance period for the repository was too short. However, the court rejected several other challenges to EPA's Yucca Mountain regulations.

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 currently scheduled, and up to $600 million if waste acceptance does not begin until 2015.

Funding for the nuclear waste program comes from two sources. Under the FY2005 budget request, $749.0 million would be appropriated from the Nuclear Waste Fund, which consists of fees paid by nuclear utilities, and $131.0 million from the defense nuclear waste disposal account, which pays for disposing of high-level waste from the nuclear weapons program in the planned civilian repository. However, as noted above, the Administration is proposing that the $749 million appropriated from the Nuclear Waste Fund be offset by nuclear waste fee collections. The Administration is also proposing that DOE's Office of Radioactive Waste Management (OCRWM), which runs the Yucca Mountain Project, take over management of DOE defense and research waste that is currently under another program, bringing the total FY2005 funding request for OCRWM to $907.5 million. However, those transfers were rejected by the House-passed FY2005 appropriations bill.

(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 FY2005 funding request February 2, 2004. The FY2005 Energy and Water Development Appropriations bill (H.R. 4614, H.Rept. 108-554) was passed the House June 25, 2004. Because the bill did not pass before the start of the new fiscal year, nuclear energy funding is currently provided under a continuing resolution (P.L. 108-309).

Table 1. Funding for the Nuclear Regulatory Commission

(budget authority* in millions of current dollars)

	FY2003 Approp.	FY2004 Approp.	FY2005 Request	FY2005 House	
Nuclear Regulatory Commission					
Reactor Safety	276.4	307.0	435.1	— **	
Nuclear Materials Safety	60.0	65.8	100.3	—	
Nuclear Waste Safety	70.4	72.3	118.1	—	
International Nuclear Safety	5.2	5.8	9.2	—	
Management and Support	165.8	167.9	— *	—	
Inspector General	6.8	7.3	7.5	7.5	
TOTAL NRC BUDGET AUTHORITY	**584.6**	**626.1**	**670.3**	**670.3**	
Offsetting fees	**526.3**	**545.6**	**541.2**	**541.2**	
Net appropriation	**58.3**	**80.5**	**129.2**	**129.2**	

* For the FY2005 request, management and support is divided among the functional program areas.
** Subcategories not specified.

Table 2. DOE Funding for Nuclear Activities

(budget authority in millions of current dollars)

	FY2003 Approp.	FY2004 Approp.	FY2005 Request	FY2005 House	
Nuclear Energy (selected programs)					
University Reactor Assistance	18.0	22.9	21.0	24.0	
Nuclear Energy Plant Optimization	4.8	2.9	0	0	
Nuclear Energy Research Initiative	17.4	6.6	0	0	
Nuclear Energy Technologies	31.6	19.6	10.2	5.0	
Generation IV Nuclear Systems	16.9	27.7	30.5	40.5	
Nuclear Hydrogen Initiative	2.0	6.4	9.0	9.0	
Advanced Fuel Cycle Initiative	57.3	66.7	46.3	68.0	
Nuclear R&D Infrastructure*	104.1	111.7	112.8	114.3	
Total, Nuclear Energy	375.4	404.8	412.6	463.8	
Civilian Nuclear Waste Disposal**	457.0	576.6	880.0	131.0	

* Funded under "other defense activities."
** Funded by a 1-mill-per-kilowatt-hour fee on nuclear power, plus appropriations for defense waste disposal. Administration proposes direct offset of $749 million in FY2005, for net appropriation of $131 million. Proposed transfers from other programs would increase FY2005 budget to $907.5 million.

LEGISLATION

H.R. 6 (Tauzin)

Includes extension of Price-Anderson Act nuclear liability system and reauthorization of nuclear R&D programs. Introduced April 7, 2003; referred to multiple committees. Incorporates H.R. 39, H.R. 238, H.R. 1531, H.R. 1644. Passed by House April 11, 2003, by vote of 247-145. Senate version, with text of H.R. 4 from the 107th Congress, passed July 31, 2003, by vote of 84-14. Conference report passed House November 18, 2003. Senate cloture motion failed, 57-40, on November 21, 2003.

H.R. 238 (Boehlert)

Energy Research, Development, Demonstration, and Commercial Application Act of 2003. Authorizes appropriations for nuclear energy research programs. Introduced January 8, 2003; referred to Committee on Science and Committee on Resources. Incorporated into H.R. 6.

H.R. 330 (H. Wilson)

Price-Anderson Amendments Act of 2003. Extends Price-Anderson Act nuclear accident liability system for 15 years and increases liability limits. Introduced January 8, 2003; referred to Committee on Energy and Commerce.

H.R. 1644 (Barton)

Energy Policy Act of 2003. Includes extension of Price-Anderson Act nuclear liability system and reauthorization of nuclear R&D programs. Introduced April 7, 2003; referred to multiple committees. Reported by Committee on Energy and Commerce April 8, 2003 (H.Rept. 108-65, Part 1).

H.R. 3429 (Shimkus)

Changes the funding mechanism for the Department of Energy Civilian Radioactive Waste Management Program. Introduced November 4, 2003; referred to Committee on Energy and Commerce. Subcommittee on Energy and Air Quality held hearing March 25, 2004.

H.R. 3981 (Barton)

Reclassifies fees paid into the Nuclear Waste Fund as offsetting collections. Introduced March 17, 2004; referred to Committee on Energy and Commerce. Approved by Committee June 24, 2004, by vote of 29-19 (H.Rept. 108-594).

H.R. 4614 (Hobson)

Energy and Water Development Appropriations for FY2005. Includes funding for nuclear energy research and waste management. Ordered reported as an original measure by House Committee on Appropriations June 18, 2004 (H.Rept. 108-554). Passed House June 25, 2004, by vote of 370-16.

S. 6 (Daschle)

Comprehensive Homeland Security Act of 2003. Includes provisions from S. 131 on nuclear facility security. Introduced January 7, 2003; referred to Committee on Judiciary.

S. 14 (Domenici)

Energy Policy Act of 2003. Provides federal assistance for new nuclear power plants, authorizes nuclear research funding, and extends Price-Anderson Act indefinitely. Introduced April 30, 2003; placed on Senate calendar. Identical to S. 1005, reported by Senate Energy and Natural Resources Committee May 6, 2003 (S.Rept. 108-43). Senate debate began May 6, 2003.

S. 131 (Reid)

Nuclear Security Act of 2003. Requires the federal government to study a wide variety of security threats to nuclear facilities and determine which threats would come from enemies of the United States and therefore be the responsibility of the federal government and which threats should be guarded against by nuclear power plant owners. NRC would be required to review the security and emergency response plans at all nuclear power plants and other major nuclear facilities. An NRC employee is to be stationed at each nuclear facility as a "federal security coordinator." Introduced January 9, 3003; referred to Committee on Environment and Public Works.

S. 156 (Voinovich)

Price-Anderson Amendments Act of 2003. Extends Price-Anderson Act nuclear liability coverage for new commercial nuclear power plants through August 1, 2012. Introduced January 14, 2003; referred to Committee on Environment and Public Works. Ordered reported by committee April 9, 2003; amended to include nuclear power plant security provisions.

S. 843 (Carper)

Clean Air Planning Act of 2003. Provides emissions allowances for incremental nuclear power capacity. Introduced April 9, 2003; referred to Committee on Environment and Public Works.

S. 1043 (Inhofe)

Nuclear Infrastructure Security Act of 2003. Requires NRC to issue new regulations for "design basis threat" that nuclear power plant security must be able to defeat. Introduced May 12, 2003; referred to Committee on Environment and Public Works. Ordered reported May 15, 2003.

S. 2095 (Domenici)

Includes same extension of Price-Anderson Act nuclear liability system as in H.R. 6 conference report. Introduced February 12, 2004, and placed on the Senate legislative calendar.