Order Code IB88090

Issue Brief for Congress
Received through the CRS Web

Nuclear Energy Policy

Updated March 20, 2003

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

CONTENTS

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 FY2004 budget request includes $35 million for a Department of Energy (DOE) effort to encourage deployment of new commercial nuclear power plants by 2010, about the same as the FY2003 appropriation. The Administration is also seeking $4 million for the Nuclear Hydrogen Initiative, a new DOE program in which nuclear reactors would produce hydrogen to fuel motor vehicles.

Several bills were introduced, but not passed, in the 107th Congress to encourage the growth of nuclear power. A number of nuclear provisions were included in comprehensive energy legislation (H.R. 4) passed by the House August 2, 2001, and by the Senate April 25, 2002. Conferees were unable to reach agreement on the measure.

The September 11, 2001, terrorist attacks on the United States raised questions about nuclear power plant security. Reactor security provisions were included in a Price-Anderson extension bill passed by the House November 27, 2001 (H.R. 2983), and in several other bills. An extra $36 million for nuclear power plant security was provided by the FY2002 supplemental appropriations bill, included in the FY2002 Defense Appropriations Bill passed by Congress December 20, 2001 (P.L. 107-117). Bills to strengthen nuclear power plant security have been introduced in the 108th Congress (S. 6, S. 131).

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. President Bush recommended approval of the site February 15, 2002, and Nevada Governor Guinn on April 8, 2002, issued a "state veto" of the site, as allowed by NWPA. A resolution to overturn the "state veto" and allow further activity at Yucca Mountain to proceed was signed by the President July 23, 2002 (P.L. 107-200).

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

President Bush's FY2004 budget request, submitted February 3, includes $387.6 million for Department of Energy (DOE) nuclear energy research and development – including advanced reactors, fuel cycle technology, and nuclear hydrogen production That request is substantially higher than the $261.7 million appropriated for FY2003, but about $110 million of the increase is related to the transfer of primary responsibility for the Idaho National Engineering and Environmental Laboratory to the nuclear energy program from DOE's environmental management program.

Nuclear energy funding for FY2003 is included in an omnibus continuing resolution signed by the President on February 20 (P.L. 108-7). The enacted measure also includes an extension of the Price-Anderson Act nuclear liability system for commercial nuclear reactors through December 31, 2003; the Senate version had contained a 15-year extension. Under Price-Anderson, commercial reactors must pay for any radiological damages to the public through a limited industry self-insurance system, and DOE nuclear contractors are indemnified by the federal government. For DOE contractors, Price-Anderson coverage was extended for two years by the FY2003 Defense Authorization Act (P.L. 107-314), signed December 2, 2002.

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 since 1978 and more than 100 reactors have been canceled, including all ordered after 1973. No units are currently under active construction; the Tennessee Valley Authority's Watts Bar 1 reactor, ordered in 1970 and licensed to operate in 1996, was the 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 have 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 the Tennessee Valley Authority's (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 769 billion kilowatt-hours of nuclear electricity generated in the United States during 2001 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 a record-high average of more than 89% of their total capacity in 2002, according to industry statistics.[1]

Ten 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 13 more reactors are currently under NRC review.[2]

Industry consolidation could also help existing nuclear power plants, as larger nuclear operators purchase plants from utilities that run only one or two reactors. Several such sales have been announced, including the 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 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.[3] Although eight U.S. nuclear reactors have permanently shut down since 1990, recent reactor sales could indicate greater industry interest in nuclear plants that previously had been considered marginal. Despite the shutdowns, total U.S. nuclear electrical output increased nearly 25% from 1990 to 2000, 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. Exelon helped form an international consortium that may build a demonstration Pebble Bed Modular Reactor (PBMR) in South Africa, a reactor cooled by helium that is intended to be highly resistant to accidents. However, Exelon announced in April 2002 that it would leave the consortium after a feasibility study is completed. Entergy, Dominion Resources, and Exelon have chosen sites in Mississippi, Virginia, and Illinois,

---

[1] "U.S. Units Exceed 89% Average Capacity Factor," *Nucleonics Week*, February 13, 2003, p. 1.

[2] "Florida Reactors Get License Extension," *The Energy Daily*, June 10, 2002.

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

respectively, for possible future nuclear units.[4] The Department of Energy (DOE) is implementing a program to encourage construction of new commercial reactors by 2010.

Global warming that may be caused by fossil fuels — the "greenhouse effect" — is cited by nuclear power supporters as an important reason to develop a new generation of reactors. But the large obstacles noted above must still be overcome before electric 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 Bush Administration is requesting $387.6 million for FY2004. That request is substantially higher than the $261.7 million appropriated for FY2003, but about $110 million of the increase is related to the transfer of primary responsibility for the Idaho National Engineering and Environmental Laboratory (INEEL) to the nuclear energy program from DOE's environmental management program.

"Nuclear energy, which is already a vital component of our balanced energy portfolio, presents some of our most promising solutions to the world's long-term energy challenges," according to DOE's FY2004 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 requesting $48 million for the nuclear energy technologies program, which focuses on development of new reactors. That request is $3.0 million above the FY2003 appropriation. The program includes $35.0 million for an initiative to encourage construction of new commercial reactors by 2010 ("Nuclear Power 2010") and $9.7 million for advanced ("Generation IV") reactor designs that could be ready for deployment after 2010.

According to the DOE budget justification, the Nuclear Power 2010 program "will achieve near-term deployment of new power plants in the United States through cost-shared demonstration of the new, untested regulatory processes and cost-shared development of advanced reactor technologies." The program seeks to deploy both a water-cooled reactor (similar to most existing commercial plants) and a gas-cooled reactor. The current phase of the initiative includes site approval, reactor design certification, license applications, detailed design work, and development of improved construction techniques. DOE is soliciting proposals for joint DOE/industry teams in which DOE will pay up to half the cost of these activities.

---

[4] Beattie, Jeff. "Entergy Names Mississippi Site for Possible New Reactor," *Energy Daily*, April 17, 2002. p. 4. Weil, Jenny. "Exelon Selects Clinton Site for Possible New Reactor," *Nucleonics Week*, May 2, 2002. p. 1.

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 $63.0 million is requested for FY2004 – about $5 million above the FY2003 appropriation. According to the budget justification, AFCI will "develop advanced proliferation-resistant fuel treatment and fabrication technologies that could be deployed by 2015," as well as technologies that could reduce the long-term hazard of spent nuclear fuel. 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. AFCI includes a previously funded research program on accelerator transmutation called Advanced Accelerator Applications. The program also includes longstanding DOE work on 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 $4.0 million in FY2004 for a new "Nuclear Hydrogen Initiative." According to DOE's budget justification, the program would investigate the use of high-temperature nuclear reactors to make hydrogen from water in a thermo-chemical process. According to DOE, "preliminary estimates indicate that hydrogen produced using nuclear-driven thermo-chemical processes would be only slightly more expensive than gasoline" and result in far less air pollution. Activities planned in FY2004 include development of a "roadmap" for developing nuclear hydrogen technologies and laboratory testing of thermo-chemical processes and related research. 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]

The Nuclear Energy Research Initiative (NERI) provides grants for research on innovative nuclear energy technologies. DOE is requesting $12.0 million for NERI in FY2004, about half of the FY2003 appropriation. According to the budget justification, no new grants will be awarded in FY2003 and FY2004, with new program funding to be used only for completing previously initiated projects.

DOE proposes no new funding in FY2004 for the Nuclear Energy Plant Optimization program (NEPO), which received $5.0 million in FY2003. The program supports cost-shared research by the nuclear power industry on ways to improve the productivity of existing nuclear plants.

---

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

nuclear nonproliferation groups.

The Energy Research, Development, Demonstration, and Commercial Application Act of 2003 (H.R. 238), introduced by Representative Boehlert on January 8, 2003, includes funding authorizations for DOE nuclear energy programs. Similar authorizations are included in omnibus energy legislation marked up March 19, 2003, by the House Energy and Commerce Committee's Energy and Air Quality Subcommittee.

Nuclear Power Plant Safety and Regulation

Safety and Security

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 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 release of reactor cooling water.

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. In the wake of the September 11, 2001, terrorist attacks against the United States, concerns about nuclear power plant security have received heightened attention.

Domestic Reactor Safety. In terms of public health consequences, the safety record of the U.S. nuclear power industry in comparison with other major commercial energy technologies has been excellent. In more than 2,250 reactor-years of operation in the United States, the only incident at a commercial power plant that might lead to any deaths or injuries to the public has been the Three Mile Island accident, in which more than half the reactor core melted. Public exposure to radioactive materials released during that accident is expected to cause fewer than five deaths (and perhaps none) from cancer over the following 30 years. A recent 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 unsafe. There is substantial scientific uncertainty about

---

[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 on-line October 30, 2002. [http://ehpnet1.niehs.nih.gov/docs/2003/5662/abstract.html]

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. 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.

Security and Emergency Planning. Nuclear power plant security has been an ongoing issue, but concerns were considerably increased following the terrorist attacks on New York and Washington, D.C. At NRC's recommendation, nuclear power plants in the United States went to the highest level of security immediately after the attacks. The NRC Emergency Operations Center was activated, as well as regional NRC emergency centers, all of which maintained constant contact with the nation's nuclear power plants.

NRC ordered all commercial reactors on February 26, 2002, to "implement interim compensatory security measures for the generalized high-level threat environment." Some of the required security measures had been included in NRC's previous security recommendations. Although most of the detailed security requirements are secret, NRC said they generally included:

- increased patrols at nuclear power plants;
- augmented security forces and capabilities;
- establishment of additional security posts;
- installation of additional physical barriers;
- vehicle checks at greater distances from vital facilities;
- enhanced plant security coordination with law enforcement and military authorities; and
- more restrictive controls on personnel access to nuclear plant sites.

In light of the unprecedented attacks, NRC Chairman Richard A. Meserve, with the support of the other Commissioners, ordered a staff review of NRC's security regulations and procedures. NRC's FY2004 budget request includes $53.1 million for activities related to homeland security, a 50% increase over FY2003. During FY2003, NRC plans to finish revising the nuclear plant security "design-basis threat" – the potential attacks that nuclear plants must be capable of withstanding. In FY2004, NRC intends to begin conducting "full security performance reviews, including force-on-force exercises, at each nuclear power plant on a 3-year cycle instead of the 8-year cycle that the agency used before September 11, 2001."

NRC regulations require nuclear power plants to be designed and operated to prevent unauthorized intrusion and to withstand external attacks. However, reactor containment structures are not specifically designed to withstand the types of deliberate air crashes that

were carried out September 11, according to an NRC fact sheet. Groups critical of the nuclear industry contend that such a crash could cause a reactor meltdown, but some industry officials have expressed confidence that no radioactive release would occur. NRC is currently analyzing the potential effects of airliner attacks on nuclear power plants. To prevent internal threats, background checks are required for unescorted access and computerized security doors monitor the movement of personnel throughout each reactor building. However, critics contend that existing personnel controls could be circumvented.

Nuclear plant security forces are tested periodically with mock attacks under NRC's Operational Safeguards Response Evaluation (OSRE) program. Nuclear power critics have pointed out that numerous security weaknesses have been uncovered by the "force on force" OSRE exercises, although the significance of those problems has been the subject of debate. Based on interviews with 20 security guards at 13 nuclear plant sites, a report issued September 12, 2002, by the Project on Government Oversight (POGO) contended that many nuclear plants have too few guards, and that nuclear security forces often have inadequate training, equipment, and pay.

Since the September 11 terrorist attacks, a number of groups have intensified their criticism of NRC's nuclear plant security requirements as being inadequate against sophisticated assaults. The Nuclear Security Act of 2003 (S. 131), introduced January 9, 2003, by Senator Reid, would require 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." NRC-run "force on force" security exercises would be required at each nuclear facility every three years.

Stockpiling of potassium iodide (KI) tablets has also been an emergency planning issue. If taken quickly enough, the tablets can prevent radioactive iodine released during a nuclear incident from being absorbed by the thyroid gland. On December 20, 2001, NRC offered to supply potassium iodide tablets to states in which nuclear power plants are located or nearby. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (P.L. 107-188), signed June 12, 2002, required the Department of Health and Human Services to give KI tablets to state and local governments to stockpile at schools, hospitals, and other public facilities within 20 miles of nuclear power plants. That function was transferred to the new Department of Homeland Security by the Homeland Security Act of 2002 (P.L. 107-296), signed November 25, 2002.

(For more information, see CRS Report RS21131, *Nuclear Powerplants: Vulnerability to Terrorist Attack*, and CRS Terrorism Electronic Briefing Book fact sheet on *Nuclear Power Plant Emergency Response*, [http://www.congress.gov/brbk/html/ebter138.html].)

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.[7]

The United States is providing direct assistance for upgrading the safety of remaining Soviet-designed reactors, a program being coordinated by DOE, NRC, the Agency for International Development (AID), and the Department of State. DOE is seeking $14.1 million in FY2004 for improving the operation and physical condition of Soviet-designed nuclear power plants, an increase of $2.5 million from FY2003. The General Accounting Office estimates that $1.93 billion was provided through November 1999 by the United States and other industrialized nations to improve the safety of Soviet-designed reactors. Of that amount, $753 was contributed by the European Union, $532 by the United States, $43 million by the International Atomic Energy Agency, and the remainder from 14 other countries.

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 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 (P.L. 102-486) 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 proposes to pay up to half the cost of combined construction and operating licenses for a water-cooled and a gas-cooled 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

---

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

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 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.

Decommissioning and Life Extension

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

Consolidation of the nuclear industry has raised questions about the tax treatment of decommissioning funds when a commercial reactor is sold. The House and Senate versions of H.R. 4 specified that dedicated nuclear decommissioning funds could be transferred to new reactor owners without incurring additional tax liabilities.

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.

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 operating commercial reactors, up to $83.9 million per reactor. Those assessments – called "retrospective premiums" – would be paid at an annual rate of no more than $10 million per reactor, to limit the potential financial burden on reactor owners following a major accident. Including three that are not operating, 106 commercial reactors are currently covered by the Price-Anderson retrospective premium requirement.

For each nuclear incident, therefore, the Price-Anderson liability system currently would provide up to $9.2 billion in public compensation. That total includes the $300 million in insurance coverage carried by the reactor that suffered the incident, plus the $83.9 million in retrospective premiums from each of the 106 currently covered reactors. On top of those payments, a 5% surcharge may also be imposed, raising the total per-reactor retrospective premium to $88.1 million and total compensation to $9.6 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 5 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, except when the limit for commercial reactors drops because of a decline in the number of covered reactors. Since 1998, the number of covered commercial reactors has dropped from 110 to 106, so the commercial liability limit has dropped from $9.43 billion to $9.19 billion (excluding the 5% surcharge). Under the law, however, the limit for DOE contractors does not decline and so remains at $9.43 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.

In the 107th Congress, the House approved a 15-year extension of the Price-Anderson liability system November 27, 2001 (H.R. 2983). The total retrospective premium for each reactor would have been raised to $94 million and the limit on per-reactor annual payments raised to $15 million, with both to be adjusted for inflation every 5 years. For the purposes of those payment limits, a nuclear plant consisting of multiple small reactors (100-300 megawatts, up to a total of 950 megawatts) would have been considered a single reactor. Therefore, a power plant with six 120-megawatt pebble-bed modular reactors would have been liable for retrospective premiums of up to $94 million, rather than $564 million. The liability limit on DOE contractors would have been set at $10 billion per accident, also to be adjusted for inflation.

The Senate included provisions in H.R. 4 to extend Price-Anderson coverage for new commercial reactors for 10 years and indefinitely for DOE contractors. The liability limit

for commercial reactors would have remained the same, with a five-year inflation adjustment, and the limit for DOE contractors would have been set at $10 billion with an inflation adjustment. Modular reactors of 100-300 megawatts built together in a plant of up to 1,300 megawatts would have been considered a single reactor under Price-Anderson.

The House-passed Price-Anderson bill 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.

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. H.R. 2983 would have eliminated 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 have limited the civil penalties against a non-profit contractor to the amount of discretionary fees (incentive fees above actual cost reimbursement) awarded by DOE under that contract. The Senate's Price-Anderson extension in H.R. 4 included similar provisions.

The House-Senate conference committee on H.R. 4 approved a compromise Price-Anderson subtitle September 12, 2002. The compromise version would have extended Price-Anderson indemnification authority for both NRC and DOE for 15 years, through August 1, 2017. The total retrospective premium per reactor would have been set at $94 million, divided into annual payments of no more than $15 million (with both limits to be adjusted for inflation every 5 years). The liability limit for DOE contractors would have been set at $10 billion, adjusted for inflation every 5 years. Modular reactors of 100-300 megawatts would have been treated as a single reactor under Price-Anderson, up to a limit of 1,300 megawatts. The civil penalty exemption for nonprofit contractors would have been replaced with a nonprofit penalty limit. However, the 107th Congress adjourned without completing action on the measure.

In the 108th Congress, the Senate attached last year's Price-Anderson conference agreement to the FY2003 omnibus continuing resolution, but the enacted measure included only a simple extension through the end of this calendar year. Representative Heather Wilson introduced a Price-Anderson extension bill (H.R. 330) January 8, 2003, that also includes all the provisions of the H.R. 4 Price-Anderson conference agreement. A 10-year extension of Price-Anderson coverage for new commercial reactors (S. 156) was introduced January 14, 2003, by Senator Voinovich. An omnibus energy bill marked up by the House Energy and Commerce Committee's Energy and Air Quality Subcommittee on March 19, 2003, includes provisions nearly identical to the Price-Anderson extension bill passed by the House in the 107th 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 would 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. To prevent that problem, the National Defense Authorization Act for FY2003 (P.L. 107-314), signed December 2, 2002, extends Price-Anderson coverage for DOE contractors through December 31, 2004.

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 (P.L. 107-200).

The Administration is requesting $591 million for the DOE civilian nuclear waste disposal program for FY2004, a 28% boost over FY2003. The increased budget is intended primarily to pay for preparing a construction permit application for a national nuclear waste repository at Yucca Mountain, Nevada. DOE expects to submit the 10,000-page application to the Nuclear Regulatory Commission (NRC) in December 2004. The additional funds are also needed for detailed repository design work, repository performance studies, and transportation planning, according to DOE.

DOE contends that it cannot meet its 2010 target date for shipping nuclear waste to Yucca Mountain without receiving its entire FY2004 budget request for the program. Between FY2005 and FY2010, funding will have to further increase to an average of $1.3 billion per year, according to the budget justification. The Administration is proposing that discretionary spending caps be adjusted to accommodate the program's higher future funding.

(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 uranium activities, and for the NRC. The sources for the funding figures are Administration budget requests and committee reports on the Energy and Water Development Appropriations Acts, which fund all the nuclear programs. President Bush submitted his FY2003 funding request to Congress February 4, 2002. The House Appropriations Committee marked up its FY2003 funding bill September 5, 2002 (H.R. 5431, H.Rept. 107-681). The Senate Appropriations Committee marked up its FY2003 Energy and Water Development appropriations bill July 24, 2002 (S. 2784, S.Rept. 107-220). Because final action was not taken, these programs are currently under a short-term continuing resolution. Funding in the Senate-passed H.J.Res. 2 is the same as the Senate committee level.

Table 1. Funding for the Nuclear Regulatory Commission

(budget authority* in millions of current dollars)

	FY2001 Approp.	FY2002 Approp.	FY2003 Approp.	FY2004 Request	
Nuclear Regulatory Commission					
Reactor Safety	227.6	259.3	273.7	305.8	
Nuclear Materials Safety	53.1	58.8	60.3	71.2	
Nuclear Waste Safety	64.1	68.3	73.2	70.1	
International Nuclear Safety	5.1	5.0	5.2	5.4	
Management and Support	149.7	161.0	165.8	166.2	
Inspector General	5.8	6.2	6.8	7.3	
(Homeland Security)		(36.0*)	(35.4)	(53.1)	
TOTAL NRC BUDGET AUTHORITY	**505.5**	**558.7**	**585.0**	**626.1**	
Offsetting fees	**453.2**	**479.0**	**526.5**	**546.6**	
Net appropriation	**52.3**	**79.6**	**58.5**	**80.5**	

* Additional $36 million for nuclear plant security provided by FY2002 supplemental appropriations included in FY2002 Defense Appropriations Bill (P.L. 107-117), approved by Congress December 20, 2001. The FY2002 supplemental security funding is not to be offset by fees. The security funding is included in the other NRC programs, so it should not be added to the NRC total as a separate funding category.

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

	FY2001 Approp.	FY2002 Approp.	FY2003 Approp	FY2004 Request	
Nuclear Energy (selected programs)					
Program Direction	22.0	23.0	23.4	24.8	
University Reactor Assistance	12.0	17.5	18.5	18.5	
Nuclear Energy Plant Optimization	5.0	7.0	5.0	0	
Nuclear Energy Research Initiative	35.0	32.0	25.0	12.0	
Nuclear Energy Technologies	7.5	12.0	45.0	48.0	
Nuclear Hydrogen Initiative	–	–	–	4.0	
Advance Fuel Cycle Initiative	–	–	58.2	63.0	
International Nuclear Safety*	20.5	21.1	11.6	14.1	
Total, Nuclear Energy	259.9	250.5	261.7	387.6	
Uranium Facilities Maintenance and Remediation	422.5	418.4	456.5	418.1	
Nuclear Waste Activities					
Defense Environmental Management	6,122.2	6,489.2	6,766.9	6,809.8	
Non-defense Environmental Manag.	288.8	236.4	227.2	170.9	
Nuclear Waste Fund Activities**	390.4	375.0	460.0	591.0	

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

LEGISLATION

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.

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.

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. 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.