Nuclear Energy Policy

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Summary

Nuclear energy issues facing Congress include federal incentives for new commercial reactors, radioactive waste management policy, research and development priorities, power plant safety and regulation, nuclear weapons proliferation, and security against terrorist attacks.

Significant incentives for new commercial reactors were included in the Energy Policy Act of 2005 (EPACT05, P.L. 109-58). These include production tax credits, loan guarantees, insurance against regulatory delays, and extension of the Price-Anderson Act nuclear liability system. Together with higher fossil fuel prices and the possibility of greenhouse gas controls, the federal incentives for nuclear power have helped spur renewed interest by utilities and other potential reactor developers. Plans for as many as 31 reactor license applications have been announced, although it is unclear how many of those projects will move forward.

The EPACT05 Title XVII loan guarantees, administered by the Department of Energy (DOE), are widely considered crucial by the nuclear industry to obtain financing for new reactors. However, opponents contend that nuclear loan guarantees would provide an unjustifiable subsidy to a mature industry and shift investment away from environmentally preferable energy technologies. The total amount of loan guarantees to be provided to nuclear power projects has been a continuing congressional issue. Nuclear power plants are currently allocated $18.5 billion in loan guarantees, enough for two or three reactors.

DOE's nuclear energy research and development program includes advanced reactors, fuel cycle technology and facilities, and infrastructure support. The FY2010 Energy and Water Development Appropriations Act (P.L. 111-8) provides $786.6 million for those activities, $10 million above the Obama Administration request and about $5 million below the FY2009 level.

Disposal of highly radioactive waste has been one of the most controversial aspects of nuclear power. The Nuclear Waste Policy Act of 1982 (P.L. 97-425), as amended in 1987, requires DOE to conduct a detailed physical characterization of Yucca Mountain in Nevada as a permanent underground repository for high-level waste. DOE submitted a license application for the Yucca Mountain repository to the Nuclear Regulatory Commission (NRC) on June 3, 2008, with the repository to open by 2020 at the earliest.

The Obama Administration has decided to "terminate the Yucca Mountain program while developing nuclear waste disposal alternatives," according to the DOE FY2010 budget justification. Alternatives to Yucca Mountain are to be evaluated by a "blue ribbon" panel of experts convened by the Administration.

The FY2010 budget request of $198.6 million for DOE's Office of Civilian Radioactive Waste Management provides only enough funding to continue the Yucca Mountain licensing process and to evaluate alternative policies, according to DOE. The request is about $90 million below the FY2009 funding level, which was nearly $100 million below the FY2008 level. All work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted, according to the DOE budget justification. The FY2010 Energy and Water Development Appropriations Act includes the requested cuts in the waste program and provides $5 million for the blue ribbon panel. A draft of the DOE FY2011 budget request indicates that Yucca Mountain licensing is to be halted by the end of 2010.

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Funding for Department of Energy (DOE) nuclear energy research and development activities is included in the FY2010 Energy and Water Development Appropriations Act (P.L. 111-85), signed by President Obama on October 28, 2009. DOE's nuclear R&D program includes advanced reactors, fuel cycle technology and facilities, and infrastructure support. P.L. 111-85 provides $786.6 million for those activities, $10 million above the Obama Administration request and about $5 million below the FY2009 level.

The Obama Administration's FY2010 budget request called for termination of DOE's proposed nuclear waste repository at Yucca Mountain, NV, and for a "blue ribbon" panel of experts to develop alternative waste strategies. The FY2010 budget request of $198.6 million for DOE's Office of Civilian Radioactive Waste Management provides only enough funding to continue the Yucca Mountain licensing process before the Nuclear Regulatory Commission (NRC). All work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted, according to the DOE budget justification. The FY2010 Energy and Water Development Appropriations Act includes the requested cuts in the waste program and provides $5 million for the blue ribbon panel. A draft of the DOE FY2011 budget request indicates that Yucca Mountain licensing is to be halted by the end of 2010.

Seventeen applications for combined construction permits and operating licenses (COLs) for 26 new nuclear power units have been submitted to NRC, although two applications were suspended by Entergy on January 9, 2009 (see **Table 1**). NRC is anticipating COL applications for as many as 31 new reactors through 2009. None of the applicants has yet committed to actual plant construction, although some preliminary contracts have been signed.

Nuclear Power Status and Outlook

The outlook for the U.S. nuclear power industry appears to have brightened after decades of uncertainty. No nuclear power plants have been ordered in the United States since 1978, and more than 100 reactors have been canceled, including all ordered after 1973. The most recent U.S. nuclear unit to be completed was TVA's Watts Bar 1 reactor, ordered in 1970 and licensed to operate in 1996. But nuclear power is now receiving renewed interest, prompted by volatile fossil fuel prices, possible carbon dioxide controls, and new federal subsidies and incentives.

The U.S. nuclear power industry currently comprises 104 licensed reactors at 65 plant sites in 31 states and generates about 20% of the nation's electricity.[1] That number includes TVA's Browns Ferry 1, which restarted May 22, 2007, after a 22-year shutdown and $1.8 billion refurbishment. TVA's board of directors voted August 1, 2007, to resume construction on Watts Bar 2, which had been suspended in 1985; the project is to cost about $2.5 billion and be completed in 2013. At TVA's request, NRC in March 2009 reinstated the construction authorization for the two-unit Bellefonte (AL) nuclear plant, which had been deferred in 1988 and canceled in 2006.[2]

[1] U.S. Nuclear Regulatory Commission, *Information Digest 2008-2009*, NUREG-1350, Vol. 20, August 2008, p. 32, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/v20/sr1350v20.pdf.

[2] Nuclear Regulatory Commission, "In the Matter of Tennessee Valley Authority (Bellefonte Nuclear Plant Units 1 and 2)," 74 *Federal Register* 10969, March 13, 2009.

Annual electricity production from U.S. nuclear power plants is greater than that from oil and hydropower, and slightly below natural gas, although it remains well behind coal, which accounts for about half of U.S. electricity generation. Nuclear plants generate more than half the electricity in six states. The near-record 842 billion kilowatt-hours of nuclear electricity generated in the United States during 2008[3] was more than the nation's entire electrical output in the early 1960s, when the oldest of today's operating U.S. commercial reactors were ordered.[4]

Reasons for the 30-year halt in U.S. nuclear plant orders include high capital costs, public concern about nuclear safety and waste disposal, and regulatory compliance costs.

High construction costs may pose the most serious obstacle to nuclear power expansion. Construction costs for reactors completed since the mid-1980s ranged from $2 to $6 billion, averaging more than $3,700 per kilowatt of electric generating capacity (in 2007 dollars). The nuclear industry predicts that new plant designs could be built for less than that if many identical plants were built in a series, but current estimates for new reactors show little if any reduction in cost.[5]

Average U.S. nuclear plant operating costs, however, dropped substantially since 1990, and costly downtime has been steadily reduced. Licensed commercial reactors generated electricity at an average of 90% of their total capacity in 2008, according to industry statistics.[6]

Fifty-seven commercial reactors have received 20-year license extensions from the Nuclear Regulatory Commission (NRC), giving them up to a total of 60 years of operation. License extensions for 20 additional reactors are currently under review, and more are anticipated, according to NRC.[7] The FY2010 Energy and Water Development Appropriations Act provides $10 million for DOE to study further reactor life extension to 80 years.

Existing nuclear power plants appear to hold a strong position in electricity wholesale markets. In most cases, nuclear utilities have received favorable regulatory treatment of past construction costs, and average nuclear operating costs are estimated to be competitive with those of fossil fuel technologies.[8] Although eight U.S. nuclear reactors were permanently shut down during the 1990s, none has been closed since 1998. Despite the shutdowns, annual U.S. nuclear electrical output increased by more than one-third from 1990 to 2006, according to the Energy Information Administration and industry statistics. The increase resulted primarily from reduced downtime at the remaining plants, the startup of five new units (most recently Watts Bar 1 in 1996), and reactor modifications to boost capacity.

[3] "World Nuclear Performance in 2008 Close to Output in 2007," *Nucleonics Week*, March 5, 2009, p. 1.

[4] All of today's 104 operating U.S. commercial reactors were ordered from 1963 through 1973; see "Historical Profile of U.S. Nuclear Power Development," U.S. Council for Energy Awareness, 1992.

[5] CRS Report RL34746, *Power Plants: Characteristics and Costs*, by Stan Mark Kaplan

[6] "World Nuclear Performance in 2008 Close to Output in 2007," *Nucleonics Week*, March 5, 2009, p. 1.

[7] http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html

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

Possible New Reactors

The improved performance of existing reactors, the possibility of carbon dioxide controls that could affect coal plants, and volatile prices for natural gas—the favored fuel for new power plants for most of the past 15 years—have prompted renewed electric industry consideration of the feasibility of building new reactors. Electric utilities and other firms have announced plans to apply for combined construction permits and operating licenses (COLs) for about 30 reactors (see **Table 1**).[9]

No firm commitments have been made to build the proposed plants if the COLs are issued, but the sponsors of four nuclear projects have signed preliminary engineering, procurement, and construction (EPC) contracts. However, Entergy suspended further license review of its planned GE ESBWR reactors at River Bend, LA, and Grand Gulf, MS, and Dominion is seeking other potential vendors for its planned ESBWR at North Anna, VA, although it is continuing with the licensing process. AmerenUE suspended review of a COL for its proposed new Callaway unit in Missouri, and Exelon announced June 30, 2009, that it would no longer pursue a COL for a proposed two-unit plant in Victoria County, TX, but would seek an early site permit instead, laying the groundwork for possible future licensing. TVA announced August 7, 2009, that it would consider building one of the two new reactors it had proposed for the Bellefonte site in Alabama, or completing one of two partially built reactors at the site. The Department of Energy (DOE) is assisting Dominion's COL application as part of a program to encourage new commercial reactor orders by 2010, a program discussed in more detail below.

Table 1. Announced Nuclear Plant License Applications

Announced Applicant	Site	Planned Application	Reactor Type	Units	Status
Alternate Energy	Hammett (ID)	2009	Areva EPR	1	
AmerenUE	Callaway (MO)	Submitted 7/24/08	Areva EPR	1	Construction plans suspended 4/23/09; NRC license review suspended 6/23/09
Amarillo Power	Near Amarillo (TX)	2009	Areva EPR	2	
Dominion	North Anna (VA)	Submitted 11/27/07	GE ESBWR	1	Other reactor vendors being considered 1/9/09
DTE Energy	Fermi (MI)	Submitted 9/18/08	GE ESBWR	1	
Duke Energy	Cherokee (SC)	Submitted 12/13/07	Westing.house AP1000	2	
Entergy	River Bend (LA)	Submitted 9/25/08	Not specified	1	Licensing suspended 1/9/09
Luminant Power (formerly TXU)	Comanche Peak (TX)	Submitted 9/19/08	Mitsubishi US-APWR	2	
FPL	Turkey Point (FL)	Submitted 6/30/09	Westinghouse AP1000	2	

[9] Nuclear Regulatory Commission, New Reactors, http://www.nrc.gov/reactors/new-reactors.html

Announced Applicant	Site	Planned Application	Reactor Type	Units	Status
NRG Energy	South Texas Project	Submitted 9/20/07	GE ABWR	2	EPC contract signed with Toshiba 2/12/09
NuStart	Grand Gulf (MS), Entergy	Submitted 2/27/08	Not specified	1	Licensing suspended Jan. 9, 2009
	Bellefonte (AL), TVA	Submitted 10/30/07	Westinghouse AP1000	2	NuStart announced shift of lead unit to Vogtle 4/30/09
PPL	Bell Bend (PA)	Submitted 10/10/08	Areva EPR	1	
Progress Energy	Harris (NC)	Submitted 2/19/08	Westinghouse AP1000	2	EPC contract signed 1/5/09
	Levy County (FL)	Submitted 7/30/08	Westinghouse AP1000	2	
SCE&G	Summer (SC)	Submitted 3/31/08	Westinghouse AP1000	2	EPC contract signed 5/27/08
Southern	Vogtle (GA)	Submitted 3/31/08	Westinghouse AP1000	2	EPC contract signed 4/8/08; Vogtle to be NuStart lead unit
UniStar (Constellation Energy and EDF)	Calvert Cliffs (MD)	Submitted 7/13/07 (Part 1), 3/13/08 (Part 2)	Areva EPR	1	
	Nine Mile Point (NY)	Submitted 9/30/08	Areva EPR	1	
Total Units				**29**	

Sources: NRC, *Nucleonics Week*, *Nuclear News*, Nuclear Energy Institute, company news releases.

NRC's current schedules indicate that the first COLs could be issued by 2011 or 2012, depending on the time required for hearings and other factors.[10] Issuance of a COL allows construction to begin and also is a prerequisite for federal loan guarantees and "regulatory risk insurance" as described below. If full-scale construction were to begin soon after receipt of the COLs, the first new reactors could begin operating before 2020. Southern Company is projecting that its planned two new reactors at the Vogtle site, currently scheduled to get the first COLs, will begin commercial operation by 2016 and 2017.[11]

How many of the reactors listed above are likely to move toward construction after receiving COLs remains highly uncertain. Major variables include construction costs, the availability of financing, construction capacity, fossil fuel prices, and federal incentives and carbon control policy. Recent projections of U.S. electric generating capacity show a wide variation in the amount of new nuclear generation that could be built by 2030—from none to 100 gigawatts (approximately double current capacity). (See Table 9 of CRS Report R40809, *Climate Change:*

[10] http://www.nrc.gov/reactors/new-reactors/col.html

[11] http://www.southerncompany.com/nuclearenergy/timeline.aspx

Costs and Benefits of the Cap-and-Trade Provisions of H.R. 2454, by Larry Parker and Brent D. Yacobucci.)

Federal Support

The nuclear power industry contends that support from the federal government would be needed for "a major expansion of nuclear energy generation."[12] Significant incentives for building new nuclear power plants were included in the Energy Policy Act of 2005 (EPACT05, P.L. 109-58), signed by President Bush on August 8, 2005. These include production tax credits, loan guarantees, insurance against regulatory delays, and extension of the Price-Anderson Act nuclear liability system (discussed in the "Nuclear Accident Liability" section of this report). Relatively low prices for natural gas—nuclear power's chief competitor—and rising estimated nuclear plant construction costs have decreased the likelihood that new reactors would be built without federal support. As a result, many draft proposals are currently circulating in Congress to strengthen or add to the EPACT incentives, possibly as part of climate change legislation. Nuclear power critics have denounced the federal support programs as a "bailout" of the nuclear industry, contending that federal efforts should focus instead on renewable energy and energy efficiency.[13]

Nuclear Production Tax Credit

EPACT05 provides a 1.8-cents/kilowatt-hour tax credit for up to 6,000 megawatts of new nuclear capacity for the first eight years of operation, up to $125 million annually per 1,000 megawatts.

The Treasury Department published interim guidance for the nuclear production tax credit on May 1, 2006.[14] Under the guidance, the 6,000 megawatts of eligible capacity (enough for about four or five reactors) are to be allocated among reactors that filed license applications by the end of 2008. If more than 6,000 megawatts of nuclear capacity ultimately qualify for the production tax credit, then the credit is to be allocated proportionally among any of the qualifying reactors that begin operating before 2021.

By the end of 2008, license applications had been submitted to NRC for more than 34,000 megawatts of nuclear generating capacity,[15] so if all those reactors were built before 2021 they would receive less than 20% of the maximum tax credit. However, the Energy Information Administration estimates that 8,000 megawatts of new nuclear capacity will ultimately qualify for the credit;[16] in this case the credit amount drops to 1.35 cents per kilowatt-hour once all the qualifying plants are on line. The credit is not adjusted for inflation.

[12] Nuclear Energy Institute, "NEI Unveils Package of Policy Initiatives Needed to Achieve Climate Change Goals," press release, October 26, 2009, http://www.nei.org/newsandevents/newsreleases/nei-unveils-package-of-policy-initiatives-needed-to-achieve-climate-change-goals/.

[13] Nuclear Information and Resource Service, "Senate Appropriators Lard President Obama's Stimulus Package with up to $50 Billion in Nuclear Reactor Pork," press release, January 30, 2009, http://www.nirs.org/press/01-30-2009/1.

[14] Department of the Treasury, Internal Revenue Service, *Internal Revenue Bulletin*, No. 2006-18, "Credit for Production From Advanced Nuclear Facilities," Notice 2006-40, May 1, 2006, p. 855.

[15] Energy Information Administration, *Status of Potential New Commercial Nuclear Reactors in the United States*, February 19, 2009.

[16] For a discussion of the operation of the credit, see EIA, *Annual Energy Outlook 2007*, p. 21. For the forecast of 8,000 MW of nuclear capacity on-line before 2021, see the *Annual Energy Outlook 2008*, p. 70.

The Nuclear Energy Institute (NEI) is urging Congress to remove the 6,000 megawatt capacity limit for the production tax credit, index it for inflation, and extend the deadline for plants to begin operation to the start of 2025. NEI is also proposing that a 30% investment tax credit be available for new nuclear construction as an alternative to the production credit.[17]

Standby Support

Because the nuclear industry has often blamed licensing delays for past nuclear reactor construction cost overruns, EPACT05 authorizes the Secretary of Energy to provide "standby support," or regulatory risk insurance, to help pay the cost of regulatory delays at up to six new commercial nuclear reactors, subject to funding availability. For the first two reactors that begin construction, the DOE payments could cover all the eligible delay-related costs, such as additional interest, up to $500 million each. For the next four reactors, half of the eligible costs could be paid by DOE, with a payment cap of $250 million per reactor. Delays caused by the failure of a reactor owner to comply with laws or regulations would not be covered. Project sponsors will be required to pay the "subsidy cost" of the program, consisting of the estimated present value of likely future government payments.

DOE published a final rule for the "standby support" program August 11, 2006.[18] According to a DOE description of the final rule:

> Events that would be covered by the risk insurance include delays associated with the Nuclear Regulatory Commission's reviews of inspections, tests, analyses and acceptance criteria or other licensing schedule delays as well as certain delays associated with litigation in federal, state or tribal courts. Insurance coverage is not available for normal business risks such as employment strikes and weather delays. Covered losses would include principal and interest on debt and losses resulting from the purchase of replacement power to satisfy contractual obligations.[19]

Under the program's regulations, a project sponsor may enter into a conditional agreement for standby support before NRC issues a combined operating license. The first six conditional agreements to meet all the program requirements, including the issuance of a COL and payment of the estimated subsidy costs, can be converted to standby support contracts. No conditional agreements have yet been reached, according to DOE, primarily because the subsidy cost estimates have not been approved by the Office of Management and Budget.[20]

The Nuclear Energy Institute has called for expanding the Standby Support program to $500 million for all six covered plants, rather than just the first two. In addition, NEI proposed that if a plant begins operating without any delay payments, that plant's Standby Support coverage,

[17] Nuclear Energy Institute, *Legislative Proposal to Help Meet Climate Change Goals by Expanding U.S. Nuclear Energy Production*, Washington, DC, October 28, 2009, p. 4, http://www.nei.org/resourcesandstats/documentlibrary/newplants/policybrief/2009-nuclear-policy-initiative.

[18] Department of Energy, "Standby Support for Certain Nuclear Plant Delays," *Federal Register*, August 11, 2006, p. 46306.

[19] DOE press release, August 4, 2006 http://nuclear.gov/home/08-04-06.html.

[20] Meeting with Rebecca F. Smith-Kevern, Director, DOE Office of Light Water Reactor Deployment, October 7, 2009.

instead of expiring unused, be allowed to "roll over" to the next plant with a conditional agreement.[21]

Loan Guarantees

Title XVII of EPACT05 authorizes federal loan guarantees for up to 80% of construction costs for advanced energy projects that reduce greenhouse gas emissions, including new nuclear power plants. The Title XVII loan guarantees are widely considered crucial by the nuclear industry to obtain financing for new reactors. However, opponents contend that nuclear loan guarantees would provide an unjustifiable subsidy to a mature industry and shift investment away from environmentally preferable energy technologies.[22]

The FY2007 continuing resolution (P.L. 110-5) established an initial cap of $4 billion in loan guarantees under the program. DOE issued final rules for the program October 4, 2007,[23] and finalized the first loan guarantee on September 4, 2009, totaling $535 million for a plant to produce photovoltaic panels.[24]

DOE's proposed loan guarantee rules, published May 16, 2007, had been sharply criticized by the nuclear industry for limiting the guarantees to 90% of a project's debt. The industry contended that EPACT05 allows all of a project's debt to be covered, as long as debt does not exceed 80% of total construction costs. In its explanation of the proposed rules, DOE expressed concern that guaranteeing 100% of a project's debt could reduce lenders' incentive to perform adequate due diligence and therefore increase default risks. In the final rule, however, DOE agreed to guarantee up to 100% of debt, but only for loans issued by the Federal Financing Bank.

Title XVII requires that estimated future government costs resulting from defaults on guaranteed loans be covered up-front by appropriations or by payments from project sponsors. These "subsidy costs" are calculated as the present value of probable future net costs to the government for each loan guarantee. If those calculations are accurate, the subsidy cost payments for all the guaranteed projects together should cover the future costs of the program. However, the Congressional Budget Office has predicted that the up-front subsidy cost payments will prove too low by at least 1% and is scoring bills accordingly.[25] For example, appropriations bills that provide loan guarantee authorizations include an adjustment totaling 1% of the loan guarantee ceiling.

DOE loan guarantees for renewable energy and electricity transmission projects under EPACT05 section 1705, added by the American Recovery and Reinvestment Act of 2009 (P.L. 111-5), do not require payments by project sponsors, because potential losses are covered by advance

[21] Nuclear Energy Institute, *op. cit.*

[22] Thomas B. Cochran and Christopher E. Paine, *Statement on Nuclear Developments Before the Committee on Energy and Natural Resources, United States Senate*, Natural Resources Defense Council, March 18, 2009, http://energy.senate.gov/public/index.cfm?FuseAction=Hearings.Testimony&Hearing_ID=f25ddd10-c1f5-9e2e-528e-c4321cca4c1b&Witness_ID=9f14a78d-58d0-43fb-bf5b-21426d1d888e.

[23] Published October 23, 2007 (72 *Federal Register* 60116).

[24] Department of Energy, "Vice President Biden Announces Finalized $535 Million Loan Guarantee," press release, September 4, 2009, http://www.lgprogram.energy.gov/press/090409.pdf.

[25] Congressional Budget Office, *S. 1321, Energy Savings Act of 2007*, CBO Cost Estimate, Washington, DC, June 11, 2007, pp. 7-9, http://www.cbo.gov/ftpdocs/82xx/doc8206/s1321.pdf.

appropriations in the act. No such appropriations are currently available for nuclear power projects, so it is anticipated that nuclear loan guarantee subsidy costs would be paid by the project sponsors. As a result, the level of the subsidy costs could have a powerful effect on the viability of nuclear power projects, which are currently expected to cost between $5 billion and $10 billion per reactor. For example, a 10% subsidy cost for a $7 billion loan guarantee would require an up-front payment of $700 million.

The amount of loan guarantees to be available for nuclear power has been the subject of considerable congressional debate. Under the Federal Credit Reform Act (FCRA), federal loan guarantees cannot be provided without an authorized level in an appropriations act. The Senate-passed version of omnibus energy legislation in the 110th Congress (H.R. 6) would have explicitly eliminated FCRA's applicability to DOE's planned loan guarantees under EPACT05 (Section 124(b)). That provision would have given DOE essentially unlimited loan guarantee authority for guarantees whose subsidy costs were paid by project sponsors, but it was dropped from the final legislation (P.L. 110-140). Similar language has been included in subsequent legislative proposals, such as energy legislation reported by the Senate Committee on Energy and Natural Resources July 16, 2009 (S. 1462).

The explanatory statement for the FY2008 omnibus funding act (P.L. 110-161) directed DOE to limit the loan guarantees for nuclear power plants to $18.5 billion through FY2009—enough for about two or three large reactors under current cost estimates. An additional $2 billion in loan guarantee authority was provided for uranium enrichment plants, and $18 billion in authority was provided for non-nuclear energy technologies, such as renewable energy.[26]

The FY2009 omnibus funding act increased DOE's total loan guarantee authority to $47 billion, in addition to the previously authorized $4 billion. Of the $47 billion, $18.5 billion continued to be reserved for nuclear power, $18.5 was for energy efficiency and renewables, $6 billion was for coal, $2 billion was for carbon capture and sequestration, and $2 billion was for uranium enrichment. The time limits on the loan guarantee authority were eliminated. The loan guarantee ceilings remain the same for FY2010.

DOE issued a solicitation for up to $20.5 billion in nuclear power and uranium enrichment plant loan guarantees on June 30, 2008.[27] According to the nuclear industry, 10 nuclear power projects are currently seeking $93.2 billion in loan guarantees, and two uranium enrichment projects are asking for $4.8 billion in guarantees, several times the amount available.[28] Several of the proposed projects listed in **Table 1** have been reported to be finalists for the first conditional nuclear loan guarantee commitments, including the South Texas Project, Calvert Cliffs, Summer, and Vogtle.[29] Under the program's regulations, a conditional loan guarantee commitment cannot become a binding loan guarantee agreement until the project receives a COL and all other regulatory requirements are met; as noted above, the first COLs are not expected until late 2011 at the earliest.

[26] *Congressional Record*, December 17, 2007, p. H15585.

[27] http://www.lgprogram.energy.gov/keydocs.html

[28] Marvin S. Fertel, *Statement for the Record to the Committee on Energy and Natural Resources, U.S. Senate*, Nuclear Energy Institute, March 18, 2009, p. 9, http://energy.senate.gov/public/index.cfm?FuseAction=Hearings.Testimony&Hearing_ID=f25ddd10-c1f5-9e2e-528e-c4321cca4c1b&Witness_ID=4de5e2df-53fe-49ba-906e-9b69d3674e41.

[29] Eileen O'Grady, "DOE Drops Luminant Texas from Nuclear Loan Talks," *Reuters*, May 7, 2009.

Global Climate Change

Global climate change that may be caused by carbon dioxide and other greenhouse gas emissions is cited by nuclear power supporters as an important reason to develop a new generation of reactors. Nuclear power plants emit relatively little carbon dioxide, mostly from nuclear fuel production and auxiliary plant equipment. This "green" nuclear power argument has received growing attention in think tanks and academia. As stated by the Massachusetts Institute of Technology in its major study *The Future of Nuclear Power*: "Our position is that the prospect of global climate change from greenhouse gas emissions and the adverse consequences that flow from these emissions is the principal justification for government support of the nuclear energy option."[30]

However, environmental groups have contended that nuclear power's potential greenhouse gas benefits are modest and must be weighed against the technology's safety risks, its potential for nuclear weapons proliferation, and the hazards of radioactive waste.[31] They also contend that energy efficiency and renewable energy would be far more productive investments for reducing greenhouse gas emissions.[32]

Congressional proposals to reduce carbon dioxide emissions, either through taxation or a cap-and-trade system, could significantly increase the cost of generating electricity with fossil fuels and improve the competitive position of nuclear power. Utilities that have applied for nuclear power plant licenses have often cited the possibility of federal greenhouse gas controls as one of the reasons for pursuing new reactors. (For more on federal incentives and the economics of nuclear power and other electricity generation technologies, see CRS Report RL34746, *Power Plants: Characteristics and Costs*, by Stan Mark Kaplan.)

Nuclear Power Research and Development

DOE's nuclear energy research and development program includes advanced reactors, fuel cycle technology and facilities, and infrastructure support. The Obama Administration's initial FY2010 funding request for nuclear energy R&D activities totaled $761.3 million—about $30 million below the comparable FY2009 level. The FY2010 Energy and Water Development Appropriations Act (P.L. 111-85), signed on October 28, 2009, provides $786.6 million.

According to DOE's FY2010 budget justification, the nuclear energy R&D program includes "generation, safety, waste storage and management, and security technologies, to help meet energy and climate goals." 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.

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[30] Interdisciplinary MIT Study, *The Future of Nuclear Power*, Massachusetts Institute of Technology, 2003, p. 79.

[31] Gronlund, Lisbeth, David Lochbaum, and Edwin Lyman, *Nuclear Power in a Warming World*, Union of Concerned Scientists, December 2007.

[32] Travis Madsen, Tony Dutzik, and Bernadette Del Chiaro, et al., *Generating Failure: How Building Nuclear Power Plants Would Set America Back in the Race Against Global Warming*, Environment America Research and Policy Center, November 2009, http://www.environmentamerica.org/uploads/39/62/3962c378b66c4552624d09cbd8ebba02/Generating-Failure—Environment-America—Web.pdf.

Although total funding in the FY2010 nuclear energy request was similar to levels in previous years, the Obama Administration proposed significant priority changes. Funding for the Nuclear Power 2010 Program, which assists the near-term design and licensing of new nuclear power plants, was to be closed out during the fiscal year. The Advanced Fuel Cycle Initiative (AFCI), which had been the primary research component of the Bush Administration's Global Nuclear Energy Partnership (GNEP), has been renamed Fuel Cycle Research and Development and shifted away from the design and construction of nuclear fuel recycling facilities toward an emphasis on longer-term research.

Nuclear Power 2010

Under President Bush, DOE's initial efforts to encourage near-term construction of new commercial reactors—for which there have been no new U.S. orders since 1978—focused on the Nuclear Power 2010 Program. The program provided up to half the costs of licensing lead plant sites and reactors and preparing detailed reactor designs. Nuclear Power 2010 also includes the Standby Support Program, authorized by the Energy Policy Act of 2005 (P.L. 109-58) to pay for regulatory delays that might be experienced by new reactors.

The Obama Administration proposed to cut the Nuclear Power 2010 Program's funding from $177.5 million in FY2009 to $20 million in FY2010 and then terminate the program. Administration of the Standby Support Program was to continue under the Office of Nuclear Energy's program direction account.

DOE's budget justification contended that industry interest in new nuclear power plants has now been demonstrated to the extent that federal funding is no longer needed. The $20 million requested for FY2010 was to provide the final assistance to an industry consortium called NuStart for licensing a new reactor at the Vogtle plant in Georgia. No further funding was to be provided for a second industry consortium led by Dominion Resources, or for the design of General Electric-Hitachi's ESBWR reactor or the Westinghouse AP-1000 reactor. "By FY 2010 sufficient momentum will have been created by the cost-shared programs that the vendors (GEH and Westinghouse) and other partners will have adequate incentive to complete any additional work through private funding," according to the DOE justification.

The House approved a funding level of $71.0 million for the program, to "complete the Department's commitment to this effort." The Senate voted to provide $120 million for the program, with no mention of program termination. The conference agreement provides $105.0 million "as the final installment" for the Nuclear Power 2010 program.

Generation IV

Advanced commercial reactor technologies that are not yet close to deployment are the focus of Generation IV Nuclear Energy Systems, for which $191.0 million was requested for FY2010, $11 million above the FY2009 appropriation. The budget request would have cut $24 million from activities previously conducted by the program, a reduction that "reflects the emphasis shifting from near-term R&D activities to those R&D activities aimed at long-term technology advances," according to the DOE justification. The request included $35 million to establish the Energy Innovation Hub for Modeling and Simulation, which would focus on computer assistance for the development, implementation, and management of nuclear power and radioactive waste. The House provided no funding for the Modeling and Simulation Hub, while boosting total

Generation IV funding to $272.4 million. The Senate approved a funding level of $143 million, including the Modeling and Simulation Hub. The conference agreement provides $220.1 million, including $22.0 million for the Modeling and Simulation Hub.

The focus in the budget request on "long-term technology advances" differed sharply from the program's previous emphasis on developing the Next Generation Nuclear Plant (NGNP). Most of the FY2009 appropriation—$169.0 million—was for NGNP research and development. NGNP is currently planned to use Very High Temperature Reactor (VHTR) technology, which features helium as a coolant and coated-particle fuel that can withstand temperatures up to 1,600 degrees Celsius. Phase I research on the NGNP was to continue until 2011, when a decision was to be made on moving to the Phase II design and construction stage, according to the FY2009 DOE budget justification. In its recommendation on the FY2009 budget, the House Appropriations Committee had provided additional funding "to accelerate work" on NGNP.

DOE's proposed FY2010 nuclear research program did not mention NGNP, although it included several research activities related to the development of VHTR technology, including fuel testing, graphite experiments, and development of VHTR simulation software. Fundamental research on other advanced reactor concepts, such as sodium-cooled fast reactors and molten salt reactors, were also to continue. For FY2010, the House Appropriations Committee report noted that NGNP had been one of its priorities and specified that at least $245.0 million of the Generation IV funding be devoted to the project. The Senate Appropriations Committee's FY2010 report did not specifically mention NGNP, but it called for DOE to select two advanced reactor technologies as the focus of future research and potential deployment.

The conference agreement provides $169.0 million for NGNP and directs DOE within 90 days to prepare a detailed plan for moving forward with the NGNP project. The conference agreement also provides $17.8 million for other Generation IV reactor concepts and $10.0 million for research on extending the lives of existing light water reactors. No funding is provided for gas centrifuge enrichment technology.

The Energy Policy Act of 2005 authorized $1.25 billion through FY2015 for NGNP development and construction (Title VI, Subtitle C). The authorization requires that NGNP be based on research conducted by the Generation IV program and be capable of producing electricity, hydrogen, or both. The act's target date for operation of the demonstration reactor is September 30, 2021. The FY2010 budget request anticipated that Generation IV reactors "could be available in the 2030 timeframe."

Fuel Cycle Research and Development

Formerly called the Advanced Fuel Cycle Initiative, DOE's Fuel Cycle Research and Development program is to be redirected from the development of engineering-scale and prototype reprocessing facilities toward smaller-scale "long-term, science-based research." The FY2010 budget request for the program was $192.0 million, nearly $50 million above the FY2009 level, although $35 million of that amount was to go toward establishing an Energy Innovation Hub for Extreme Materials. The House provided no funding for the Extreme Materials Hub and an overall reduction in the request to $129.2 million, citing "the lack of specificity in terms of the direction of the research in this area." The Senate provided $145.0 million, the same as FY2009, and no funding for the Extreme Materials Hub. The conference agreement provides $136.0 million, with nothing for the Extreme Materials Hub.

According to the DOE budget justification, Fuel Cycle R&D will continue previous research on technology 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 reuse in a nuclear reactor or for transmutation in a particle accelerator. DOE plans to broaden the program to include waste storage technologies, security systems, and alternative disposal options such as salt formations and deep boreholes. R&D will also focus on needs identified by a planned DOE nuclear waste strategy panel, according to the justification.

In previous years, AFCI had been the primary technology component of the Bush Administration's GNEP program, including R&D on reprocessing technology and fast reactors that could use reprocessed plutonium. Funding for GNEP was eliminated by Congress in FY2009, and GNEP was not mentioned in the FY2010 budget request, although, as noted above, much of the related R&D work is to continue at a smaller scale.

The Energy Innovation Hub for Extreme Materials was intended to support fundamental research on advanced materials for use in high-radiation and high-temperature environments. Such materials could improve the performance of nuclear waste packages, allow advances in nuclear reactor designs, and improve the safety and operation of existing commercial reactors, according to the budget justification.

(For more information about nuclear reprocessing, see CRS Report RL34579, *Advanced Nuclear Power and Fuel Cycle Technologies: Outlook and Policy Options*, by Mark Holt.)

Small Modular Reactors

Rising cost estimates for large conventional nuclear power plants—widely projected to be $6 billion or more—have contributed to growing interest in proposals for smaller, modular reactors. Ranging from about 40 to 350 megawatts of electrical capacity, such reactors would be only a fraction of the size of current commercial reactors. Several modular reactors would be installed together to make up a power block with a single control room, under most concepts.

Modular reactor concepts would use a variety of technologies, including high-temperature gas technology in the NGNP program and the light water (LWR) technology used by today's commercial reactors. According to media reports, DOE plans to request funding for FY2012 to provide licensing and engineering assistance to small reactor designs, in a program that would be similar to Nuclear Power 2010. Priority would be given to designs closest to commercialization, which DOE anticipates to be the small LWR concepts.[33] Legislation to authorize such a program (S. 2812) was introduced by Senator Bingaman November 20, 2009.

The Senate Appropriations Committee included instructions in its report on the FY2010 Energy and Water Appropriations Act that NRC use carryover funds to "support license application reviews of any new reactor designs, including modular reactors." NRC held a two-day workshop on small modular reactor licensing in early October 2009.

Small modular reactors would go against the overall trend in nuclear power technology toward ever-larger reactors intended to spread construction costs over a greater output of electricity.

[33] Randy Woods and Steven Dolley, "DOE to Seek Funds in FY-11 for Small Modular Reactors," *Nucleonics Week*, October 1, 2009.

Proponents of small reactors contend that they would be economically viable despite their far lower electrical output because modules could be assembled in factories and shipped to plant sites, and because their smaller size would allow for simpler safety systems. In addition, although modular plants might have similar or higher costs per kilowatt-hour than large conventional reactors, their ability to be constructed in smaller increments could reduce the financial commitment and risk to electric utilities.

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 one serious case, it was discovered in March 2002 that leaking boric acid had eaten a large cavity in the top of the reactor vessel in Ohio's Davis-Besse nuclear plant. The corrosion left only the vessel's quarter-inch-thick stainless steel inner liner to prevent a potentially catastrophic loss of reactor cooling water. Davis-Besse remained closed for repairs and other safety improvements until NRC allowed the reactor to restart in March 2004.

NRC's oversight of the nuclear industry is an ongoing issue; nuclear utilities often complain that they are subject to overly rigorous and inflexible regulation, but nuclear critics charge that NRC frequently relaxes safety standards when compliance may prove difficult or costly to the industry.

Domestic Reactor Safety

In terms of public health consequences, the safety record of the U.S. nuclear power industry in comparison with other major commercial energy technologies has been excellent. During approximately 3,000 reactor-years of operation in the United States,[34] the only incident at a commercial nuclear 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. 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 noted that some potential health effects "cannot be definitively excluded."[35]

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 unacceptably 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

[34] *Nuclear Engineering International*, "Country Averages to the End of December 2008," April 2009, p. 38.

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

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.

NRC's safety regulations are designed to keep the probability of accidental core damage (fuel melting) below one in 10,000 per year for each reactor. The regulations also are intended to ensure that reactor containments would be successful at least 90% of the time in preventing major radioactive releases during a core-damage accident. Therefore, the probability of a major release at any given reactor is intended to be below one in 100,000 per year.[36] (For the current U.S. fleet of about 100 reactors, that rate would yield an average of one core-damage accident every 100 years and a major release every 1,000 years.) On the other hand, some groups challenge the complex calculations that go into predicting such accident frequencies, contending that accidents with serious public health consequences may be more frequent.[37]

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 2006 report by the Chernobyl Forum organized by the International Atomic Energy Agency, the primary observable health consequence of the accident was a dramatic increase in childhood thyroid cancer. The Chernobyl Forum estimated that about 4,000 cases of thyroid cancer have occurred in children who after the accident drank milk contaminated with high levels of radioactive iodine, which concentrates in the thyroid. Although the Chernobyl Forum found only 15 deaths from those thyroid cancers, it estimated that about 4,000 other cancer deaths may have occurred among the 600,000 people with the highest radiation exposures, plus an estimated 1% increase in cancer deaths among persons with less exposure. The report estimated that about 77,000 square miles were significantly contaminated by radioactive cesium.[38] Greenpeace issued a report in 2006 estimating that 200,000 deaths in Belarus, Russia, and Ukraine resulted from the Chernobyl accident between 1990 and 2004.[39]

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.

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[36] U.S. NRC, Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," July 1998.

[37] Public Citizen Energy Program, "The Myth of Nuclear Safety" http://www.citizen.org/cmep/energy_enviro_nuclear/nuclear_power_plants/reactor_safety/articles.cfm?ID=4454

[38] The Chernobyl Forum: 2003-2005, *Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts,* International Atomic Energy Agency, April 2006.

[39] Greenpeace. *The Chernobyl Catastrophe: Consequences on Human Health,* April 2006, p. 10.

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 license 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 of 1992 provided 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 they met all construction requirements—called "inspections, tests, analyses, and acceptance criteria," or ITAAC. NRC would hold preoperational hearings on the adequacy of plant construction only in specified circumstances.

DOE's Nuclear Power 2010 initiative (discussed above) has been paying up to half the cost of combined construction and operating licenses for two advanced reactors to demonstrate the process. However, the new licensing process cannot be fully tested until construction of new reactors is completed. At that point, it could be seen whether completed plants will be able to operate without delays or whether adjudicable disputes over construction adequacy may arise. As discussed above, Section 638 of the Energy Policy Act of 2005 authorizes federal payments to the owner of a completed reactor whose operation is delayed by regulatory action. The nuclear industry is asking Congress to require NRC to use informal procedures in determining whether ITAAC have been met, eliminate mandatory hearings for COLs on uncontested issues, and make other changes in the licensing process.[40]

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 reorganized and overhauled many of its procedures. The Commission has moved toward "risk-informed regulation," in which safety enforcement is guided by the relative risks identified by detailed individual plant studies. NRC's risk-informed reactor oversight system, inaugurated April 2, 2000, relies on a series of performance indicators to determine the level of scrutiny that each reactor should receive.[41]

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[40] Nuclear Energy Institute, *Legislative Proposal to Help Meet Climate Change Goals by Expanding U.S. Nuclear Energy Production*, Washington, DC, October 28, 2009, p. 5, http://www.nei.org/resourcesandstats/documentlibrary/newplants/policybrief/2009-nuclear-policy-initiative.

[41] For more information about the NRC reactor oversight process, see http://www.nrc.gov/NRR/OVERSIGHT/ (continued...)

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 against access to vital reactor areas and are required to maintain a trained security force to protect them.

A key element in protecting nuclear plants is the requirement that simulated terrorist attacks, 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 is specified in the form of a "design basis threat" (DBT).

EPACT05 required NRC to revise the DBT based on an assessment of terrorist threats, the potential for multiple coordinated attacks, possible suicide attacks, and other criteria. NRC approved the DBT revision based on those requirements on January 29, 2007. The revised DBT does not require nuclear power plants to defend against deliberate aircraft attacks. NRC contended that nuclear facilities were already required to mitigate the effects of large fires and explosions, no matter what the cause, and that active protection against airborne threats was being addressed by U.S. military and other agencies.[42] After much consideration, NRC voted February 17, 2009, to require all new nuclear power plants to incorporate design features that would ensure that, in the event of a crash by a large commercial aircraft, the reactor core would remain cooled or the reactor containment would remain intact, and radioactive releases would not occur from spent fuel storage pools.[43]

NRC rejected proposals that existing reactors also be required to protect against aircraft crashes, such as by adding large external steel barriers. However, NRC did impose some additional requirements related to aircraft crashes on all reactors, both new and existing, after the 9/11 terrorist attacks of 2001. In 2002, as noted above, NRC ordered all nuclear power plants to develop strategies to mitigate the effects of large fires and explosions that could result from aircraft crashes or other causes. An NRC regulation on fire mitigation strategies, along with requirements that reactors establish procedures for responding to specific aircraft threats, was approved December 17, 2008.[44]

Other ongoing nuclear plant security issues include the vulnerability of spent fuel pools, which hold highly radioactive nuclear fuel after its removal from the reactor, standards for nuclear plant security personnel, and nuclear plant emergency planning. NRC's December 2008 security regulations addressed some of those concerns and included a number of other security enhancements.

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[42] NRC Office of Public Affairs, *NRC Approves Final Rule Amending Security Requirements*, News Release No. 07-012, January 29, 2007.

[43] Nuclear Regulatory Commission, *Final Rule—Consideration of Aircraft Impacts for New Nuclear Power Reactors, Commission Voting Record*, SECY-08-0152, February 17, 2009.

[44] Nuclear Regulatory Commission, "NRC Approves Final Rule Expanding Security Requirements for Nuclear Power Plants," press release, December 17, 2008, http://www.nrc.gov/reading-rm/doc-collections/news/2008/08-227.html.

EPACT05 required NRC to conduct force-on-force security exercises at nuclear power plants every three years (which was NRC's previous policy), authorized firearms use by nuclear security personnel (preempting some state restrictions), established federal security coordinators, and required fingerprinting of nuclear facility workers.

(For background on security issues, see CRS Report RL34331, *Nuclear Power Plant Security and Vulnerabilities*, by Mark Holt and Anthony Andrews.)

Decommissioning

When nuclear power plants reach the end of 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.

The first full-sized U.S. commercial reactors to be decommissioned were the Trojan plant in Oregon, whose decommissioning completion received NRC approval on May 23, 2005, and the Maine Yankee plant, for which NRC approved most of the site cleanup on October 3, 2005. The Trojan decommissioning cost $429 million, according to reactor owner Portland General Electric, and the Maine Yankee decommissioning cost about $500 million.[45] Decommissioning of the Connecticut Yankee plant cost $790 million and was approved by NRC on November 26, 2007.[46] NRC approved the cleanup of the decommissioned Rancho Seco reactor site in California on October 7, 2009.[47] The decommissioning of Rancho Seco was estimated to cost $500 million, excluding future demolition of the cooling towers and other remaining plant structures.[48] Spent nuclear fuel remains stored in dry casks at the decommissioned plant sites.

The tax treatment of decommissioning funds has been a continuing issue. EPACT05 provided favorable tax treatment to nuclear decommissioning funds, subject to certain restrictions.

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). EPACT05 extended the availability of Price-Anderson coverage for new reactors and new DOE nuclear contracts through the end of 2025. (Existing reactors and contracts were already 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 with at least 100 megawatts of electric generating capacity must carry the maximum liability insurance reasonably available, currently $300 million. Any

[45] Sharp, David, "NRC Signs Off on Maine Yankee's Decommissioning," *Associated Press*, October 3, 2005.

[46] E-mail communication from Bob Capstick, Connecticut Yankee Atomic Power Company, August 28, 2008.

[47] Nuclear Regulatory Commission, "NRC Releases Rancho Seco Nuclear Plant for Unconditional Use," press release, October 7, 2009, http://www.nrc.gov/reading-rm/doc-collections/news/2009/09-165.html.

[48] "20 Years Later, Rancho Seco Ready for Final Shutdown," *Sacramento County Herald*, June 9, 2009, http://m.news10.net/news.jsp?key=190656.

damages exceeding that amount are to be assessed equally against all 100-megawatt-and-above power reactors, up to $111.9 million per reactor. Those assessments—called "retrospective premiums"—would be paid at an annual rate of no more than $17.5 million per reactor, to limit the potential financial burden on reactor owners following a major accident. According to NRC, all 104 commercial reactors are currently covered by the Price-Anderson retrospective premium requirement.[49]

For each nuclear incident, the Price-Anderson liability system currently would provide up to $12.5 billion in public compensation. That total includes the $300 million in insurance coverage carried by the reactor that suffered the incident, plus the $111.9 million in retrospective premiums from each of the 104 currently covered reactors, totaling $11.9 billion. On top of those payments, a 5% surcharge may also be imposed, raising the total per-reactor retrospective premium to $117.5 million and the total available compensation to about $12.5 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. Payment of any damages above that liability limit would require congressional approval under special procedures in the act.

EPACT05 increased the limit on per-reactor annual payments to $15 million from the previous $10 million, and required the annual limit to be adjusted for inflation every five years. As under previous law, the total retrospective premium limit is adjusted every five years as well. Both the annual and total limits were most recently adjusted October 29, 2008.[50] 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 $111.9 million, rather than $671.4 million (excluding the 5% surcharge).

The Price-Anderson Act also covers contractors who operate hazardous DOE nuclear facilities. EPACT05 set the liability limit on DOE contractors at $10 billion per accident, to be adjusted for inflation every five years. The first adjustment under EPACT, raising the liability limit to $11.961 billion, took effect October 14, 2009.[51] The liability limit for DOE contractors previously had been the same as for commercial reactors, excluding the 5% surcharge, except when the limit for commercial reactors dropped because of a decline in the number of covered reactors. Price-Anderson authorizes DOE to indemnify its contractors for the entire amount of their liability, 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.

EPACT05 limited the civil penalties against a nonprofit contractor to the amount of management fees paid under that contract. Previously, Atomic Energy Act §234A specifically exempted seven nonprofit DOE contractors and their subcontractors from civil penalties and authorized DOE to

[49] Reactors smaller than 100 megawatts must purchase an amount of liability coverage determined by NRC but are not subject to retrospective premiums. Total liability for those reactors is limited to $560 million, with the federal government indemnifying reactor operators for the difference between that amount and their liability coverage (Atomic Energy Act sec. 170 b. and c.).

[50] Nuclear Regulatory Commission, "Inflation Adjustment to the Price-Anderson Act Financial Protection Regulations," 73 *Federal Register* 56451, September 29, 2008.

[51] Department of Energy, "Adjusted Indemnification Amount," 74 *Federal Register* 52793, October 14, 2009.

automatically remit any civil penalties imposed on nonprofit educational institutions serving as DOE contractors. EPACT05 eliminated the civil penalty exemption for future contracts by the seven listed nonprofit contractors and DOE's authority to automatically remit penalties on nonprofit educational institutions.

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. Extension of the act was widely considered a prerequisite for new nuclear reactor construction in the United States. Opponents contend that Price-Anderson inappropriately subsidizes the nuclear power industry by reducing its insurance costs and protecting it from some of the financial consequences of the most severe conceivable accidents.

The United States is supporting the establishment of an international liability system that, among other purposes, would cover U.S. nuclear equipment suppliers conducting foreign business. The Convention on Supplementary Compensation for Nuclear Damage (CSC) will not enter into force until at least five countries with a specified level of installed nuclear capacity have enacted implementing legislation. Such implementing language was included in the Energy Independence and Security Act of 2007 (P.L. 110-140, section 934), signed by President Bush December 19, 2007. Supporters of the Convention hope that more countries will join now that the United States has acted. Aside from the United States, three countries have submitted the necessary instruments of ratification, but the remaining nine countries that so far have signed the convention do not have the required nuclear capacity for it to take effect. Ratification by a large nuclear energy producer such as Japan would allow the treaty to take effect, as would ratification by two significant but smaller producers such as South Korea, Canada, Russia, or Ukraine.

Under the U.S. implementing legislation, the CSC would not change the liability and payment levels already established by the Price-Anderson Act. Each party to the convention would be required to establish a nuclear damage compensation system within its borders analogous to Price-Anderson. For any damages not covered by those national compensation systems, the convention would establish a supplemental tier of damage compensation to be paid by all parties. P.L. 110-140 requires the U.S. contribution to the supplemental tier to be paid by suppliers of nuclear equipment and services, under a formula to be developed by DOE. Supporters of the convention contend that it will help U.S. exporters of nuclear technology by establishing a predictable international liability system. For example, U.S. reactor sales to the growing economies of China and India would be facilitated by those countries' participation in the CSC liability regime.

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 metric tons of highly radioactive spent nuclear fuel, for a nationwide total of about 2,000 metric tons per year. U.S. reactors also generate about 40,000 cubic meters of low-level

radioactive waste per year, including contaminated components and materials resulting from reactor decommissioning.[52]

The federal government is responsible for permanent disposal of commercial spent fuel (paid for with a fee on nuclear power production) and federally generated radioactive waste, whereas states have the authority to develop disposal facilities for most commercial low-level waste. Under the Nuclear Waste Policy Act (42 U.S.C. 10101, et seq.), 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 program is run by DOE's Office of Civilian Radioactive Waste Management (OCRWM). As amended in 1987, NWPA designated Yucca Mountain in Nevada as the only candidate site for the national repository. The act required DOE to begin taking waste from nuclear plant sites by 1998—a deadline that even under the most optimistic scenarios will be missed by more than 20 years.

The Obama Administration has decided to "terminate the Yucca Mountain program while developing nuclear waste disposal alternatives," according to the DOE FY2010 budget justification. Alternatives to Yucca Mountain are to be evaluated by a "blue ribbon" panel of experts convened by the Administration. At the same time, according to the justification, the NRC licensing process for the Yucca Mountain repository is to continue, "consistent with the provisions of the Nuclear Waste Policy Act." However, draft proposals for the FY2011 budget request indicate that DOE will seek only enough funding to terminate all program activities and that repository licensing will end in December 2009.[53]

The FY2010 OCRWM budget request of $198.6 million sought only enough funding to continue the Yucca Mountain licensing process and to evaluate alternative policies, according to DOE. The request was about $90 million below the FY2009 funding level, which was nearly $100 million below the FY2008 level. More than 2,000 waste program contract employees were to be terminated during FY2009, according to the budget justification. Most of the program's remaining work is to be taken over by federal staff.

All work related solely to preparing for construction and operation of the Yucca Mountain repository is being halted, according to the DOE budget justification. Such activities include development of repository infrastructure, waste transportation preparations, and system engineering and analysis.

The House agreed with the Administration's plans to provide funding solely for Yucca Mountain licensing activities and for a blue-ribbon panel to review waste management options. The House approved the Administration budget request, including $5 million for the blue-ribbon review. However, the House-passed bill specified that the review must include Yucca Mountain as one of the alternatives, despite the Administration's contention that the site should no longer be considered. According to the House Appropriations Committee report, "It might well be the case that an alternative to Yucca Mountain better meets the requirements of the future strategy, but the review does not have scientific integrity without considering Yucca Mountain." The House panel

[52] DOE, Manifest Information Management System http://mims.apps.em.doe.gov. Average annual utility disposal from 2002 through 2007.

[53] Letter from Joe Barton, Ranking Member, House Committee on Energy and Commerce, and Greg Walden, Ranking Member, Subcommittee on Oversight and Investigations, to Steven Chu, Secretary of Energy, November 18, 2009, http://republicans.energycommerce.house.gov/Media/file/News/111809_Letter_to_Chu_Yucca.pdf.

also recommended that at least $70 million of the program's funding be devoted to maintaining expertise by the Yucca Mountain Project management contractor to support the licensing effort, rather than relying entirely on federal staff. The Senate also recommended approval of the Administration request, but without any restrictions on the blue-ribbon panel.

Funding for the nuclear waste program is provided under two appropriations accounts. The Administration's FY2010 request is divided evenly between an appropriation from the Nuclear Waste Fund, which holds fees paid by nuclear utilities, and the Defense Nuclear Waste Disposal account, which pays for disposal of high-level waste from the nuclear weapons program. The Senate Appropriations Committee report called for the Secretary of Energy to suspend fee collections, "given the Administration's decision to terminate the Yucca Mountain repository program while developing disposal alternatives."

The conference agreement provides the reduced funding requested by the Administration and includes bill language that states, "$5,000,000 shall be provided to create a Blue Ribbon Commission to consider all alternatives for nuclear waste disposal." That is the same language that appeared in the House-passed bill, along with House Appropriations Committee instructions that the Blue Ribbon panel include Yucca Mountain as a disposal option. However, the Conference Committee Joint Explanatory Statement states that "all guidance provided by the House and Senate reports is superseded by the conference agreement."

Additional funding from the Nuclear Waste Fund for the Yucca Mountain licensing process was included in the NRC budget request. The House provided the full $56 million requested, while the Senate voted to cut the request to $29 million. The conference agreement includes the Senate reduction.

The Yucca Mountain project faces regulatory uncertainty, in addition to the Obama Administration's policy review. A ruling on July 9, 2004, by the U.S. Court of Appeals for the District of Columbia Circuit overturned a key aspect of the Environmental Protection Agency's (EPA's) regulations for the planned repository.[54] The three-judge panel ruled that EPA's 10,000-year compliance period was too short, but it rejected several other challenges to the rules. EPA published new standards on October 15, 2008, that would allow radiation exposure from the repository to increase after 10,000 years.[55] The State of Nevada has filed a federal Appeals Court challenge to the EPA standards. (For more information on the EPA standards, see CRS Report RL34698, *EPA's Final Health and Safety Standard for Yucca Mountain*, by Bonnie C. Gitlin.)

NWPA required DOE to begin taking waste from nuclear plant sites by January 31, 1998. Nuclear utilities, upset over DOE's failure to meet that deadline, have won two federal court decisions upholding the department's obligation to meet the deadline and to compensate utilities for any resulting damages. Utilities have also won several cases in the U.S. Court of Federal Claims. DOE estimates that liability payments would eventually total $11 billion if DOE were to begin removing waste from reactor sites by 2020, the previous target for opening Yucca Mountain.[56] (For more information, see CRS Report R40202, *Nuclear Waste Disposal: Alternatives to Yucca*

[54] *Nuclear Energy Institute v. Environmental Protection Agency*, U.S. Court of Appeals for the District of Columbia Circuit, no. 01-1258, July 9, 2004.

[55] Environmental Protection Agency, "Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada," 73 *Federal Register* 61256, October 15, 2008.

[56] Statement of Edward F. Sproat III, Director of the Office of Civilian Radioactive Waste Management, Before the House Budget Committee, October 4, 2007.

Mountain, by Mark Holt, and CRS Report RL33461, *Civilian Nuclear Waste Disposal*, by Mark Holt.)

Nuclear Weapons Proliferation

Renewed interest in nuclear power throughout the world has led to increased concern about nuclear weapons proliferation, because technology for making nuclear fuel can also be used to produce nuclear weapons material. Of particular concern are uranium enrichment, a process to separate and concentrate the fissile isotope uranium-235, and nuclear spent fuel reprocessing, which can produce weapons-useable plutonium.

The International Atomic Energy Agency (IAEA) conducts a safeguards program that is intended to prevent civilian nuclear fuel facilities from being used for weapons purposes, but not all potential weapons proliferators belong to the system, and there are ongoing questions about its effectiveness. Several proposals have been developed to guarantee nations without fuel cycle facilities a supply of nuclear fuel in exchange for commitments to forgo enrichment and reprocessing, which was one of the original goals of the Bush Administration's GNEP program (discussed above under "Nuclear Power Research and Development").

Several situations have arisen throughout the world in which ostensibly commercial uranium enrichment and reprocessing technologies have been subverted for military purposes. In 2003 and 2004, it became evident that Pakistani nuclear scientist A.Q. Khan had sold sensitive technology and equipment related to uranium enrichment to states such as Libya, Iran, and North Korea. Although Pakistan's leaders maintain they did not acquiesce in or abet Khan's activities, Pakistan remains outside the Nuclear Nonproliferation Treaty (NPT) and the Nuclear Suppliers Group (NSG). Iran has been a direct recipient of Pakistani enrichment technology.

IAEA's Board of Governors found in 2005 that Iran's breach of its safeguards obligations constituted noncompliance with its safeguards agreement, and referred the case to the U.N. Security Council in February 2006. Despite repeated calls by the U.N. Security Council for Iran to halt enrichment and reprocessing-related activities, and imposition of sanctions, Iran continues to develop enrichment capability at Natanz and at a site near Qom disclosed in September 2009. Iran insists on its inalienable right to develop the peaceful uses of nuclear energy, pursuant to Article IV of the NPT. Interpretations of this right have varied over time. Former IAEA Director General Mohamed ElBaradei did not dispute this inalienable right and, by and large, neither have U.S. government officials. However, the case of Iran raises perhaps the most critical question in this decade for strengthening the nuclear nonproliferation regime: How can access to sensitive fuel cycle activities (which could be used to produce fissile material for weapons) be circumscribed without further alienating non-nuclear weapon states in the NPT?

Leaders of the international nuclear nonproliferation regime have suggested ways of reining in the diffusion of such inherently dual-use technology, primarily through the creation of incentives not to enrich uranium or reprocess spent fuel. The international community is in the process of evaluating those proposals and may decide upon a mix of approaches. At the same time, there is debate on how to improve the IAEA safeguards system and its means of detecting diversion of nuclear material to a weapons program in the face of expanded nuclear power facilities worldwide.

(For more information, see CRS Report RL34234, *Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power*, coordinated by Mary Beth Nikitin.)

Federal Funding for Nuclear Energy Programs

The following tables summarize current funding for DOE nuclear energy 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 DOE and NRC. FY2009 funding for energy and water programs was included in the Omnibus Appropriations Act for FY2009 (P.L. 111-8), signed March 11, 2009. Detailed funding tables for the act are provided by the Committee Print of the House Committee on Appropriations on H.R. 1105. FY2010 funding is included in the Energy and Water Development and Related Agencies Appropriations Act, 2010 (P.L. 111-85, H.Rept. 111-278), signed October 28, 2009.

Table 2. Funding for the Nuclear Regulatory Commission

(budget authority in millions of current dollars)

	FY2009 Approp.	FY2010 Request	FY2010 House	FY2020 Senate	FY2010 Approp.
Nuclear Regulatory Commission					
Reactor Safety	788.3	799.8	—a	—a	—a
Nuclear Materials and Waste	197.3	205.2	—a	—a	—a
Yucca Mountain Licensing	49.0	56.0	56.0	29.0	29.0
Inspector General	10.9	10.1	10.1	10.9	10.9
Total NRC budget authority	1,045.5	1,071.1	1,071.1	1,071.9	1,066.9
—Offsetting fees	-870.6	887.2	-887.2	-912.2	-912.2
Net appropriation	**174.9**	**183.9**	**183.9**	**159.7**	**154.7**

a. Subcategories not specified.

Table 3. DOE Funding for Nuclear Activities

(budget authority in millions of current dollars)

	FY2009 Approp.	FY2010 Request	FY2010 House	FY2010 Senate	FY2010 Approp.
Nuclear Energy (selected programs)					
Integrated University Program	5.0	0	0	5.0	5.0
Nuclear Power 2010	177.5	20.0	71.0	120.0	105.0
Generation IV Nuclear Systems	180.0	206.0	272.4	143.0	220.1
Nuclear Hydrogen Initiative	7.5	0	0	0	0
Fuel Cycle R&D	145.0	192.0	129.2	145.0	136.0
Radiological Facilities Management	66.1	77.0	67.0	62.0	72.0

	FY2009 Approp.	FY2010 Request	FY2010 House	FY2010 Senate	FY2010 Approp.
Idaho National Laboratory Infrastructure	218.8	286.8	277.4	356.7	173.0
Program Direction	73.0	77.9	77.9	73.0	73.0
Total, Nuclear Energy[a]	792.0	776.6	812.0	761.3	786.6
Civilian Nuclear Waste Disposal[b]	288.4	196.8	196.8	196.8	196.8

a. Excludes funding provided under other accounts.

b. Funded by a 1-mill-per-kilowatt-hour fee on nuclear power, plus appropriations for defense waste disposal and homeland security.

Legislation in the 111th Congress

H.R. 513 (Forbes)

New Manhattan Project for Energy Independence. Establishes program to develop new energy-related technologies, including treatment of nuclear waste. Introduced January 14, 2009; referred to Committee on Science and Technology.

H.R. 1698 (Van Hollen)

Establishes a Green Bank to finance qualified clean energy projects. Nuclear power projects could receive financing only after exhausting all other existing federal financial support. Introduced March 24, 2009; referred to Committees on Ways and Means and Energy and Commerce.

H.R. 1812 (Bachmann)

Promoting New American Energy Act of 2009. Provides tax benefits for investments in nuclear power plants and other energy investments. Introduced March 31, 2009; referred to Committee on Ways and Means.

H.R. 1936 (Lowey)

Nuclear Power Licensing Reform Act of 2009. Expands requirements for nuclear plant evacuation plans from a 10-mile radius to a 50-mile radius and makes reactor license renewals subject to the same criteria as a new plant. Introduced April 2, 2009; referred to Committee on Energy and Commerce.

H.R. 1937 (Lowey)

Requires NRC to distribute safety-related fines imposed on a nuclear plant to surrounding counties to help pay for emergency planning. Introduced April 2, 2009; referred to Committee on Energy and Commerce.

H.R. 2454 (Waxman)

American Clean Energy and Security Act. Modifies DOE loan guarantee program and establishes Clean Energy Deployment Administration to administer DOE assistance, including loan guarantees, for nuclear energy and other energy technologies. Establishes cap-and-trade program for carbon dioxide emissions. Introduced May 15, 2009, referred to multiple committees. Reported by Committee on Energy and Commerce June 5, 2009 (H.Rept. 111-137, part I). Passed by House June 26, 2009, by vote of 219-212.

H.R. 2768 (Wamp)

Declares that any reference to clean energy in federal law shall be considered to include nuclear energy. Introduced June 9, 2009; referred to Committee on Energy and Commerce.

H.R. 2828 (Bishop)

American Energy Innovation Act. Amends EPACT Title XVII loan guarantee provisions, modifies DOE standby support program for new reactors, reauthorizes the Nuclear Power 2010 program, establishes a tax credit for investments in manufacturing capacity for nuclear plant components, allows the Nuclear Waste Fund to be used for spent fuel reprocessing, modifies reactor licensing requirements, establishes an investment tax credit for nuclear power plants, authorizes temporary spent fuel storage agreements, requires DOE to offer to settle lawsuits for nuclear waste disposal delays, prohibits NRC from considering nuclear waste storage when licensing new nuclear facilities, and prohibits new waste facilities authorized under the act from being located in Nevada. Introduced June 11, 2009; referred to multiple committees.

H.R. 2846 (Boehner)

American Energy Act. Requires expedited procedures for nuclear plant licensing, establishes goal of licensing 100 new reactors by 2030, establishes uranium reserve, requires continued development of the Yucca Mountain repository unless it is found scientifically unsuitable, removes the statutory limit on Yucca Mountain disposal capacity, allows the Nuclear Waste Fund to be used for reprocessing, requires NRC to determine that sufficient waste disposal capacity will be available for proposed new reactors, establishes a National Nuclear Energy Council to advise the Secretary of Energy, and provides investment tax credit for nuclear power plants. Introduced June 12, 2009; referred to multiple committees.

H.R. 3009 (Ross)

American-Made Energy Act of 2009. Establishes American-Made Energy Trust Fund and includes nuclear power among technologies eligible for expenditures from the fund. Introduced June 23, 2009; referred to Committee on Energy and Commerce.

H.R. 3183 (Pastor)

Energy and Water Development Appropriations Act for FY2010. Includes funding for DOE nuclear energy programs. Introduced July 13, 2009; signed into law October 28, 2009 (see *CRS FY2010 Status Table of Appropriations*, http://www.crs.gov/Pages/appover.aspx).

H.R. 3385 (Barton)

Authorizes DOE to use the Nuclear Waste Fund to pay for grants or long-term contracts for spent nuclear fuel recycling or reprocessing and places the Waste Fund off-budget. Introduced July 29, 2009; referred to committees on Energy and Commerce and the Budget.

H.R. 3448 (Pitts)

Streamline America's Future Energy Nuclear Act. Requires NRC to establish expedited nuclear plant licensing procedures, requires NRC to reduce the time required to certify new reactor designs by half, requires NRC to develop technology-neutral guidelines for nuclear plant licensing, establishes a National Nuclear Energy Council to advise the Secretary of Energy, authorizes a final year of appropriations for the Nuclear Power 2010 program, requires DOE to prepare a schedule for accelerating completion of the Next Generation Nuclear Plant from 2021 to 2015, and limits fees and procedural restrictions on uranium mining on federal lands. Introduced July 31, 2009; referred to Committees on Energy and Commerce and Natural Resources.

H.R. 3505 (Gary Miller)

American Energy Production and Price Reduction Act. Prohibits NRC from considering nuclear waste storage when licensing new nuclear facilities and establishes investment tax credit for the costs of obtaining a nuclear manufacturing certification from the American Society of Mechanical Engineers. Introduced July 31, 2009; referred to multiple committees.

S. 591 (Reid)

National Commission on High-Level Radioactive Waste and Spent Nuclear Fuel Establishment Act of 2009. Establishes a commission to recommend alternative nuclear waste management options in the event that the proposed Yucca Mountain, NV, repository does not become operational. Introduced March 12, 2009; referred to Committee on Environment and Public Works.

S. 807 (Nelson)

SMART Energy Act. Authorizes funds for NRC to expedite nuclear plant license applications, authorizes nuclear workforce training program, establishes interagency working group to increase U.S. nuclear plant component manufacturing base, authorizes construction of a spent nuclear fuel recycling development facility, modifies the Standby Support program for new reactors, modifies the EPACT loan guarantee program, expands the nuclear power production tax credit, and provides accelerated depreciation for new reactors. Introduced April 2, 2009; referred to Committee on Finance.

S. 861 (Graham)

Rebating America's Deposits Act. Requires the President to certify that the Yucca Mountain site continues to be the designated location for a nuclear waste repository under the Nuclear Waste Policy Act. If such a certification is not made within 30 days after enactment or is subsequently

revoked, the Treasury is to refund all payments, plus interest, made by nuclear reactor owners to the Nuclear Waste Fund. DOE is to begin shipping defense-related high-level radioactive waste to Yucca Mountain by 2017 or pay $1 million per day to each state in which such waste is located. Introduced April 22, 2009; referred to Committee on Energy and Natural Resources.

S. 1333 (Barrasso)

Clean, Affordable, and Reliable Energy Act of 2009. Includes provisions to take the Nuclear Waste Fund off-budget, authorize DOE to use the Nuclear Waste Fund to pay for grants or long-term contracts for spent nuclear fuel recycling or reprocessing, and prohibit NRC from denying licenses for new nuclear facilities because of a lack of waste disposal capacity. Introduced June 24, 2009; referred to Committee on Finance.

S. 1462 (Bingaman)

American Clean Energy Leadership Act of 2009. Establishes Clean Energy Deployment Administration to administer DOE assistance, including loan guarantees, for nuclear energy and other energy technologies. Bill would also establish a national commission to study nuclear waste management alternatives and requirements for nuclear fuel cycle research. Introduced and reported as an original measure from the Committee on Energy and Natural Resources July 16, 2009 (S.Rept. 111-48).

S. 1733 (Kerry)

Clean Energy Jobs and American Power Act. Authorizes programs for nuclear worker training, nuclear safety, and nuclear waste research. Establishes a carbon dioxide cap-and-trade program. Introduced September 30, 2009; referred to Committee on Environment and Public Works. Ordered reported November 5, 2009.

S. 2052 (Mark Udall)

Nuclear Energy Research Initiative Improvement Act of 2009. Authorizes DOE research to reduce nuclear reactor manufacturing and construction costs. Introduced October 29, 2009; referred to Committee on Energy and Natural Resources.

S. 2776 (Alexander)

Clean Energy Act of 2009. Revises DOE loan guarantee program, authorizes DOE assistance for small modular reactors, requires NRC to consider waste disposal to be adequate for potential new reactors, and authorizes funding for nuclear workforce development and research. Introduced November 16, 2009; referred to Committee on Energy and Natural Resources.

S. 2812 (Bingaman)

Nuclear Power 2021 Act. Establishes a cost-shared program between DOE and the nuclear industry to develop and license standard designs for two reactors below 300 megawatts of electric generating capacity. Introduced November 20, 2009; referred to Committee on Energy and Natural Resources.

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