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# Nuclear Energy: Overview of Congressional Issues

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# Summary

The policy debate over the role of nuclear power in the nation's energy mix is rooted in the technology's fundamental characteristics. Nuclear reactors can produce potentially vast amounts of useful energy with relatively low consumption of natural resources and emissions of greenhouse gases and other pollutants. However, facilities that produce nuclear fuel for civilian power reactors can also produce materials for nuclear weapons. In addition, the process of nuclear fission (splitting of atomic nuclei) to generate power results in the production of radioactive material that must be contained and can remain hazardous for thousands of years. How to manage the weapons proliferation and safety risks of nuclear power, or whether the benefits of nuclear power are worth those risks, are issues that have long been debated in Congress.

The 100 licensed nuclear power reactors at 61 sites in the United States generate about 20% of the nation's electricity. Four new reactors are currently under construction. About a dozen more are planned, but whether they move forward will depend largely on their economic competitiveness with natural gas and coal plants. Throughout the world, 438 reactors are currently in service or operable, and 65 more are under construction.

The March 2011 disaster at the Fukushima Dai-ichi nuclear power plant in Japan increased attention to nuclear safety throughout the world. The U.S. Nuclear Regulatory Commission (NRC), which issues and enforces nuclear safety requirements, established a task force to identify lessons from Fukushima applicable to U.S. reactors. The task force's report led to NRC's first Fukushima-related regulatory requirements on March 12, 2012. Several other countries, such as Germany and Japan, eliminated or reduced their planned future reliance on nuclear power after the accident.

Highly radioactive spent nuclear fuel that is regularly removed from nuclear power plants is currently stored at plant sites in the United States. Plans for a permanent underground repository at Yucca Mountain, NV, were abandoned by the Obama Administration, which appointed the Blue Ribbon Commission on America's Nuclear Future to recommend an alternative nuclear waste policy. In response to the commission's recommendations, the Department of Energy (DOE) issued a new waste strategy in January 2013 that calls for the selection of new candidate sites for nuclear waste storage and disposal facilities through a "consent-based" process and for a surface storage pilot facility to open by 2021. However, a new nuclear waste policy has not been enacted by Congress.

The level of security that must be provided at nuclear power plants has been a high-profile issue since the 9/11 terrorist attacks on the United States in 2001. Since those attacks, NRC issued a series of orders and regulations that substantially increased nuclear plant security requirements, although industry critics contend that those measures are still insufficient.

Encouraging exports of U.S. civilian nuclear products, services, and technology while making sure they are not used for foreign nuclear weapons programs has long been a fundamental goal of U.S. nuclear energy policy. Recent proposals to build nuclear power plants in several countries in the less developed world, including the Middle East, have prompted concerns that international controls may prove inadequate.

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# Synthesis of Key Issues

The long-running policy debate over the future of nuclear energy is rooted in the technology's inherent characteristics. Initially developed for its unprecedented destructive power during World War II, nuclear energy seemed to hold equal promise after the war as a way of providing limitless energy to all mankind. International diplomacy has focused ever since on finding institutional mechanisms for spreading the perceived benefits of nuclear energy throughout the world while preventing the technology from being used for the proliferation of nuclear weapons. Much of this international effort is focused on key nuclear fuel cycle facilities—plants for enriching uranium in the fissile isotope U-235 and for separating plutonium from irradiated nuclear fuel. Such plants can be used to produce civilian nuclear reactor fuel as well as fissile material for nuclear warheads.

Yet even the use of nuclear power solely for peaceful energy production has proven intrinsically controversial. The harnessing of nuclear fission in a reactor creates highly radioactive materials that must be kept from overheating and escaping from the reactor building, as occurred during the disasters at Fukushima and Chernobyl. Spent nuclear fuel that is regularly removed from reactors during refueling must be isolated from the environment for up to a million years. Potential technologies to reduce nuclear waste through recycling usually involve separating plutonium that could be used for nuclear weapons and would still leave substantial amounts of radioactive waste to be stored and disposed of. Long-term storage and disposal sites for nuclear waste have proven difficult to develop throughout the world, as illustrated by the Obama Administration's cancellation of the proposed U.S. waste repository at Yucca Mountain, NV.

The March 2011 disaster at Japan's Fukushima Dai-ichi nuclear power plant, which forced the evacuation of areas as far as 30 miles away, has slowed nuclear power expansion plans around the world, particularly in Japan and Western Europe. However, dozens of new reactors are still being planned and built in China, India, Eastern Europe, and elsewhere.[1] In these areas, nuclear power's initial promise of generating large amounts of electricity without the need for often-imported fossil fuels, along with the more recent desire to reduce greenhouse gas emissions, remains a compelling motivation.

With 100 licensed reactors, the United States has the largest nuclear power industry in the world. But U.S. nuclear power growth has been largely stagnant for the past two decades, as natural gas has captured most of the market for new electric generating capacity.[2] Congress enacted incentives for new nuclear plants in the Energy Policy Act of 2005 (P.L. 109-58), including production tax credits, loan guarantees, and insurance against regulatory delays. Those incentives, combined with rising natural gas prices and concerns about federal restrictions on carbon dioxide emissions, prompted announcements by late 2009 of up to 30 new nuclear power reactors in the United States.[3] However, falling natural gas prices and uncertainty about carbon dioxide controls have put many of those projects on hold. Currently, four new reactors, in Georgia and South Carolina, are under construction. An older reactor, Watts Bar 2 in Tennessee, received an NRC operating license on October 22, 2015, after construction had been suspended for two decades. Its

[1] World Nuclear Association, "World Nuclear Power Reactors & Uranium Requirements," November 3, 2015, http://www.world-nuclear.org/info/Facts-and-Figures/World-Nuclear-Power-Reactors-and-Uranium-Requirements.

[2] Energy Information Administration, "Most Electric Generating Capacity Additions in the Last Decade Were Natural Gas-Fired," July 5, 2011, http://www.eia.gov/todayinenergy/detail.cfm?id=2070.

[3] Nuclear Regulatory Commission, "Expected New Nuclear Power Plant Applications," updated September 28, 2009. Available from the author.

twin unit, Watts Bar 1, the previous U.S. reactor to start up, received its operating license in 1996. A variety of incentives to renew the growth of nuclear power have been proposed, including a plan by President Obama to include nuclear power, along with natural gas and advanced coal technologies, in a federal mandate for the production of "clean energy."

Existing U.S. nuclear power plants are facing difficult competition from natural gas and renewable energy. Five U.S. reactors were permanently closed in 2013 and 2014, and shutdowns of two more units within the next few years were announced during 2015. Three of those units closed because of the need for expensive repairs, while the others were operating well but could not compete in their local wholesale electricity markets. All seven units had or have substantial time remaining on their initial 40-year operating licenses or had received or applied for 20-year license extensions from the Nuclear Regulatory Commission (NRC). The shutdowns have prompted widespread discussion about the future of other aging U.S. reactors.

The extent to which the growth of nuclear power should be encouraged in the United States and around the world will continue to be a major component of the U.S. energy policy debate. Questions for Congress will include the implementation of policies to encourage or discourage nuclear power, post-Fukushima safety standards, development of new nuclear power and fuel cycle technologies, and nuclear waste management strategies.

# Basic Facts and Statistics

The 100 licensed nuclear power reactors at 61 sites in the United States generate about 20% of the nation's electricity. The oldest of today's operating reactors were licensed in 1969, and the most recent had been in 1996, before the 2015 issuance of an operating license to Watts Bar 2. The reactors were initially licensed to operate for 40 years, but 80% have received or applied for 20-year license renewals by NRC. Under the current mixture of 40- and 60-year licenses, 33 of today's operating reactors would have to shut down by 2030 and the rest by 2049, except for the newly licensed Watts Bar 2.[4]

Whether new reactors will be constructed to replace the existing fleet or even to expand nuclear power's market share will depend largely on costs. The cost of building and operating a new nuclear power plant in the United States is generally estimated to be significantly higher than natural gas combined-cycle plants (which use both combustion and steam turbines) and somewhat above conventional coal-fired plants. For example, the Energy Information Administration (EIA) estimates that, for plants coming on line in 2020, electricity generation from a nuclear power plant would cost 9.5 cents per kilowatt-hour (kwh), while advanced combined-cycle gas would cost 7.3 cents/kwh, conventional coal would cost 9.5 cents/kwh, and advanced coal would cost 11.6 cents/kwh. EIA estimates that onshore wind would cost 7.4 cents/kwh, offshore wind 19.7 cents/kwh, solar photovoltaic 12.5 cents/kwh, and geothermal 4.8 cents/kwh.[5] Such estimates depend on a wide range of variables, however, such as future fuel costs and environmental regulations. Targeted tax credits and other incentives for specific technologies, which are not included in the EIA estimates, would also affect nuclear power's economic competitiveness.

[4] Nuclear Regulatory Commission, *Information Digest*,2015–2016, NUREG-1350, Volume 27, August 2015, Section 3: Nuclear Reactors, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350.

[5] Energy Information Administration, "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2015," April 14, 2015, http://www.eia.gov/forecasts/aeo/electricity_generation.cfm. Levelized costs include capital costs averaged over the life of the plant, plus fuel and maintenance costs. Nuclear costs are for a plant coming on line in 2022.

As noted above, the United States currently has four reactors under construction, in addition to Watts Bar 2, which is now undergoing startup. The new reactors, after construction delays, are now scheduled to begin operating in 2019 and 2020.[6] Licenses to build and operate 12 additional reactors are currently pending at NRC, although some of their review schedules are uncertain.[7] If those additional U.S. reactors are licensed and built, they could begin coming on line in the early 2020s.

Throughout the world, 438 reactors are currently in service or operable, and 65 more are under construction. France is the most heavily nuclear-reliant country in the world, with 58 reactors generating 77% of the country's electricity in 2014. Thirty countries in 2014 generated at least some of their electricity from nuclear power. After the Fukushima accident, Germany, which had previously generated about 30% of its electricity with nuclear power, closed 8 of the country's 17 power reactors and decided to shut the remainder by 2022. Japan, which had also generated about 30% of its electricity with nuclear power and had planned to raise that level to 50%, is reconsidering its energy policy. Only 2 of Japan's 43 operable reactors are currently running. Safety improvements in response to the tsunami are currently being implemented, and 24 reactors are undergoing regulatory reviews for possible restart.[8] It is not clear how many of Japan's operable reactors will ultimately seek restart approval.

# Major Nuclear Energy Issues

## Safety

The Fukushima Dai-ichi disaster, triggered by a huge earthquake and tsunami, greatly increased concerns about safety in the nuclear policy debate. The accident clearly demonstrated the potential consequences of a total loss of power (or "station blackout") at today's commercial nuclear plants. Even when a reactor shuts down, as the Fukushima plant did after the initial earthquake, residual radioactivity in the reactor core continues to generate heat that must be removed, typically by electrically driven or controlled cooling systems. When the tsunami knocked out power at three of the Fukushima reactors, the buildup of heat and pressure became so great that it melted the reactors' nuclear fuel and exceeded the limits of their containment structures. Cooling was also lost in Fukushima's spent fuel storage pools, causing concern that they could overheat, although later examination indicated that they did not.

Safety requirements for nuclear power plants are established and enforced in the United States by NRC, an independent regulatory commission. NRC safety regulations address the effects of external events such as earthquakes and floods, equipment failure such as breaks in coolant pipes, and other problems that could lead to radioactive releases into the environment. Critics of nuclear power contend that NRC is often reluctant to impose necessary safety requirements that would be costly or disruptive to the nuclear industry. However, the industry has frequently contended that costly safety proposals are unnecessary and would not significantly increase large existing safety margins.

[6] South Carolina Electric and Gas, "Project Schedule," http://www.sceg.com/en/about-sceg/power-plants/new-nuclear-development/schedule; Southern Company, "Plant Vogtle Units 3 & 4 Fact Sheet," http://www.southerncompany.com/what-doing/energy-innovation/nuclear-energy/pdfs/Vogtle-Units-3-and-4-FactSheet.pdf.

[7] Nuclear Regulatory Commission, "New Reactor Licensing Applications," September 10, 2012, http://www.nrc.gov/reactors/new-reactors.html.

[8] World Nuclear Association, "Public Information Service," http://www.world-nuclear.org.

## Recent Events

Following the Fukushima disaster, NRC established a task force to identify lessons applicable to U.S. reactors and recommend safety improvements. The task force's report led to NRC's first Fukushima-related regulatory requirements, on March 12, 2012. NRC ordered all reactors to develop strategies to maintain cooling and containment integrity during external events, such as floods and earthquakes, that were more severe than anticipated by the plants' designs ("beyond design basis"). In addition, NRC required that U.S. reactors of similar design to the Fukushima reactors have "reliable hardened vents" to remove excess pressure from their primary containments, and that better instrumentation be installed to monitor the condition of spent fuel pools during accidents.[9] The NRC commissioners on March 19, 2013, required NRC staff to study whether to require the newly mandated containment vents to include filters or other means to reduce the release of radioactive material if the vents have to be used. The idea of requiring filters had drawn praise from nuclear critics but opposition from the industry on cost grounds.[10] NRC voted on August 19, 2015, not to proceed with rulemaking on filtered vents.[11]

## Selected Congressional Action

### *Nuclear Regulatory Commission Reorganization Plan Codification and Complements Act (S. 58, Vitter)*

Specifies functions and authorities of the Chairman and Commissioners of NRC. Specifies that any commissioner may request a vote on whether a particular issue should be reserved for the Chairman or handled by the full Commission. Introduced January 7, 2015; referred to Committee on Environment and Public Works.

### *Nuclear Power Licensing Reform Act of 2015 (H.R. 1972, Lowey)*

Requires that renewals of nuclear plant licenses be subject to the same criteria as new plants, including changes in surrounding population and new seismic and other scientific data since a plant was first licensed. Introduced April 22, 2015; referred to Committee on Energy and Commerce.

### *Hearing: Oversight of the Nuclear Regulatory Commission*

Oversight hearing by the Senate Committee on Environment and Public Works, October 7, 2015. Witnesses: Chairman and commissioners of the Nuclear Regulatory Commission.

[9] Nuclear Regulatory Commission, "Actions in Response to the Japan Nuclear Accident: March 12, 2012," updated May 30, 2012, http://www.nrc.gov/reactors/operating/ops-experience/japan/timeline/03122012.html.

[10] NRC, "Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments," staff requirements memorandum, SECY-12-0157, March 19, 2013, http://www.nrc.gov/reading-rm/doc-collections/commission/srm/2012/2012-0157srm.pdf; Freebairn, William, "NRC Staff Recommends Ordering Filtered Vents for 31 Power Reactors," *Inside NRC*, November 5, 2012, p. 1.

[11] Nuclear Regulatory Commission, "Hardened Vents and Filtration (for Boiling Water Reactors with Mark I and Mark II containment designs)," http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard/hardened-vents.html.

### *Oversight Hearing: Oversight of the Nuclear Regulatory Commission*

Oversight hearing by the House Committee on Energy and Commerce Subcommittee on Environment and the Economy, September 9, 2015. Witnesses: Chairman and commissioners of the Nuclear Regulatory Commission.

### CRS Reports

CRS Report RL33558, *Nuclear Energy Policy*, by (name redacted)

CRS Report R41694, *Fukushima Nuclear Disaster*, by (name redacted), (name redacted), and (name redacted)

### Additional References

*What Are the Lessons Learned from Fukushima?*, Nuclear Regulatory Commission, web page, reviewed/updated April 17, 2015, http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard/priorities.html.

*Nuclear Safety: Countries' Regulatory Bodies Have Made Changes in Response to the Fukushima Daiichi Accident*, Report to the Chairman, Subcommittee on Transportation and Infrastructure, Committee on Environment and Public Works, U.S. Senate, Government Accountability Office, GAO-14-109, March 2014, http://www.gao.gov/products/GAO-14-109.

*State-of-the-Art Reactor Consequence Analyses (SOARCA) Report: Draft Report for Comment*, Nuclear Regulatory Commission, NUREG-1935, January 2012, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1935.

## Radioactive Waste

Highly radioactive spent nuclear fuel must regularly be removed from operating reactors and stored in adjacent pools of water. After several years of cooling, the spent fuel can be placed in dry casks for storage elsewhere on the plant site. When existing U.S. reactors were built, spent fuel had been expected to be taken away for reprocessing (separation of plutonium and uranium to make new fuel) or permanent disposal. However, reprocessing has not become commercialized in the United States, for economic and nonproliferation reasons, and central waste storage and disposal facilities have proven difficult to site. As a result, the vast majority of U.S. commercial spent fuel remains at the nuclear plants where it was generated—totaling 71,775 metric tons in 2013 and rising at the rate of about 2,000 metric tons per year.[12]

### Recent Events

The Nuclear Waste Policy Act (P.L. 97-425, NWPA), as amended in 1987, named Yucca Mountain, NV, as the nation's sole candidate site for a permanent high-level nuclear waste repository. However, the Obama Administration decided to halt the Yucca Mountain project, and no funding has been appropriated for it since FY2010. To develop an alternative policy, the Administration appointed the Blue Ribbon Commission on America's Nuclear Future, which issued its final report in January 2012. The Department of Energy (DOE) responded in January 2013 with a new waste strategy that calls for a "consent-based" process to select nuclear waste

[12] Gutherman Technical Services, "2013 Used Fuel Data," Report to Nuclear Energy Institute, January 20, 2014.

storage and disposal sites and for a surface storage pilot facility to open by 2021.[13] DOE invited public comment on a consent-based siting program on December 23, 2015.[14]

A federal appeals court on August 13, 2013, ordered NRC to continue the Yucca Mountain licensing process with previously appropriated funds.[15] In response, NRC issued the final volumes of the Yucca Mountain Safety Evaluation Report (SER), which provided the NRC staff's determination that the repository would meet all applicable standards. However, the staff said upon completing the SER that NRC should not authorize construction of the repository until all land and water rights requirements were met and a supplement to DOE's environmental impact statement (EIS) was completed.[16] NRC ordered its staff on March 3, 2015, to complete the supplemental EIS and make its database of Yucca Mountain licensing documents publicly available, using all the remaining previously appropriated licensing funds.[17]

## Selected Congressional Action

### *Nuclear Waste Administration Act of 2015 (S. 854, Alexander)*

Establishes an independent Nuclear Waste Administration to develop nuclear waste storage and disposal facilities. Siting of such facilities would require the consent of the affected state, local, and tribal governments. NWA would be required to prepare a mission plan to open a pilot storage facility by the end of 2021 for nuclear waste from shutdown reactors and other emergency deliveries (called "priority waste"). A storage facility for waste from operating reactors or other "nonpriority waste" would open by the end of 2025, and a permanent repository by the end of 2048. The current disposal limit of 70,000 metric tons for the nation's first permanent repository would be repealed. Nuclear waste fees collected after enactment of the bill would be held in a newly established Working Capital Fund. The Nuclear Waste Administration could immediately draw from that fund any amounts needed to carry out S. 854, unless limited by annual appropriations or authorizations. Introduced March 24, 2015; referred to Committee on Energy and Natural Resources.

### *Dry Cask Storage Act of 2015 (S. 945, Markey)*

Requires spent fuel at nuclear power plants to be moved from spent fuel pools to dry casks after it has sufficiently cooled, pursuant to NRC-approved transfer plans. Emergency planning zones would have to be expanded from 10 to 50 miles in radius around any reactor determined by NRC to be out of compliance with its spent fuel transfer plan. The emergency zone for a decommissioned reactor could not be reduced below a 10-mile radius until all its spent fuel had been placed in dry storage. NRC would be authorized to use interest earned by the Nuclear Waste

[13] DOE, *Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste*, January 2013, http://energy.gov/sites/prod/files/2013%201-15%20Nuclear_Waste_Report.pdf.

[14] DOE, "Consent Based Siting," http://energy.gov/ne/consent-based-siting.

[15] U.S. Court of Appeals for the District of Columbia Circuit, In re: Aiken County et al., No. 11-1271, writ of mandamus, August 13, 2013, http://www.cadc.uscourts.gov/internet/opinions.nsf/BAE0CF34F762EBD985257BC6004DEB18/$file/11-1271-1451347.pdf.

[16] NRC, "NRC Publishes Final Two Volumes of Yucca Mountain Safety Evaluation," news release 15-005, January 29. 2015, http://www.nrc.gov/reading-rm/doc-collections/news/2015/.

[17] NRC, "NRC Staff to Prepare Supplement to Yucca Mountain Environmental Impact Statement," news release 15-016, March 12, 2015, http://www.nrc.gov/reading-rm/doc-collections/news/2015/.

Fund to provide grants to nuclear power plants to transfer spent fuel to dry storage. Introduced April 15, 2015; referred to Committee on Environment and Public Works.

### *Nuclear Plant Decommissioning Act of 2015 (S. 964, Sanders)*

Establishes criteria for NRC approval of decommissioning plans for nuclear power plants, including recommendations from the plant's host state. Introduced April 15, 2015; referred to Committee on Environment and Public Works.

### *Nuclear Waste Informed Consent Act (S. 1825, Reid)*

Prohibits the Secretary of Energy from making any expenditure from the Nuclear Waste Fund for developing nuclear waste storage and disposal facilities and conducting waste transportation activities unless agreements have been reached with affected states, local governments, and Indian tribes. Introduced July 22, 2015; referred to Committee on Energy and Natural Resources.

### *Oversight Hearing: Update on the Current Status of Nuclear Waste Management Policy*

Oversight hearing by the House Committee on Energy and Commerce Subcommittee on Environment and the Economy, May 15, 2015. Panel of witnesses representing the Nuclear Regulatory Commission and nuclear waste interest groups.

### *Oversight Hearing: Transporting Nuclear Materials: Design, Logistics, and Shipment*

Oversight hearing by the House Committee on Energy and Commerce Subcommittee on Environment and the Economy, October 1, 2015. Panel of witnesses focusing on transportation of spent nuclear fuel.

### *Oversight Hearing: Update on Low-Level Radioactive Waste Disposal Issues*

Oversight hearing by the House Committee on Energy and Commerce Subcommittee on Environment and the Economy, October 21, 2015. Lead witnesses: Mark Whitney, Principal Deputy Assistant Secretary for Environmental Management, Department of Energy, and Michael Weber, Deputy Executive Director of Operations for Materials, Waste, Research, State, and Compliance Programs, Nuclear Regulatory Commission.

## CRS Reports

CRS Report RL33461, *Civilian Nuclear Waste Disposal*, by (name redacted)

CRS Report R42513, *U.S. Spent Nuclear Fuel Storage*, by (name redacted)

CRS Report R40996, *Contract Liability Arising from the Nuclear Waste Policy Act (NWPA) of 1982*, by (name redacted)

## Additional References

*Report to the Secretary of Energy*, Blue Ribbon Commission on America's Nuclear Future, January 2012, http://cybercemetery.unt.edu/archive/brc/20120620211605/http:/brc.gov.

Designing a Process for Selecting a Site for a Deep-Mined, Geologic Repository for High-Level Radioactive Waste and Spent Nuclear Fuel, Nuclear Waste Technical Review Board, November 2015, http://www.nwtrb.gov/reports/siting_report_analysis.pdf.

*Managing Spent Nuclear Fuel: Strategy Alternatives and Policy Implications*, RAND Corporation, 2010, http://www.rand.org/pubs/monographs/MG970.html.

## Federal Support and Incentives

Congress has long debated the role that nuclear power should play in meeting national energy and environmental goals. Nuclear power supporters generally point to the technology as crucial for providing a secure, domestic source of energy with low greenhouse gas and other emissions. Opponents generally counter that safety and proliferation risks, nuclear waste hazards, and high costs outweigh those benefits. The debate over nuclear power's role often focuses on the level of federal support that should be provided to encourage the construction of new nuclear plants, through such mechanisms as loan guarantees, tax credits, clean energy mandates, and liability limits under the Price-Anderson Act. Because of the relatively high cost of new nuclear reactors, especially compared with natural gas plants, the level of federal support is expected to be a key determinant of the future growth or decline of nuclear power in the United States. Recent closures and planned closures of several existing reactors before their license expirations have also prompted debate over whether the federal government should take action to prevent further shutdowns.

Federal funding for nuclear energy research and development, along with related infrastructure and security, is debated annually in Congress as part of the Energy and Water Development appropriations bill. DOE nuclear energy funding totaled $833.4 million for FY2015, while for FY2016 the President requested $907.6 million, the House approved $936.2 million, and the Senate Appropriations Committee recommended $950.2 million. The Consolidated Appropriations Act for FY2016 (H.R. 2029, P.L. 114-113) provided $986.2 million.

### Recent Events

One nuclear power project, consisting of two new reactors at the Vogtle plant in Georgia, has received loan guarantees from DOE totaling $8.33 billion, as authorized by Section 1703 of the Energy Policy Act of 2005 (P.L. 109-58). Energy Secretary Ernest Moniz announced the issuance of $6.5 billion in loan guarantees on February 19, 2014, to two of the three utility partners in the project, Georgia Power and Oglethorpe Power. The final $1.8 billion loan guarantee for another partner, Municipal Electric Authority of Georgia, was issued June 24, 2015. No other planned nuclear plants have received any commitments for DOE loan guarantees.

Federal policy on carbon dioxide emissions could also have a significant impact on the expansion of nuclear power and the economic viability of existing reactors. The Obama Administration released final regulations August 3, 2015, for its Clean Power Plan, which requires states to reduce carbon dioxide emissions from existing power plants. Nuclear power could be an element in state plans for meeting the new standards.

### Selected Congressional Action

#### *Energy Policy Modernization Act of 2015 (S. 2012, Murkowski)*

Among other provisions, requires the Department of Energy to report on its capabilities to authorize, host, and oversee privately funded fusion and fission reactor prototypes of up to 20

megawatts thermal output and related demonstration facilities at DOE-owned sites. Introduced September 9, 2015; reported by Committee on Energy and Natural Resources.

### *Nuclear Energy Innovation Capabilities Act (H.R. 4084, Weber)*

Requires the Department of Energy to support development of nuclear fission and fusion technologies through computer modeling and simulation, and through testing and demonstration at DOE national laboratories and other sites. The Secretary of Energy would determine the need for a reactor-based fast neutron source. Introduced November 19, 2015; referred to Committee on Science, Space, and Technology. Hearing held December 3, 2015, by Subcommittee on Energy.

### *Oversight Hearing: Nuclear Regulatory Commission Licensing Process*

Oversight hearing by the Energy Subcommittee of the House Committee on Science, Space, and Technology on licensing issues related to advanced nuclear energy technologies. Witness: NRC Chairman Stephen G. Burns.

### CRS Reports

CRS Report RL33558, *Nuclear Energy Policy*, by (name redacted)

### Additional References

*Advanced Nuclear 101*, Third Way, December 1, 2015, http://www.thirdway.org/report/advanced-nuclear-101.

*World Nuclear Industry Status Report 2015*, Mycle Scheider Consulting, July 28, 2015, http://www.worldnuclearreport.org/-2015-.html.

## Security and Emergency Response

The level of security that must be provided at nuclear power plants has been a high-profile issue since the 9/11 terrorist attacks on the United States in 2001. Since those attacks, NRC issued a series of orders and regulations that substantially increased nuclear plant security requirements, although industry critics contend that those measures are still insufficient. Key measures include an increase in the level of attacks that nuclear plant security forces must be able to repel, requirements for mitigating the effects of large fires and explosions, and a requirement that new reactors be capable of withstanding aircraft crashes without releasing radioactive material. NRC also modified its planning requirements for evacuations and other emergency responses after the 9/11 attacks, and the Fukushima disaster illustrated the importance of emergency response to radioactive releases from any cause.

### Recent Events

NRC issued wide-ranging revisions to its emergency preparedness regulations on November 1, 2011, dealing with duties of emergency personnel and the inclusion of hostile actions in emergency planning drills.[18] In response to Fukushima, NRC staff recommended that nuclear emergency plans be required to address events affecting multiple reactors and prolonged station

[18] NRC, "Enhancements to Emergency Preparedness Regulations," final rule, *Federal Register*, November 23, 2011, p. 72560.

blackout. NRC told nuclear power plants on March 12, 2012, to provide specific information and analysis on those issues.[19]

NRC established a Cyber Security Directorate in June 2013 to coordinate rulemaking, guidance, and oversight of cybersecurity at nuclear power plants and other regulated nuclear facilities. As part of the Directorate, NRC's Cyber Assessment Team responds to cybersecurity events at NRC-licensed facilities and coordinates threat assessments with other federal agencies.[20]

### CRS Reports

CRS Report RL34331, *Nuclear Power Plant Security and Vulnerabilities*, by (name redacted) and (name redacted)

### Additional References

*Protecting Our Nation*, Nuclear Regulatory Commission, NUREG/BR-0314, Rev. 3, October 2013, http://pbadupws.nrc.gov/docs/ML1327/ML13270A213.pdf.

## Nuclear Weapons Nonproliferation

Encouraging exports of U.S. civilian nuclear products, services, and technology while making sure they are not used for foreign nuclear weapons programs has long been a fundamental goal of U.S. nuclear energy policy. International controls and inspections are intended to ensure the peaceful use of civilian nuclear facilities and prevent the proliferation of nuclear weapons. However, recent proposals to build nuclear power plants in as many as 18 countries[21] that have not previously used nuclear energy, including several in the Middle East and elsewhere in the less developed world, have prompted concerns that international controls may prove inadequate. Numerous recommendations have been made in the United States and elsewhere to create new incentives for nations to forgo the development of uranium enrichment and spent nuclear fuel reprocessing facilities that could produce weapons materials as well as civilian nuclear fuel.

### Recent Events

Iran is currently the prime example of the tension between peaceful and weapons uses of nuclear technology. Long-standing world concern had focused on the Iranian uranium enrichment program, which Iran contended was solely for peaceful purposes but which the United States and other countries suspected was for producing weapons material. The U.N. Security Council had imposed sanctions and passed several resolutions calling on Iran to suspend its enrichment program and other sensitive nuclear activities. Iran finalized a Joint Comprehensive Plan of Action on July 14, 2015, with the United States and five major European countries that would lift the U.N. sanctions in return for specified Iranian actions to preclude nuclear weapons development.

[19] NRC, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," March 12, 2012, http://pbadupws.nrc.gov/docs/ML1205/ML12053A340.pdf.

[20] NRC, "Backgrounder on Cyber Security," December 2014, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/cyber-security-bg.html.

[21] World Nuclear Association, "World Nuclear Power Reactors & Uranium Requirements," February 1, 2014, http://www.world-nuclear.org/info/reactors.html.

Recent extensions of U.S. peaceful nuclear cooperation agreements with China and South Korea generated controversy but no congressional action to block them. During negotiations on the U.S.-South Korea nuclear cooperation extension, which entered into force November 25, 2015, South Korea had sought advance U.S. consent for spent fuel reprocessing and uranium enrichment. The United States did not provide such consent, on general nonproliferation grounds and because such consent could affect other ongoing issues on the Korean peninsula. The new agreement does, however, establish a bilateral "high level commission" to further consider those issues. The extension of the U.S.-China peaceful nuclear cooperation agreement includes advance consent for reprocessing and enrichment, which raised some controversy, although both countries are internationally recognized nuclear weapons states. The agreement with China entered into force after the mandatory congressional review period ended on July 31, 2015.

## Selected Congressional Action

### *Hearing: Implications of a Nuclear Agreement with Iran (Part I-IV)*

Five-part hearing by the House Committee on Foreign Affairs, July 9, 14, and 23 and September 9, 2015. Examined the potential outcomes of lifting sanctions on Iran and the likely effectiveness of restrictions on Iran's nuclear program. Numerous witnesses.

### *Hearing: Reviewing the U.S.-China Civil Nuclear Cooperation Agreement*

Joint hearing by the House Committee on Foreign Affairs Subcommittee on Asia and the Pacific and the Subcommittee on Terrorism, Nonproliferation, and Trade, July 16, 2015. Examined the U.S. peaceful nuclear cooperation agreement extension with China, including the granting of advance consent for spent nuclear fuel reprocessing and uranium enrichment and controls on the transfer of nuclear technology. Witnesses included Assistant Secretary of State Thomas M. Countryman and National Nuclear Security Administration Administrator Frank G. Klotz.

### *Hearing: Reviewing the Civil Nuclear Agreement with the Republic of Korea*

Hearing by the Senate Committee on Foreign Relations, October 1, 2015. Examined provisions of the U.S.-South Korea peaceful nuclear cooperation agreement, focusing on provisions for joint studies of spent fuel reprocessing technology and a bilateral "high level commission" to consider future issues related to reprocessing and uranium enrichment. Witness: Assistant Secretary of State Thomas M. Countryman.

## CRS Reports

CRS Report RL34234, *Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power*, coordinated by (name redacted)

CRS Report R41910, *Nuclear Energy Cooperation with Foreign Countries: Issues for Congress*, by (name redacted), (name redacted), and (name redacted)

CRS Report RL31559, *Proliferation Control Regimes: Background and Status*, coordinated by (name redacted)

CRS Report R41032, *U.S. and South Korean Cooperation in the World Nuclear Energy Market: Major Policy Considerations*, by (name redacted)

CRS Report R43333, *Iran Nuclear Agreement*, by (name redacted) and (name redacted)

CRS Report RL33192, *U.S.-China Nuclear Cooperation Agreement*, by (name redacted), (name redacte d), and (name redacted)

### Other References

*Nuclear Nonproliferation: IAEA Has Made Progress in Implementing Critical Programs But Continues to Face Challenges*, Government Accountability Office, GAO-13-139, May 16, 2013, http://www.gao.gov/products/GAO-13-139.

*U.S. Nuclear Cooperation as Nonproliferation: Reforms, or the Devil You Know?* Nuclear Threat Initiative, November 27, 2012, http://www.nti.org/analysis/articles/us-nuclear-cooperation-nonproliferation-reforms-or-devil-you-know.

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