U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

NRC

Information Digest

2016–2017

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NRC

Information Digest 2016–2017

Section Photo Captions:

Section 1: NRC: An Independent Regulatory Agency

1. *The Prairie Island nuclear power plant in Minnesota.*
2. *The NRC Headquarters complex in Rockville, MD.*
3. *An NRC inspector conducts routine inspections of plant equipment to ensure the plant is meeting NRC regulations.*

Section 2: Nuclear Energy in the U.S. and Worldwide

1. *A satellite photograph captures the sunrise over the Earth.*
2. *The NRC participates in the annual General Conference for the International Atomic Energy Agency in Vienna, Austria.*
3. *NRC Chairman Stephen Burns (center of the table on the right) meets with Japan's Chief Cabinet Secretary Yoshihide Suga (center of the table on the left) to discuss nuclear regulatory issues.*

Section 3: Nuclear Reactors

1. *The St. Lucie nuclear power plant in Florida.*
2. *An NRC inspector conducts routine inspections of plant equipment to ensure the plant is meeting NRC regulations.*
3. *Transmission lines distribute electricity generated by nuclear power plants to the power grid.*

Section 4: Nuclear Materials

1. *Physicians use yttrium-90 (Y-90) microspheres to treat liver cancers.*
2. *A moisture density gauge indicates whether a foundation is suitable for constructing a building or roadway.*
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Section 5: Radioactive Waste

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2. *Social media enables the NRC to reach a broader audience and to better engage, inform, and educate the public—in real time, through multiple channels.*
3. *NRC regulations are contained in Title 10, "Energy" of the Code of Federal Regulations, Chapter 1, Parts 1 to 199.*

Abstract

The U.S. Nuclear Regulatory Commission (NRC) has published the Information Digest annually since 1989. The Information Digest provides information about the agency and the industries it regulates. It describes the agency's responsibilities and activities and provides general information on nuclear-related topics. The Information Digest includes NRC and industry data in an easy-to-read format. Infographics help explain the information with visual aids.

The 2016–2017 Information Digest includes NRC data in the appendices and non-NRC data (i.e., International Atomic Energy Agency, Energy Information Administration, and U.S. Department of Energy data) throughout the publication that is from the August 2015 edition, with the exception of data associated with maps and graphics. The next Information Digest, scheduled for publication in August 2017, will reflect updated data. Going forward, the Digest will remain an annual publication, but data will only be updated every two years. Readers will be directed to the most current and updated information, which is available online.

The NRC reviews the information from industry and international sources but does not independently verify it. The Web Link Index provides sources for more information on major topics. The NRC is the source of all photographs, graphics, and tables unless otherwise noted. All information is final unless otherwise noted. Corrections and updates will appear in the digital version of the publication on the NRC Web site at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1350/.

The NRC welcomes comments or suggestions on the Information Digest. To submit comments, write to the Office of Public Affairs at U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or email at OPA.Resource@nrc.gov.

NRC resident inspectors perform routine inspection activities to ensure nuclear power plants operate according to NRC regulations.

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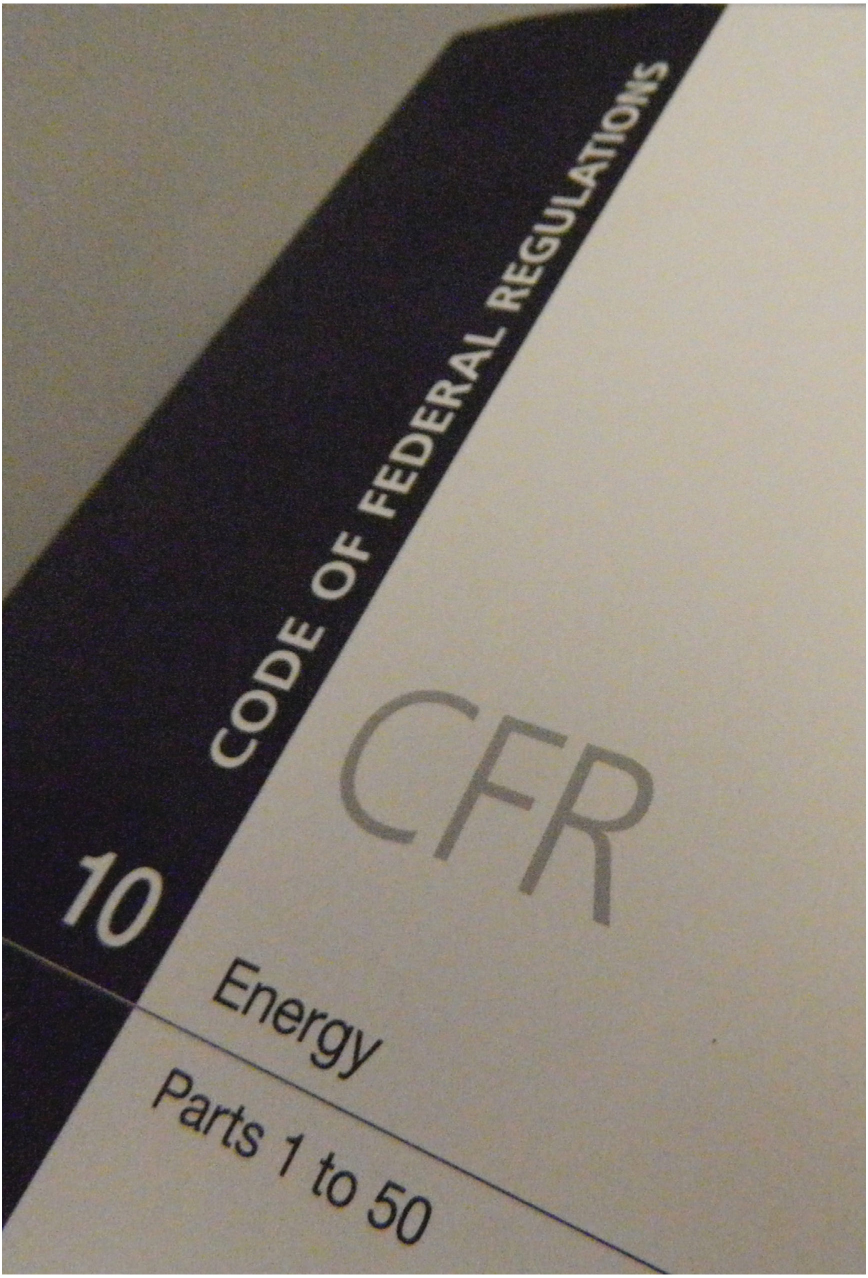

NRC regulations are contained in Title 10, "Energy," of the Code of Federal Regulations, Chapter 1, Parts 1 to 199.

Mission

The U.S. Nuclear Regulatory Commission (NRC) is an independent agency created by Congress. Its mission is to license and regulate the civilian use of radioactive materials in the United States to protect public health and safety, promote the common defense and security, and protect the environment.

The NRC regulates commercial nuclear power plants; research, test, and training reactors; nuclear fuel cycle facilities; and radioactive materials used in medicine, academia, and industry. The agency also regulates the transport, storage, and disposal of radioactive materials and waste, most Federal agencies' use and possession of radioactive materials, and the export and import of radioactive materials.

Commission

Chairman Stephen G. Burns	Term ends June 30, 2019
Commissioner Kristine L. Svinicki	Term ends June 30, 2017
Commissioner Jeff Baran	Term ends June 30, 2018
Vacant	
Vacant	

Locations

Headquarters:
U.S. Nuclear Regulatory Commission
Rockville, MD, 301-415-7000, 1-800-368-5642

Regional Offices:
Region I - King of Prussia, PA, 610-337-5000, 1-800-432-1156
Region II - Atlanta, GA, 404-997-4000, 1-800-577-8510
Region III - Lisle, IL, 630-829-9500, 1-800-522-3025
Region IV - Arlington, TX, 817-860-8100, 1-800-952-9677

Headquarters Operations Center:
Rockville, MD, 301-816-5100
The NRC maintains a staffed, 24-hour Operations Center that coordinates incident response with State, local, and Federal agencies.

Training and Professional Development:
Technical Training Center, Chattanooga, TN, 423-855-6500
Professional Development Center, Rockville, MD, 301-287-0556

Resident Sites:
At least two NRC resident inspectors, who report to the appropriate regional office, are located at each nuclear power plant site.

NRC Fiscal Year 2016 Budget

- Total authority: $1,002.1 million
- Total authorized staff: 3,595
- Estimated fees to be recovered: $882.9 million
- The Office of the Inspector General received its own appropriation of $12.1 million
- Total Research Budget: $51 million with 217 full-time equivalents
  - Reactor Program: $43 million
  - New/Advanced Reactor Licensing: $6 million
  - Materials and Waste: $2 million

What Does the NRC Do?

- Regulation and guidance—rulemaking
- Policymaking
- Licensing, decommissioning, and certification
- Research
- Oversight and enforcement
- Emergency preparedness and response
- Incident response

NRC Governing Legislation

The NRC was established by the Energy Reorganization Act of 1974. The most significant laws that govern the regulatory process of the agency are in Appendix W. The NRC's regulations are found in Title 10 of the *Code of Federal Regulations.* The text of many laws may be found in NUREG-0980, "Nuclear Regulatory Legislation."

NRC by the Numbers

U.S. Electricity Generated by Commercial Nuclear Power

NRC-licensed nuclear reactors generate about 19 percent of U.S. net electricity, or about 771 billion kilowatt-hours.

Nuclear Reactors

- 100 commercial nuclear power plants operating in 30 States at 61 sites
  - 66 pressurized-water reactors and 34 boiling-water reactors
- Four reactor fuel vendors
- 23 parent operating companies
- About 80 different designs
- About 6,500 total inspection hours at each operating reactor site in 2015

Licensees have announced via the media or letter their intent to either shut down or not renew licenses for the following:

- Omaha Public Power District will close Fort Calhoun by end of 2016.
- Entergy's will close Fitzpatrick in 2017 and Pilgrim Nuclear Power Station by end of 2018
- Exelon's Clinton Power Station and its Quad Cities Generating Station will close on June 1, 2017, and June 1, 2018, respectively; and Oyster Creek plans to shut down in December 2019.
- Pacific Gas & Electric, Diablo Canyon nuclear plants will close when their licenses expire by 2025.

Reactor License Renewal

Commercial power reactor operating licenses are valid for 40 years and may be renewed for additional 20-year terms.

- 19 reactors operate under their original license.
- 50 sites comprising 83 reactors were issued renewal licenses.
- Eight sites have license renewal applications in review.
- Four sites have submitted letters of intent to request renewal.

Early Site Permits for New Reactors

- Five early site permits (ESPs) issued and one new application received:
  - System Energy Resources, Inc., for the Grand Gulf site in Mississippi
  - Exelon Generation Company, LLC, for the Clinton site in Illinois
  - Dominion Nuclear North Anna, LLC, for the North Anna site in Virginia
  - Southern Nuclear Operating Company, for the Vogtle site in Georgia
  - PSEG Power, LLC, and PSEG Nuclear, LLC, for the PSEG site in New Jersey
  - In May 2016, the NRC received an ESP application from the Tennessee Valley Authority (TVA) for two or more small modular reactor (SMR) modules at the Clinch River Nuclear Site in Roane County, Tennnessee.

Combined License—Construction and Operating for New Reactors

- Since June 2007, the NRC has received and docketed 18 combined license (COL) applications for 28 new, large light-water reactors.
- The NRC suspended or canceled 10 COL application reviews at the request of the applicants, because of changes to their business plans (Bell Bend, Bellefonte, Calvert Cliffs, Comanche Peak, Grand Gulf, Callaway, Nine Mile Point, River Bend, Shearon Harris, and Victoria County Station).
- The NRC has issued COLs for seven reactors at Vogtle, V.C. Summer, Fermi, and South Texas Project.
- As of June 2016, the NRC is actively reviewing four applications for seven new reactors: North Anna (VA), William States Lee III (SC), Levy County (FL), and Turkey Point (FL).

Reactor Design Certification

- Five reactor design certifications (DCs) were issued:
  - General Electric Nuclear Energy's ABWR (Advanced Boiling-Water Reactor)
  - Westinghouse Electric Company's System 80+
  - Westinghouse Electric Company's AP600
  - Westinghouse Electric Company's AP1000
  - General Electric-Hitachi Nuclear Energy's ESBWR (Economic Simplified Boiling-Water Reactor)
- Two DC applications are currently under review for the APR1400 and US-APWR designs.
- One DC application is suspended at the request of the applicant (US EPR).
- One DC renewal application is under review for the ABWR design.

Nuclear Research and Test Reactors

- 31 licensed research and test reactors are operating in 21 States.

Nuclear Materials

Materials Licensing

- The NRC and the Agreement States have approximately 20,000 licensees for medical, academic, industrial, and general users of nuclear materials.
  - The NRC administers approximately 2,700 licenses.
  - 37 Agreement States oversee approximately 17,300 licenses.
- Two States have letters of intent to become Agreement States: Vermont and Wyoming.
- The NRC issues approximately 2,000 new licenses, renewals, or amendments for existing materials licenses annually. The NRC conducts approximately 900 health, safety, and security inspections of materials licensees each year.

Nuclear Fuel Cycle

- 10 uranium recovery sites licensed by the NRC:
  - Nine in situ recovery sites
  - One conventional mill in standby status with the potential to restart in the future
- One application for a new uranium recovery facility is under review.
- Two applications for renewal are under review; a third has been received.
- Seven applications for facility expansion have been received. Five of those applications are under review.
- 13 fuel cycle facilities:
  - One uranium hexafluoride conversion facility
  - Five uranium fuel fabrication facilities
  - Four gas centrifuge uranium enrichment facilities (one operating, one test and development, and two construction pending)
  - One mixed-oxide fuel fabrication facility (under construction and review)
  - One laser separation enrichment facility (construction decision pending)
  - One uranium hexafluoride deconversion facility (construction decision pending)
- The NRC issues about 75 fuel cycle facility licensing actions per year, including amendments; renewals; new licenses; and safety, environmental, and safeguards reviews.

National Source Tracking System

The National Source Tracking System (NSTS) tracks more than 80,000 sources held by about 1,400 NRC and Agreement State licensees. Of those sources, about 46 percent are Category 1 sources and 54 percent are Category 2. The majority are cobalt-60, the most widely used isotope in large sources.

Domestic Safeguards

The NRC has issued licenses authorizing some 180 facilities to possess special nuclear material in quantities ranging from a single kilogram to multiple tons.

Radioactive Waste

Low-Level Radioactive Waste

- 10 regional compacts
- Four licensed disposal facilities

High-Level Radioactive Waste Management

Spent Nuclear Fuel Storage

- 75 licenses for independent spent fuel storage installations in 34 States:
  - 15 site-specific licenses
  - 60 general licenses

Transportation—Principal Licensing and Inspection Activities

- 1,000 safety inspections of fuel, reactor, and materials licensees are conducted annually.
- 65 new, renewal, or amended container-design applications for the transport of nuclear materials are reviewed annually.
- 150 license applications for the import and export of nuclear materials from the United States are reviewed annually.
- More than 3 million packages of radioactive materials are shipped each year in the United States by road, rail, air, or water. This represents less than 1 percent of the Nation's yearly hazardous material shipments.

Decommissioning

Approximately 150 materials licenses are terminated each year. The NRC's decommissioning program focuses on the termination of licenses that are not routine and that require complex activities.

- 19 nuclear power reactors in various stages of decommissioning (DECON or SAFSTOR)
- Four research and test reactors permanently shut down and in various stages of decommissioning
- 13 complex material sites in various stages of decommissioning
- Two fuel cycle facilities (partial decommissioning)
- 11 NRC-licensed uranium recovery facilities in various stages of decommissioning

Security and Emergency Preparedness

- Once every 2 years, each operating nuclear power plant performs a full-scale emergency preparedness exercise inspected by the NRC and evaluated by the Federal Emergency Management Agency.
- Plants conduct additional emergency drills between full-scale exercises to maintain their preparedness and proficiency in responding to emergencies.
- Once every 3 years, each nuclear plant undergoes a force-on-force security inspection. These inspections include mock combat drills. The NRC spends about 16,000 hours a year scrutinizing security at nuclear power plants, including 8,000 hours of force-on-force inspections.

Nuclear Reactors

Power Reactors

- Made significant progress implementing lessons learned from the Fukushima accident in Japan, with a focus on the highest priority (Tier 1) activities.
- Completed over 799 licensing actions and other licensing tasks, including approving additional transitions to the National Fire Protection Association Standard NFPA-805, “Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generation Plants,” while also actively reviewing a number of nuclear power plant license renewal applications.
- Issued one early site permit for the PSEG site in New Jersey.
- Issued combined licenses for Fermi Unit 3 (Michigan) and for South Texas Project, Units 3 and 4 (Texas).
- Issued the final environment impact statement for the Bell Bend Nuclear Power Plant (Pennsylvania) combined license application.
- Continued oversight of construction at two new reactor construction sites.
- Issued the Tennessee Valley Authority’s operating license for the Watts Bar Unit 2 reactor.
- Completed all required inspection and assessment activities of the Reactor Oversight Process, including initiating eight inspections in response to safety-significant events.
- Strengthened cyber security for nuclear facilities through new requirements and cooperation with industry.
- Participated in Southern Exposure 2015, a national exercise simulating response to and recovery from a nuclear power plant catastrophe.
- Collaborated with States, Federal agencies, and licensees in responding to natural events and extreme weather (such as tornadoes, floods, hurricanes, and earthquakes) affecting licensed facilities.
- Strengthened nuclear safety cooperation through more than 20 new international agreements, adding to the existing 100 active international agreements for cooperative research.
- Published extensive research results on a variety of topics that confirmed the safety of operating facilities, including analysis of power uprate thermal-hydraulic margins, fracture toughness of cast stainless steel under irradiated and thermal conditions, and improvements for fire probabilistic risk assessment.

Nonpower Reactors

- Issued a construction permit for SHINE Medical Technologies, Inc., for a facility in Janesville, WI, to produce medical isotopes.
- Continued reviewing a construction permit application for Northwest Medical Isotopes, LLC, for a medical isotope production facility in Missouri.

Materials and Waste

- Completed approximately 2,075 radioactive material licensing actions.
- Completed the technical safety review of the U.S. Department of Energy’s application and released the final volumes of the Yucca Mountain safety evaluation report.
- Issued NUREG-2184, “Supplement to the U.S. Department of Energy’s Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada.”
- Published the final rule to make conforming changes to Title 10 of the *Code of Federal Regulations,* Part 71, “Packaging and Transportation of Radioactive Material,” in order to maintain consistency with the U.S. Department of Transportation regulations, which are based on the International Atomic Energy Agency’s 2009 standards for the interantional transportation of radioactive material.
- Published the Safety Culture Educational Resource, a training aid endorsed by the Agreement States, on the Safety Culture Policy Statement for licensees.

- Terminated the certificate of compliance for the Paducah Gaseous Diffusion facility.
- Completed a series of five Tribal training sessions at various Tribal colleges, with focuses on health physics, the National Environmental Policy Act, and the uranium recovery process.
- Completed seven Integrated Materials Performance Evaluation Program reviews of Agreement States, and all were found adequate to protect public health and safety.
- Approved a license amendment for the expansion of the Louisiana Energy Services Uranium Enrichment facility.
- Authorized Strata Energy, Inc., to operate a uranium recovery facility.
- Issued two independent spent fuel storage installations license renewals for Calvert Cliffs and Prairie Island.
- Terminated the research and test reactor operating licenses at Worchester Polytechnic Institute, the University of Michigan Ford Reactor and the Veterans Administration reactor in Omaha, NE.
- Worked with other Federal agencies (U.S. Department of Energy, U.S. Department of State, U.S. Environmental Protection Agency) to complete the fifth review meeting of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Agencywide

- Initiated a rebaselining effort under Project Aim to reprioritize the agency's work, increase efficiency and effectiveness, and improve the agency's ability to adapt to a changing work environment.
- Pursued substantial rulemaking activities on topics including the standards for protection against radiation, the control and accounting of special nuclear material, the decommissioning of nuclear reactors, and the fee structure for small modular reactors.
- Issued the (FY) 2015 proposed fee rule, held a public meeting to support stakeholder outreach, and incorporated the comments received in the FY 2015 final fee rule.

International Activities

- Participated in various U.S. Government nuclear safety and security initiatives in collaboration with U.S. Executive Branch agencies and non-U.S. regulatory counterparts through activities such as the 2016 Nuclear Security Summit in Washington, DC, and the 2016 International Regulators Conference on Nuclear Security in Spain.
- Participated as part of U.S. Government delegations to international meetings addressing implementation of treaties and conventions, including: a diplomatic conference to consider amending the Convention on Nuclear Safety, the Fifth Review Meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and the technical meeting of points of contact for the Convention on the Physical Protection of Nuclear Material.
- Supported multiple International Atomic Energy Agency regulatory peer review missions, such as the Integrated Regulatory Review Service and the International Physical Protection Advisory Service.
- Represented the U.S. Government on the Nuclear Security Guidance Committee, an International Atomic Energy Agency committee that will set the international guidance in this area for decades to come.
- Participated with U.S. Executive Branch agencies and others on the first ever United States-Republic of Korea High Level Bilateral Commission meeting to discuss civilian nuclear safety.
- Supported completion of verified national registries of radioactive sources, through the NRC's Radioactive Sources Regulatory Partnership, for six non-U.S. regulatory counterparts.
- Continued regulatory program development assistance, through the NRC's International Regulatory Development Partnership, for over 20 countries considering civilian nuclear power programs.

Administration

- Closed approximately 600 Freedom of Information Act requests and appeals.
- By the end of FY 2015, reduced the number of backlogged Freedom of Information Act requests by 73 percent, from 27 to 8.
- Issued 80 escalated enforcement actions, 15 actions involving civil penalties, and 61 escalated notices of violation without a proposed civil penalty.
- Continued to conduct agency outreach to audiences interested in NRC activities, including through the use of social media.
- Awarded 46 grants to 32 institutes of higher education in 23 States and Puerto Rico, including six minority-serving institutions.
- In FY 2015, awarded $2.4 million in grants to 11 minority-serving institutions of higher education.
- Further consolidated headquarters by relinquishing the 21 Church Street building (64,000 square feet) and four floors of the 3 White Flint North building (92,000 square feet), thereby reducing the overall footprint.

Public Meetings and Involvement

- Hosted both the annual Regulatory Information Conference and the annual Fuel Cycle Information Exchange, where thousands of participants from around the world discussed the latest technical issues.
- Conducted approximately 1,000 public meetings in the Washington, DC, area and around the country addressing a full range of NRC issues.
- The Advisory Committee on Reactor Safeguards held 10 full committee meetings and 61 subcommittee meetings in calendar year 2015.
- The Advisory Committee on the Medical Uses of Isotopes held five public meetings in calendar year 2015.

News and Information

- NRC news releases are posted on the Web site and available through a free listserv subscription at www.nrc.gov/public-involve/listserver.html.
- The NRC uses social media as a communication tool to allow the public to stay connected through the NRC Blog, Twitter, Flickr, YouTube, and Facebook.

For more information on the agency's accomplishments, find the reports to Congress on the NRC Web site at http://www.nrc.gov/reading-rm/doc-collections/congress-docs/.

Contact Us

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Report a Concern

Emergency

Report an emergency involving a nuclear facility or radioactive materials, including:

- any accident involving a nuclear reactor, nuclear fuel facility, or radioactive materials
- lost or damaged radioactive materials
- any threat, theft, smuggling, vandalism, or terrorist activity involving a nuclear facility or radioactive materials

Call the NRC's 24-Hour
Headquarters Operations Center:
301-816-5100

We accept collect calls. We record all calls to this number.

Non-Emergency

This includes any concern involving a nuclear reactor, nuclear fuel facility, or radioactive materials.

You may send an e-mail to allegations@nrc.gov. However, because e-mail transmission may not be completely secure, if you are concerned about protecting your identity, it is preferable that you contact us by telephone or in person. You may contact any NRC employee (including a resident inspector) or call:

NRC's Toll-Free Safety Hotline:
800-695-7403

Calls to this number are not recorded between the hours of 7 a.m. and 5 p.m. Eastern Standard Time. However, calls received outside these hours are answered by the Incident Response Operations Center on a recorded line.

Some materials and activities are regulated by Agreement States, and concerns should be directed to the appropriate State radiation control program at https://scp.nrc.gov/allegations.html.

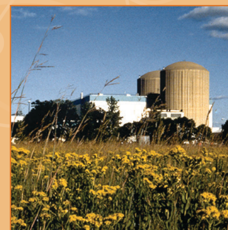
The NRC's Office of the Inspector General

The Office of the Inspector General (OIG) at the NRC established the OIG Hotline to provide NRC employees, other government employees, licensee and utility employees, contractor employees, and the public with a confidential means of reporting incidences of suspicious activity to OIG concerning fraud, waste, abuse, and employee or management misconduct. Mismanagement of agency programs or danger to public health and safety may also be reported through the hotline.

It is not OIG policy to attempt to identify people contacting the OIG Hotline. People may contact OIG by telephone, through an online form, or by mail. There is no caller identification feature associated with the hotline or any other telephone line in the Inspector General's office. No identifying information is captured when you submit an online form. You may provide your name, address, or telephone number, if you wish.

Call the OIG Hotline:
1-800-233-3497, TDD: 1-800-270-2787
7 a.m.–4 p.m. (Eastern Standard Time)
After hours, please leave a message.

NRC



NRC An Independent Regulatory Agency

Mission

The U.S. Nuclear Regulatory Commission (NRC) is an independent agency created by Congress. Its mission is to license and regulate the civilian use of radioactive materials in the United States to protect public health and safety, promote the common defense and security, and protect the environment.

The NRC regulates commercial nuclear power plants; research, test, and training reactors; nuclear fuel cycle facilities; and radioactive materials used in medicine, academia, and industry. The agency also regulates the transport, storage, and disposal of radioactive materials and waste; most Federal agencies' use and possession of radioactive materials; and the export and import of radioactive materials. The NRC regulates industries within the United States and works with agencies around the world to enhance global nuclear safety and security. To fulfill its responsibilities, the NRC performs five principal regulatory functions, as seen in Figure 1: How We Regulate.

Vision and Values

A trusted, independent, transparent, and effective nuclear regulator

To be successful, the NRC must not only excel in carrying out its mission but must do so in a manner that engenders the trust of the public and stakeholders. This vision is an outgrowth of the NRC operating in a manner consistent with its longstanding Principles of Good Regulation—independence, openness, efficiency, clarity, and reliability—and its organizational values.

These principles guide the agency. They affect how the NRC reaches decisions on safety, security, and the environment; how the NRC performs administrative tasks; and how its employees interact with each other as well as external stakeholders. By adhering to these principles and values, the NRC maintains its regulatory competence, conveys that competence to the stakeholders, and promotes trust in the agency. The agency puts these principles into practice with effective, realistic, and timely actions.

NRC Organizational Values

Integrity *in our working relationships, practices, and decisions*

Service *to the public and others who are affected by our work*

Openness *in communications and decisionmaking*

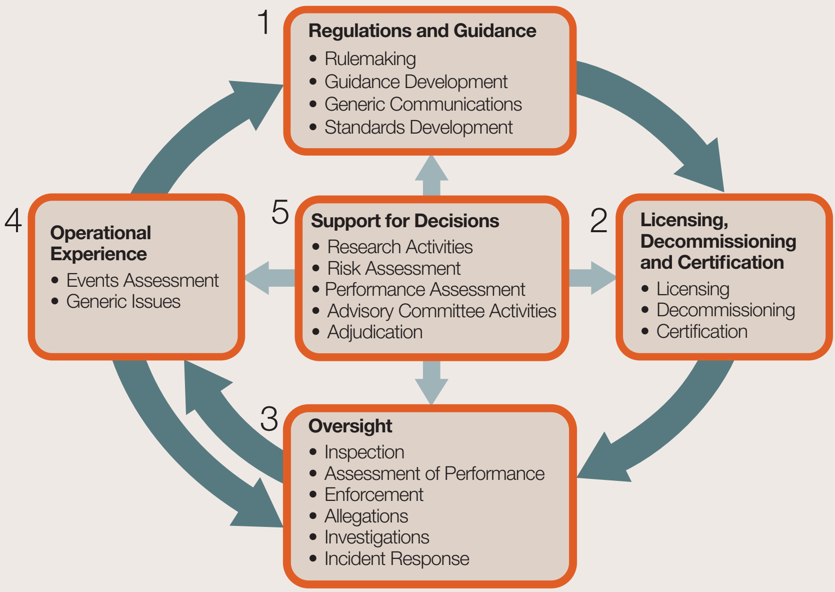
Commitment *to public health and safety, security, and the environment*

Cooperation *in the planning, management, and performance of agency work*

Excellence *in our individual and collective actions*

Respect *for individuals' diversity, roles, beliefs, viewpoints, and work/life balance*

Figure 1. How We Regulate



1. *Developing regulations and guidance for applicants and licensees.*
2. *Licensing or certifying applicants to use nuclear materials, operate nuclear facilities, and decommission facilities.*
3. *Inspecting and assessing licensee operations and facilities to ensure licensees comply with NRC requirements, responding to incidents, investigating allegations of wrongdoing, and taking appropriate followup or enforcement actions when necessary.*
4. *Evaluating operational experience of licensed facilities and activities.*
5. *Conducting research, holding hearings, and obtaining independent reviews to support regulatory decisions.*

NRC staff members meet with stakeholders to discuss the agency's regulatory issues.

Strategic Goals

Safety: Ensure the safe use of radioactive materials.

Security: Ensure the secure use of radioactive materials.

Statutory Authority

The Energy Reorganization Act of 1974 created the NRC from a portion of the former Atomic Energy Commission. The new agency was to independently oversee—but not promote—the commercial nuclear industry so the United States could benefit from the use of radioactive materials while also protecting people and the environment. The agency began operations on January 18, 1975. The NRC's regulations can be found in Title 10, "Energy," of the *Code of Federal Regulations* (10 CFR). The principal statutory authorities that govern the NRC's work can be found on the NRC's Web site (see the Web Link Index for more information).

The NRC, its licensees (those licensed by the NRC to use radioactive materials), and the Agreement States (States that assume regulatory authority over certain nuclear materials) share responsibility for protecting public health and safety and the environment. Federal regulations and the NRC's regulatory program play a key role. Ultimately, however, the licensees bear the primary responsibility for safely handling and using radioactive materials.

Major Activities

The NRC fulfills its responsibilities by:

- licensing the design, construction, operation, and decommissioning of commercial nuclear power plants and other nuclear facilities
- licensing the possession, use, processing, handling, exporting, and importing of nuclear materials
- licensing the siting, design, construction, operation, and closure of low-level radioactive waste (LLW) disposal sites in States under NRC jurisdiction
- certifying the design, construction, and operation of commercial transportation casks
- licensing the design, construction, and operation of spent fuel storage casks and interim storage facilities for spent fuel and high-level radioactive waste
- licensing nuclear reactor operators
- licensing uranium enrichment facilities

- conducting research to develop regulations and to anticipate potential reactor and other nuclear facility safety issues
- collecting, analyzing, and disseminating information about the safe operation of commercial nuclear power reactors and certain nonreactor activities
- issuing safety and security regulations, policies, goals, and orders that govern nuclear activities
- interacting with other Federal agencies, foreign governments, and international organizations on safety and security issues
- investigating nuclear incidents and allegations concerning any matter regulated by the NRC
- inspecting NRC licensees to ensure adequate performance of safety and security programs
- enforcing NRC regulations and the conditions of NRC licenses and imposing, when necessary, civil sanctions and penalties
- conducting public hearings on nuclear and radiological safety and security and on environmental concerns
- implementing international legal commitments made by the U.S. Government in treaties and conventions
- developing effective working relationships with State and Tribal governments
- maintaining an effective incident response program and overseeing required emergency response activities at NRC-licensed facilities
- implementing lessons learned from the March 2011 nuclear accident in Japan to enhance safety at U.S. commercial nuclear facilities
- involving the public in the regulatory process through meetings, conferences, and workshops; providing opportunities for commenting on proposed new regulations, petitions, guidance documents, and technical reports; providing ways to report safety concerns; and providing documents under the Freedom of Information Act and through the NRC's Web site
- engaging and informing the public through social media platforms and by providing interactive, high-value data sets (data in a form that allows members of the public to search, filter, or repackage information)

See the complete list of NRC's authorizing legislation in Appendix W.

Organizations and Functions

The NRC's Commission has five members nominated by the President and confirmed by the U.S. Senate for 5-year terms. The members' terms are staggered so one Commissioner's term expires on June 30 of each year. The President designates one member to serve as Chairman. The Chairman is the principal executive officer and spokesperson of the agency. No more than three Commissioners can belong to the same political party. The Commission as a whole formulates policies and regulations governing the safety and security of nuclear reactors and materials, issues orders to licensees, and adjudicates legal matters brought before it. The Executive Director for Operations carries out the policies and decisions of the Commission and directs the activities of the program and regional offices (see Figure 2: NRC Organizational Chart).

Commissioner Term Expiration*

Stephen G. Burns
Chairman
June 30, 2019

Kristine L. Svinicki
June 30, 2017

Jeff Baran
June 30, 2018

Vacant

Vacant

** Commissioners listed by seniority. There are two positions vacant.*

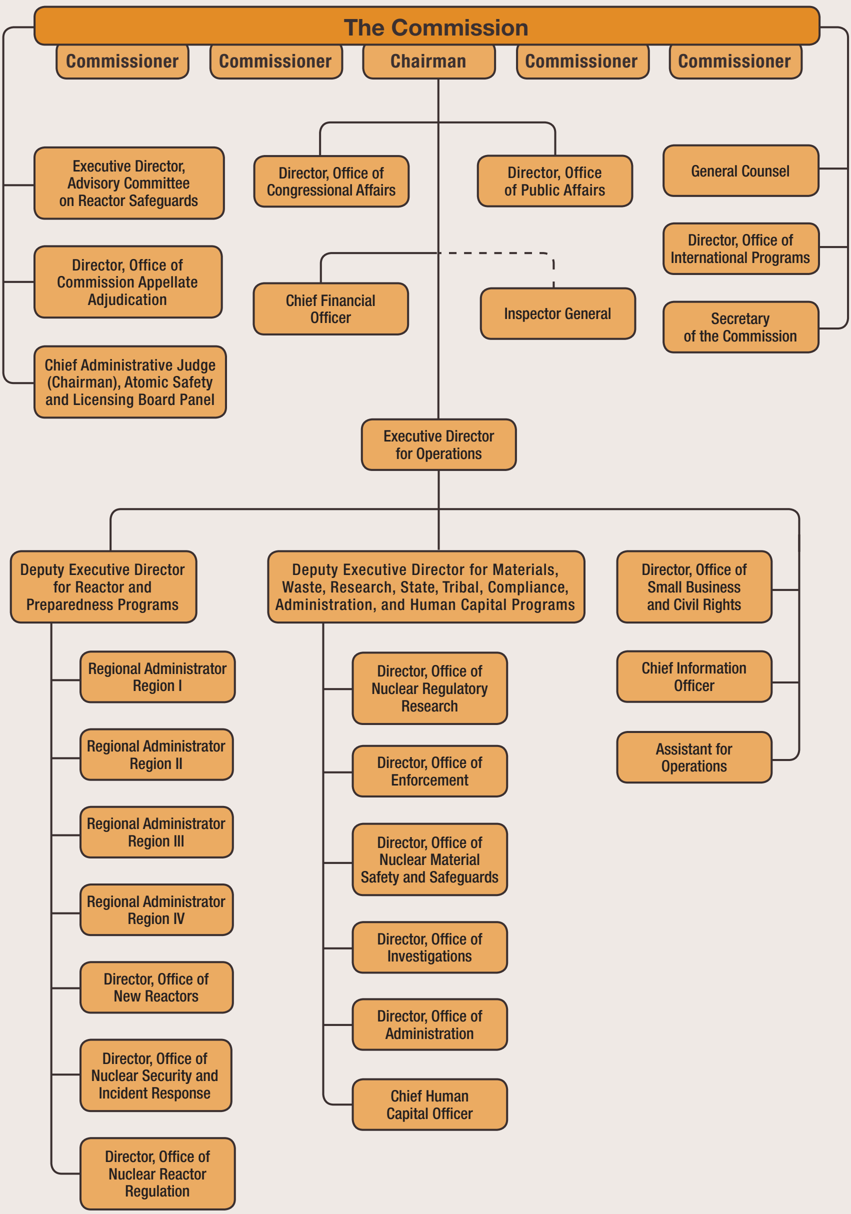
The NRC is headquartered in Rockville, MD, and has four regional offices. They are located in King of Prussia, PA; Atlanta, GA; Lisle, IL; and Arlington, TX. The major program offices within the NRC include:

The **Office of Nuclear Reactor Regulation** handles all licensing and inspection activities for existing nuclear power reactors and research and test reactors.

The **Office of New Reactors** oversees the design, siting, licensing, and construction of new commercial nuclear power reactors.

The **Office of Nuclear Regulatory Research** provides independent expertise and information for making timely regulatory judgments, anticipating potentially significant safety problems, and resolving safety issues. It helps develop technical regulations and standards, and collects, analyzes, and disseminates information about the safety of commercial nuclear power plants and certain nuclear materials activities.

Figure 2. NRC Organizational Chart



Note: For the most recent information, go to NRC Organizational Chart at www.nrc.gov/about-nrc/organization.html

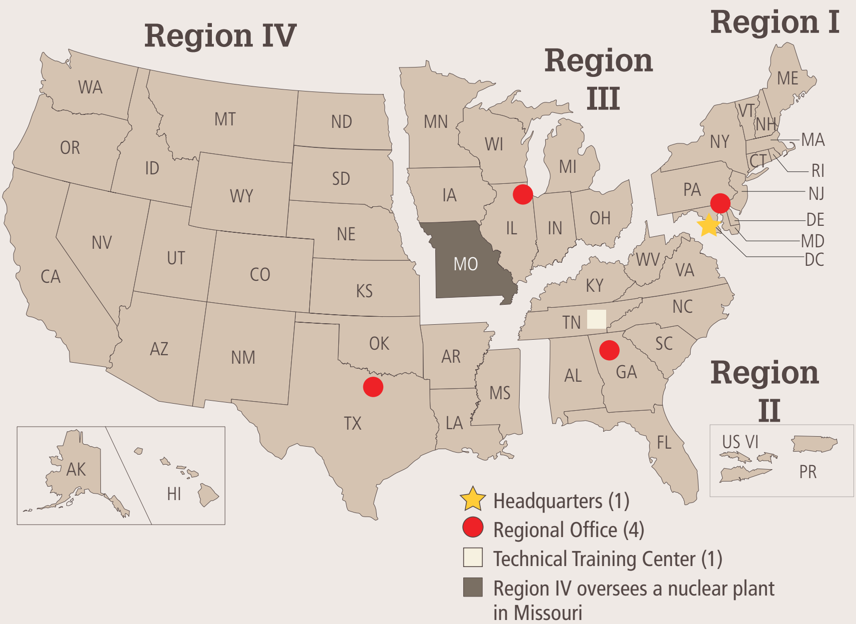
The **Office of Nuclear Material Safety and Safeguards** regulates the production of commercial nuclear fuel; uranium-recovery activities; decommissioning of nuclear facilities; and the use of radioactive materials in medical, industrial, academic, and commercial appplications. It regulates safe storage, transportation, and disposal of high- and low-level radioactive waste and spent nuclear fuel. The office also works with other Federal agencies, States, and Tribal and local governments on regulatory matters.

The **Office of Nuclear Security and Incident Response** initiates and oversees implementation of agency security policy for nuclear facilities and users of radioactive material and coordinates with other Federal agencies and international organizations on security issues. This office also maintains the NRC's emergency preparedness and incident response programs.

The **Regional Offices** conduct inspections and investigations, take enforcement actions (in coordination with the Office of Enforcement), and maintain emergency response programs for nuclear reactors, fuel facilities, and materials licensees. In addition, the regions carry out licensing for certain materials licensees (see Figure 3: NRC Regions).

The NRC headquarters complex is located in Rockville, MD.

Figure 3. NRC Regions



Nuclear Power Plants

- Each regional office oversees the plants in its region—except for the Callaway plant in Missouri, which Region IV oversees.

Materials Licensees

- Region I oversees licensees and Federal facilities located geographically in Region I and Region II.
- Region III oversees licensees and Federal facilities located geographically in Region III.
- Region IV oversees licensees and Federal facilities located geographically in Region IV.

Nuclear Fuel Processing Facilities

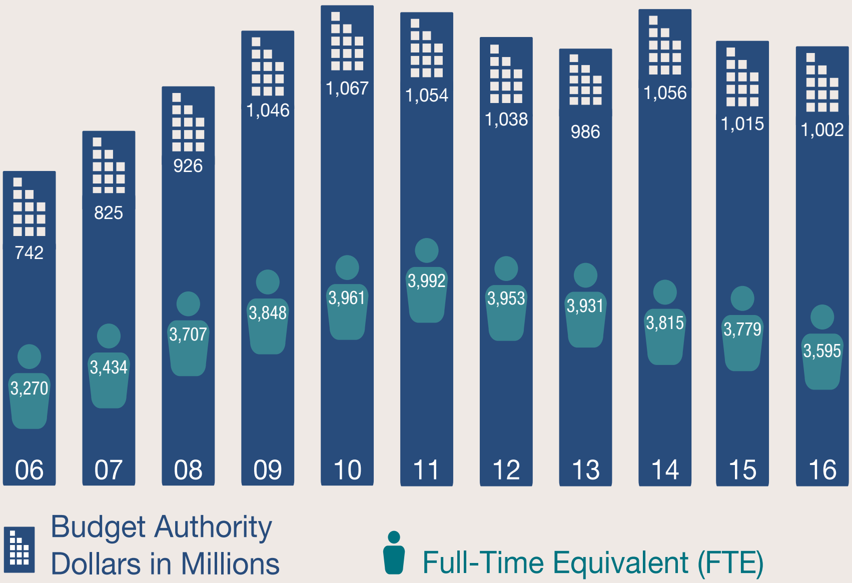
- Region II oversees all the fuel processing facilities in all regions.
- Region II also handles all construction inspection activities for new nuclear power plants and fuel cycle facilities in all regions.

Fiscal Year 2016 Budget

For fiscal year (FY) 2016 (October 1, 2015, through September 30, 2016), the NRC's budget is $1,002.1 million. The NRC's FY 2016 full-time equivalents (FTE) are 3,595; this includes the Office of the Inspector General (see Figure 4: NRC Budget Authority, FYs 2006–2016). The Office of the Inspector General received its own appropriation of $12.1 million. This amount is included in the total NRC budget.

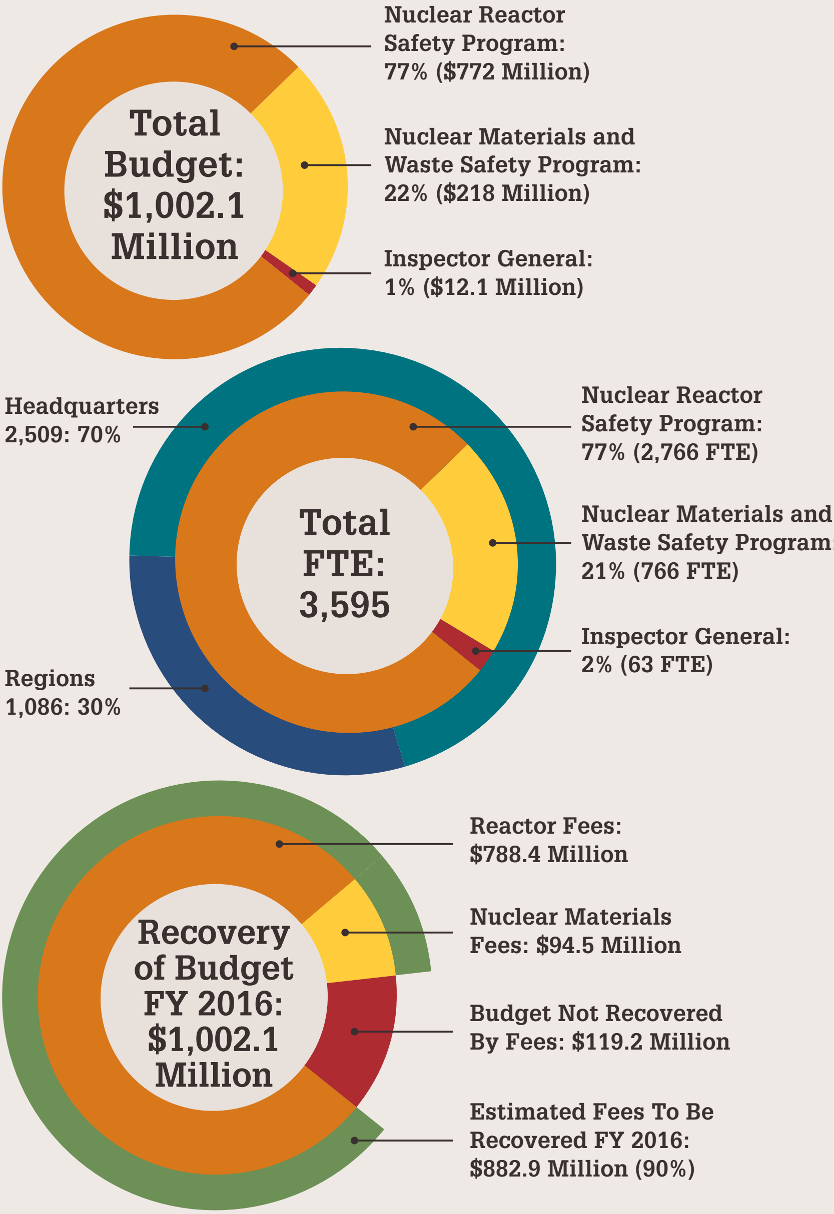
The breakdown of the budget is shown in Figure 5: NRC FY 2016 Distribution of Budget Authority; Recovery of NRC Budget. By law, the NRC must recover, through fees billed to licensees, approximately 90 percent of its budget authority, less the amounts appropriated from general funds for waste-incidental-to-reprocessing activities and generic homeland security activities. The NRC collects fees each year by September 30 and transfers them to the U.S. Treasury. Estimated fees to be recovered in FY 2016 are $882.9 million.

Figure 4. NRC Budget Authority, FYs 2006–2016

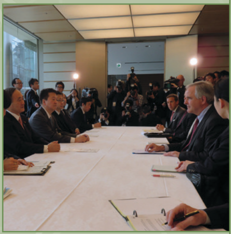


Note: Dollars are rounded to the nearest million.

Figure 5. NRC FY 2016 Distribution of Budget Authority; Recovery of NRC Budget



Note: The NRC incorporates corporate and administrative costs proportionately within programs. Numbers are rounded. Budget for FY 2016.



Nuclear Energy in the U.S. and Worldwide

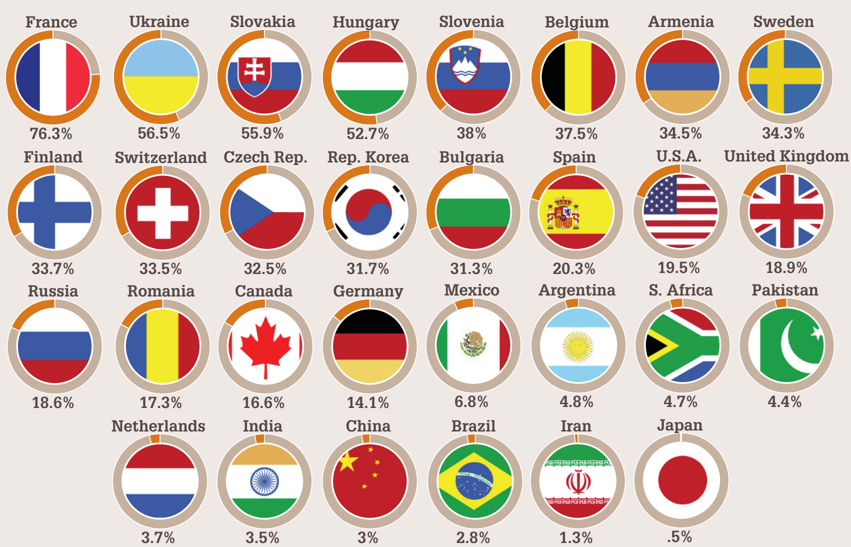
Worldwide Electricity Generated by Commercial Nuclear Power

Nuclear technology was first developed in the 1940s initially for producing weapons, but President Dwight Eisenhower's Atoms for Peace program shifted the focus to power generation, scientific research, and the production of medical and industrial isotopes. Today, nuclear technology is global, and nuclear-generated power is a part of the worldwide energy portfolio.

As of June 2016, there were 445 operating reactors in 30 countries with a total installed capacity of 387,441 megawatts electric (MWe). In addition, two nuclear power plants were in long-term shutdown and 64 were under construction. Based on preliminary data from 2015, France had the highest portion (76 percent) of total domestic energy generated by nuclear power. (Figure 6: Nuclear Share of Electricity Generated by Country).

See Appendix R for the number of nuclear power reactor units by nation and Appendix S for nuclear power reactor units by reactor type, worldwide.

Figure 6. Nuclear Share of Electricity Generated by Country



Note: The country's short-form name is used.
Source: IAEA, Power Reactor Information System database, as of May 2016

In addition to generating electricity, nuclear materials and technology are used worldwide for many other peaceful purposes, such as:

- Radioactive isotopes diagnose and treat medical conditions.
- Irradiation makes food safer and last longer and assists in making pest-resistant seed varieties with higher yields.
- Nuclear gauges maintain quality control in industry.
- Radioactive isotopes date objects and identify elements.

The NRC engages in international activities to exchange regulatory information related to the safe and secure civilian use of nuclear materials and technologies.

International Activities

The NRC aims its international efforts to meet needs identified by the Commission. The Office of International Programs oversees the regulatory framework for licensing exports and imports of nuclear materials and equipment. It also facilitates cooperation and assistance programs for other countries. Many NRC international activities are required by U.S. law, including international conventions and treaties.

The NRC works with multinational organizations, such as the International Atomic Energy Agency (IAEA), and directly with regulators in other countries through research and cooperation agreements. These activities allow the NRC to share and learn the best regulatory safety and security practices. Joint research projects also give the NRC access to research facilities not available in the United States.

See Appendices X, Y, and Z for lists of international activities.

Conventions and Treaties

Several conventions and treaties address nuclear safety and security. All countries that ratify such conventions and treaties must take action to implement them. These international agreements help ensure high levels of safety and security are given proper attention. The Treaty on the Non-Proliferation of Nuclear Weapons is one of the most important treaties obligating the U.S. Government to cooperate with and provide assistance to other treaty parties that seek the benefits of peaceful uses of nuclear energy.

The NRC works with other U.S. agencies to implement conventions and treaties by establishing and enforcing rules, regulations, and policies that address the following issues:

- nuclear nonproliferation
- export and import licensing
- safety
- international safeguards
- physical protection
- emergency notification and assistance
- spent fuel and waste management
- liability

The NRC participates in international meetings related to conventions, and at these meetings, the U.S. Government presents national reports detailing how the United States meets its obligations. Each report is peer reviewed by participating nations with the goal of encouraging all countries to enhance their regulatory programs.

Export and Import Licensing

See Appendix Z for a web link to a list of export and import licenses.

The NRC conducts reviews to license exports and imports of nuclear materials and equipment. The NRC must determine that such exports and imports will not undermine common defense and security and will not pose an unreasonable risk to U.S. public health and safety. The NRC's export and import regulations are found in 10 CFR Part 110, "Export and Import of Nuclear Equipment and Material." The NRC participates in meetings of the Nuclear Suppliers Group, and the Code of Conduct on the Safety and Security of Radioactive Sources (see the Web Link Index for the Code of Conduct) to ensure that U.S. export and import controls are appropriate.

Photo courtesy of IAEA

The NRC participates in the annual General Conference for the International Atomic Energy Agency in Vienna, Austria.

Bilateral Cooperation and Assistance

The NRC has information-sharing agreements with other countries, including Taiwan, and the European Atomic Energy Community (see Appendix Y for the list of countries that have bilateral information exchange and cooperation agreements with the NRC).

Cooperation

There are a wide range of programs that enhance the safety and security of peaceful nuclear activities worldwide. With countries that have mature nuclear power or radioactive materials programs, the NRC focuses on sharing information and best practices. With countries that have new programs, the NRC focuses on helping develop and improve their regulatory activities.

See Appendix Y for a list of the NRC's participation with multilateral organizations and a list of countries with bilateral information exchange and cooperation agreements with the NRC.

Some of the benefits of consulting with other countries include:

- awareness of reactor construction activities that could apply to new reactors being built in the United States
- prompt notification to foreign partners of U.S. safety issues
- sharing safety and security information

The NRC's Advisory Committee on Reactor Safeguards (ACRS) also works with advisory committees in other countries. The ACRS exchanges information with these committees through annual working group meetings. It holds plenary meetings every 4 years.

Assistance

The NRC offers training, workshops, and peer review of regulatory documents to assist other countries as they develop or enhance their national nuclear regulatory infrastructures and programs. The agency also supports and participates in regional working group meetings to exchange technical information among specialists. If asked, the NRC will respond directly to countries looking for help to improve their controls of radioactive material.

Foreign Assignee Program

The NRC provides on-the-job training to foreign nationals at NRC Headquarters and the regional offices. The NRC's Foreign Assignee Program allows the NRC staff to exchange information with regulators from around the world. This helps both agencies better understand the other's regulatory programs, capabilities, and commitments. It also helps enhance the expertise of both foreign assignees and the NRC staff. The program also fosters relationships between the NRC and key officials in other countries.

Multilateral Cooperation and Assistance

The NRC plays an active role in the different programs and committee work of global organizations. The agency works with multiple regulatory counterparts through the IAEA, the Organisation for Economic Co-operation and Development's Nuclear Energy Agency, and other multilateral organizations on issues related to:

- safety research
- radiation protection
- risk assessment
- emergency preparedness
- waste management
- transportation
- safeguards
- physical protection
- security
- standards development
- training
- technical assistance
- communications

International Cooperative Research

The NRC participates in international cooperative research programs to share U.S. operating experience and to learn from the experiences of other countries. The NRC also participates in international efforts to improve the security of radioactive materials and the management of radioactive wastes.

The NRC participates in cooperative research programs with many countries and Taiwan. This helps leverage access to foreign test facilities otherwise unavailable to the United States.

NRC Chairman Stephen Burns, representing U.S. Secretary of State John Kerry, attends the 2015 Nuclear Non-Proliferation Treaty Review Conference in the Council Chamber of the United Nations in New York.

5

Nuclear Reactors

U.S. Electricity Generated by Commercial Nuclear Power

In 2015, NRC-licensed nuclear reactors generated about 19.5 percent of U.S. net electricity, or about 771 billion kilowatt-hours (see Figure 7: U.S. Net Electric Generation by Energy Source, 2015, and Figure 8: U.S. Net Electric Generation by Energy Source, 2005–2015).

Since the 1970s, the Nation's utilities have asked permission to generate more electricity from existing nuclear plants. The NRC regulates how much heat a commercial nuclear reactor may generate. This amount of heat, or power level, is used with other data in many analyses that demonstrate the safety of the nuclear power plant. This power level is included in the plant's license and technical specifications. The NRC must review any licensee's requested change to a license or technical specification, and the licensee may only make the change after the NRC approves it. Increasing a commercial nuclear power plant's maximum operational power level is called a power uprate.

The NRC has approved power uprates that have collectively added the equivalent of seven new reactors' worth of electrical generation to the power grid. The NRC expects a few more power uprate applications through 2017.

See Glossary for information on electric power grid.

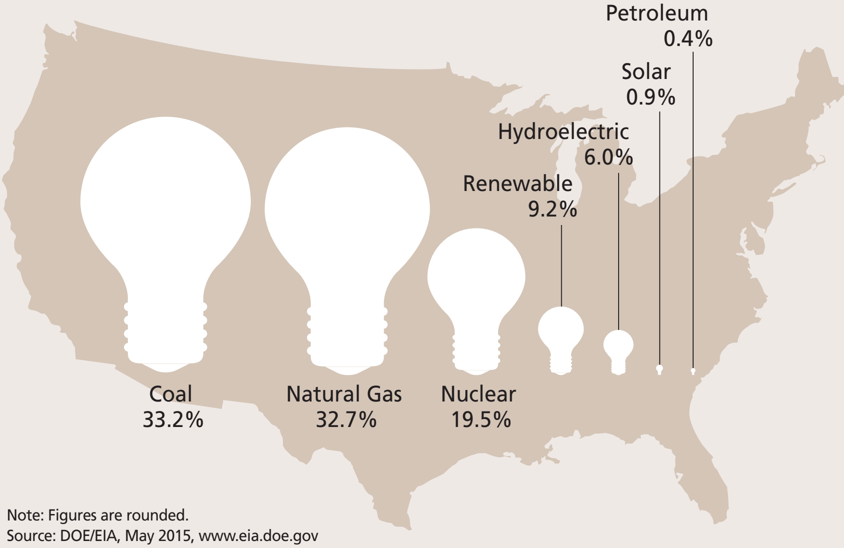
According to the U.S. Energy Information Administration, in 2014, each of the following states generated more than 40 percent of their electricity from nuclear power: Conneticut, Illinois, New Hampshire, New Jersey, South Carolina, Vermont, and Virginia. The 2014 data cited reflect the percentages of the total net generation from nuclear sources in each of these States (see Figure 9: Net Electricity Generated in each State by Nuclear Power). As of June 2016, 30 of the 50 States generate electricity from nuclear power plants (Vermont's only nuclear plant shut down at the end of 2014).

U.S. Commercial Nuclear Power Reactors

Power plants convert heat into electricity using steam. At nuclear power plants, the heat to make the steam is created when atoms split apart in a process called fission. When the process is repeated over and over, it is called a chain reaction. The heat from fission creates steam to turn a turbine. As the turbine spins, the generator turns and its magnetic field produces electricity.

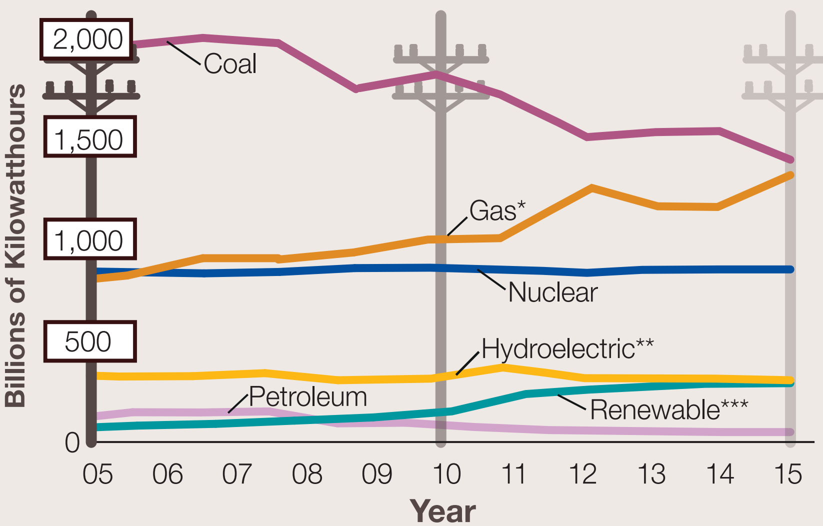
Nuclear power plants are very complex. There are many buildings at the site and many different systems. Some of the systems work directly to make electricity. Some of the systems keep the plant working correctly and safely. All nuclear power plants have a containment structure with reinforced concrete about 1.2 meters thick that houses the reactor. To keep reactors performing efficiently, operators

Figure 7. U.S. Net Electric Generation by Energy Source, 2015



Note: Figures are rounded.
Source: DOE/EIA, May 2015, www.eia.doe.gov

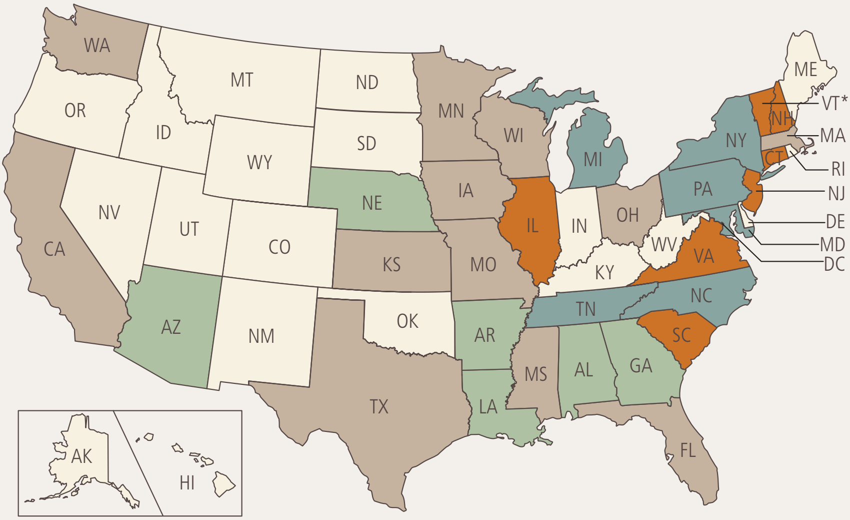
Figure 8. U.S. Net Electric Generation by Energy Source, 2005–2015



* Gas includes natural gas, blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuel.
** Hydroelectric includes conventional hydroelectric and hydroelectric pumped storage.
*** Renewable energy includes geothermal, wood and nonwood waste, wind, and solar energy.
Source: DOE/EIA, May 2015, www.eia.doe.gov

Figure 9. Net Electricity Generated in Each State by Nuclear Power

Percent of Total Nuclear Power Generated



None	1–20%	21–29%	30–39%	40+%
19 States	12 States	6 States	6 States	7 States

Total Nuclear Power Generated (in Megawatt-hours)

Illinois	97,858
Pennsylvania	78,715
S. Carolina	52,419
New York	43,039
Alabama	41,244
N. Carolina	40,967
Texas	39,287
Georgia	32,570
Arizona	32,321
New Jersey	31,507
Virginia	30,221
Michigan	31,246
Florida	27,868
Tennessee	27,670
Louisiana	17,311
California	16,986
Ohio	16,284
Connecticut	15,841
Arkansas	14,481
Maryland	14,343
Minnesota	12,707
New Hampshire	10,168
Mississippi	10,151
Nebraska	10,102
Washington	9,497
Wisconsin	9,447
Missouri	9,276
Kansas	8,558
Massachusetts	5,769
Vermont*	5,061
Iowa	4,152

Note: *Vermont's nuclear power plant, Vermont Yankee, shut down 12/28/2014 and no longer produces electricity.
Source: DOE/EIA, "State Historical Electric Tables for 2014," data updated November 2015, www.eia.doe.gov.

remove about one-third or half of the fuel every year or two and replace it with fresh fuel. Used fuel is stored and cooled in deep pools onsite. The process of removing used fuel and adding fresh fuel is known as refueling.

See Appendix E for a list of parent companies of U.S. commercial operating nuclear power reactors, Appendix A for a list of reactors and their general licensing information, Appendix T for Native American Reservations and Trust lands near nuclear power plants, and Appendix K for radiation doses and regulatory limits.

There are two types of commercial reactors in the United States. Pressurized-water reactors are known as PWRs. They keep water under pressure so it heats but does not boil. Water from the reactor and the water that is turned into steam are in separate pipes and never mix. In boiling-water reactors, or BWRs, the water heated in the reactor actually boils and turns into steam to turn the generator. In both types of plants, the steam is turned back into water and can be used again in the process.

The NRC regulates commercial nuclear power plants that generate electricity. There are several operating companies and vendors and many different types of reactor designs. Of these designs, only pressurized-water reactors and boiling-water reactors are currently in commercial operation in the United States. Although commercial U.S. reactors have many similarities, each one is considered unique (see Figure 10: U.S. Operating Commercial Nuclear Power Reactors).

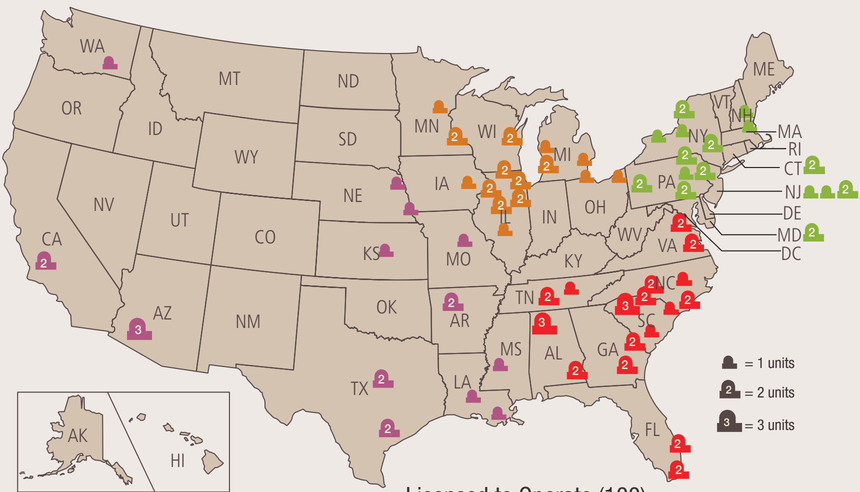
See Glossary for typical PWR and BWR design illustrations.

Resident Inspectors

Since the late 1970s, the NRC has maintained its own sets of eyes and ears at the Nation's nuclear power plants. These onsite NRC staff are referred to as resident inspectors. Each plant has at least two such inspectors, and their work is at the core of the agency's reactor inspection program. On a daily basis, these highly trained and qualified professionals scrutinize activities at the plants and verify adherence to Federal safety requirements. Oversight includes inspectors visiting the control room and reviewing operator logbook entries, visually assessing areas of the plant, observing tests of (or repairs to) important systems or components, interacting with plant employees to see if they have any safety concerns, or checking corrective action documents to ensure that problems have been identified and appropriate fixes implemented.

Resident inspectors promptly notify plant operators of any safety-significant issues the inspectors find so they are corrected, if necessary, and communicated to NRC management. If problems are significant enough, the NRC will consider whether enforcement action is warranted. More information about the NRC's Reactor Oversight Process and the resident inspector program is available on the agency's Web site (see Figure 11: Day in the Life of an NRC Resident Inspector).

Figure 10. U.S. Operating Commercial Nuclear Power Reactors



Licensed to Operate (100)

REGION I

CONNECTICUT
- Millstone 2 and 3

MARYLAND
- Calvert Cliffs 1 and 2

MASSACHUSETTS
- Pilgrim

NEW HAMPSHIRE
- Seabrook

NEW JERSEY
- Hope Creek
- Oyster Creek
- Salem 1 and 2

NEW YORK
- FitzPatrick
- Ginna
- Indian Point 2 and 3
- Nine Mile Point 1 and 2

PENNSYLVANIA
- Beaver Valley 1 and 2
- Limerick 1 and 2
- Peach Bottom 2 and 3
- Susquehanna 1 and 2
- Three Mile Island 1

REGION II

ALABAMA
- Browns Ferry 1, 2, and 3
- Farley 1 and 2

FLORIDA
- St. Lucie 1 and 2
- Turkey Point 3 and 4

GEORGIA
- Edwin I. Hatch 1 and 2
- Vogtle 1 and 2

NORTH CAROLINA
- Brunswick 1 and 2
- McGuire 1 and 2
- Harris 1

SOUTH CAROLINA
- Catawba 1 and 2
- Oconee 1, 2, and 3
- Robinson 2
- Summer

TENNESSEE
- Sequoyah 1 and 2
- Watts Bar 1 and 2*

VIRGINIA
- North Anna 1 and 2
- Surry 1 and 2

REGION III

ILLINOIS
- Braidwood 1 and 2
- Byron 1 and 2
- Clinton
- Dresden 2 and 3
- LaSalle 1 and 2
- Quad Cities 1 and 2

IOWA
- Duane Arnold

MICHIGAN
- Cook 1 and 2
- Fermi 2
- Palisades

MINNESOTA
- Monticello
- Prairie Island 1 and 2

OHIO
- Davis-Besse
- Perry

WISCONSIN
- Point Beach 1 and 2

REGION IV

ARKANSAS
- Arkansas Nuclear 1 and 2

ARIZONA
- Palo Verde 1, 2, and 3

CALIFORNIA
- Diablo Canyon 1 and 2

KANSAS
- Wolf Creek 1

LOUISIANA
- River Bend 1
- Waterford 3

MISSISSIPPI
- Grand Gulf

MISSOURI
- Callaway

NEBRASKA
- Cooper
- Fort Calhoun

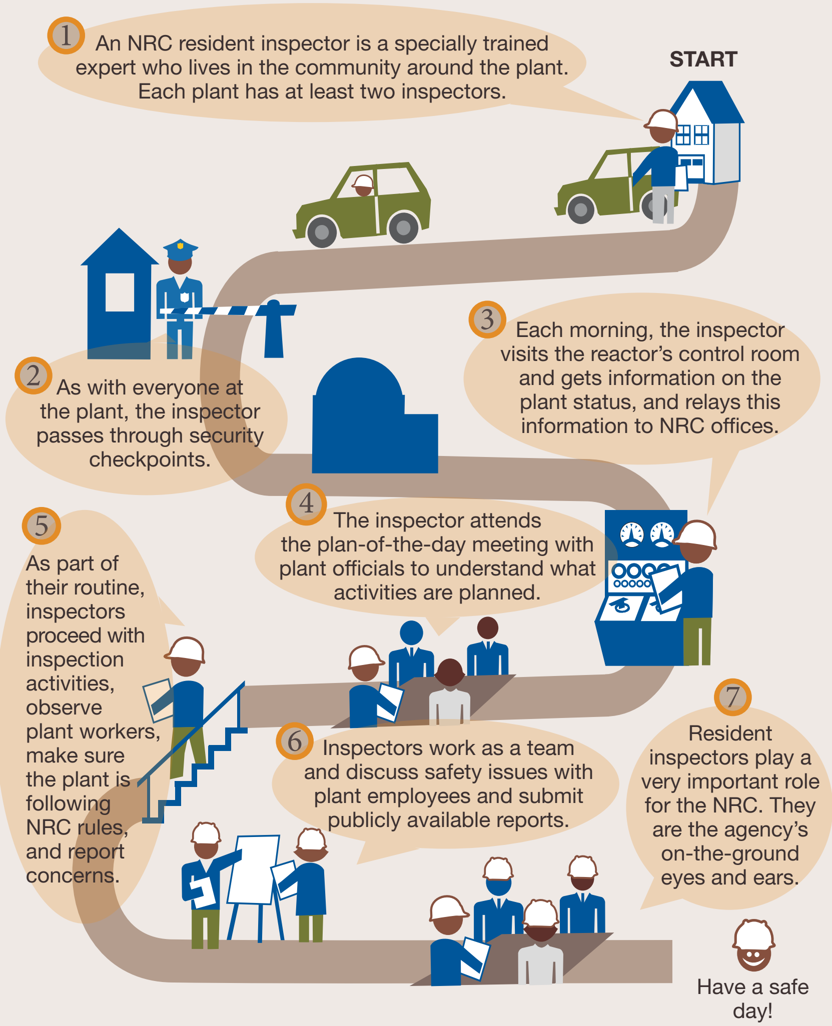
TEXAS
- Comanche Peak 1 and 2
- South Texas Project 1 and 2

WASHINGTON
- Columbia

* Watts Bar Unit 2 is currently performing startup testing, anticipated to begin commercial operation Fall 2016.

Note: NRC-abbreviated reactor names listed. Data is as of July 2016. For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Figure 11. Day in the Life of an NRC Resident Inspector



Learn more about resident inspectors. Watch the videos on the NRC YouTube Channel at www.youtube.com/user/NRCgov.

Post-Fukushima Dai-ichi Nuclear Accident

On March 11, 2011, a 9.0-magnitude earthquake struck off the coast of Japan and created a 45-foot tsunami. The reactors at the Fukushima Dai-ichi facility survived the earthquake but were damaged by the tsunami that arrived almost an hour later. Without power from the grid and with the tsunami knocking out back-up power, one of the plants suffered catastrophic failures.

The NRC sent experts to Japan in the days and weeks after the accident, and other agency staff reviewed the lessons from the accident. The review concluded that U.S. plants can operate safely while NRC actions, based on those lessons, enhance safety at U.S. commercial nuclear power plants. At the front lines of this effort were the agency's resident inspectors and regional staff. They have inspected and monitored U.S. reactors as the plants work on these enhancements. This work will continue to ensure plants have the required resources, plans, and training (see Figure 12: NRC Post-Fukushima Safety Enhancements and the Web Link Index).

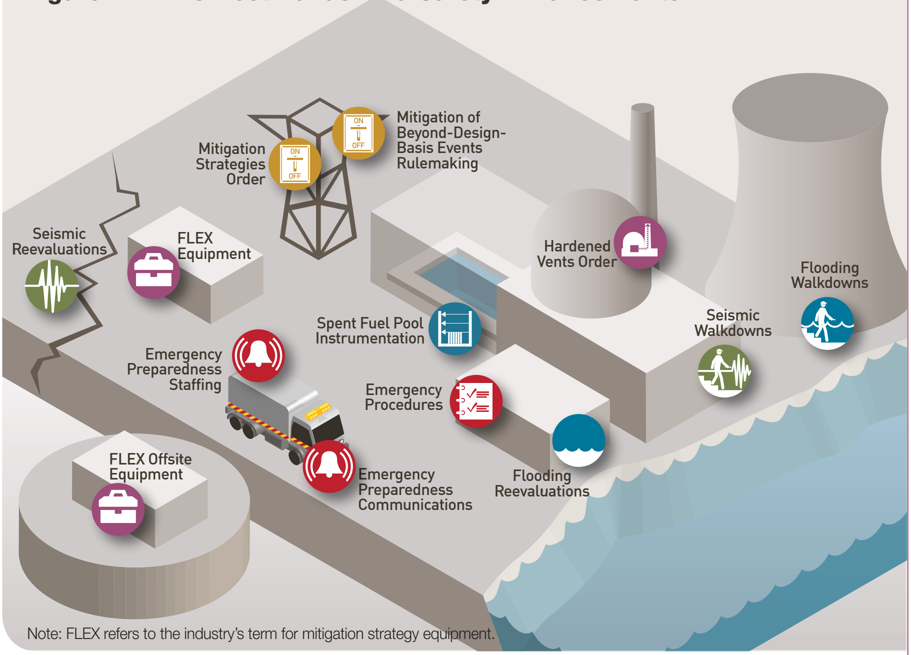
Principal Licensing, Inspection, and Enforcement Activities

The NRC's commercial reactor licensing and inspection activities include:

- reviewing separate license change requests from power reactor licensees
- performing inspection-related activities at each operating reactor site
- ensuring the qualifications of NRC-licensed reactor operators, who must requalify every 2 years and ask the NRC to renew their license every 6 years
- reviewing applications for proposed new reactors
- inspecting construction activities
- reviewing operating experience items each year and distributing lessons learned that could help licensed facilities operate more effectively
- issuing notices of violation, civil penalties, or orders to operating reactors for significant violations of NRC regulations regarding public health and safety
- investigating allegations of inadequacy or impropriety associated with NRC-regulated activities
- incorporating independent advice from the ACRS, which holds both full committee meetings and subcommittee meetings during each year to examine potential safety issues for existing or proposed reactors

See Appendix C for a list of reactors undergoing decommissioning and permanently shut down and Appendix V for a list of significant enforcement actions.

Figure 12. NRC Post-Fukushima Safety Enhancements



Note: FLEX refers to the industry's term for mitigation strategy equipment.

An NRC inspector conducts routine inspections of plant equipment to ensure the plant is meeting NRC regulations.

Oversight of U.S. Commercial Nuclear Power Reactors

The NRC establishes requirements for the design, construction, operation, and security of U.S. commercial nuclear power plants. The agency ensures the plants operate safely and securely within these requirements by licensing the plants to operate, licensing control room personnel, establishing technical specifications for operating each plant, and inspecting plants daily.

Reactor Oversight Process

The NRC's Reactor Oversight Process (ROP) verifies that U.S. reactors are operating in accordance with NRC rules, regulations, and license requirements. If reactor performance declines, the NRC increases its oversight to protect public health and the environment. This can range from conducting additional inspections to shutting a reactor down.

See Appendix H for a list of industry performance indicator averages by year.

The NRC staff uses the ROP to evaluate NRC inspection findings and performance records for each reactor and uses this information to assess the reactor's safety performance and security measures. Every 3 months, through the ROP, the NRC places each reactor in one of five categories. The top category is "fully meeting all safety cornerstone objectives," while the bottom is "unacceptable performance" (see Figure 13: Reactor Oversight Action Matrix Performance Indicators). NRC inspections start with detailed baseline-level activities for every reactor. As the number of issues at a reactor increases, the NRC's inspections increase. The agency's supplemental inspections and other actions (if needed) ensure licensees promptly address significant performance issues. The latest reactor-specific inspection findings and historical performance information can be found on the NRC's Web site (see the Web Link Index).

The ROP is informed by 30 years of improvements in nuclear industry performance. The process continues to improve approaches to inspecting and evaluating the safety and security performance of NRC-licensed nuclear plants. More ROP information is available on the NRC's Web site and in NUREG-1649, Revision 5, "Reactor Oversight Process," issued February 2014 (see Figure 14: Reactor Oversight Framework). In addition to evaluating individual plant performance, the NRC compiles data on overall nuclear industry performance using industry-level statistics.

Figure 13. Reactor Oversight Action Matrix Performance Indicators

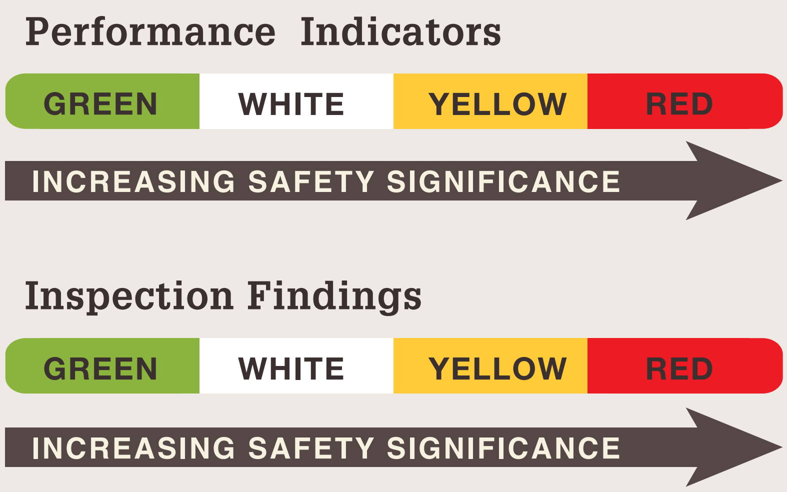
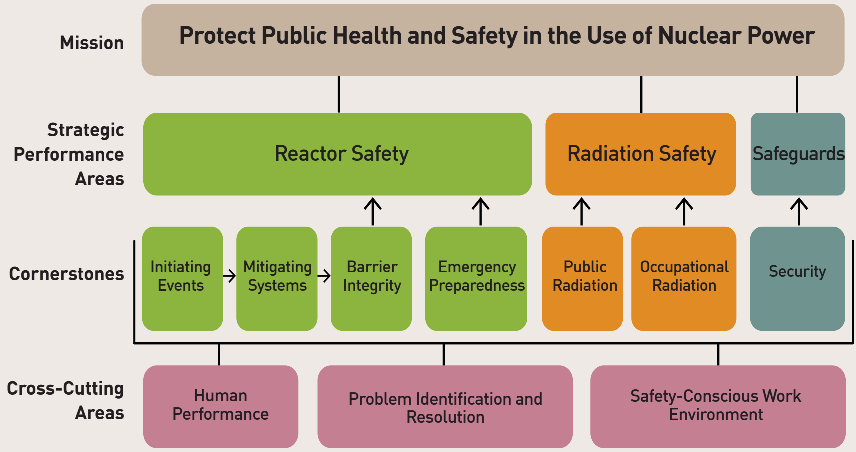


Figure 14. Reactor Oversight Framework



Reactor License Renewal

The Atomic Energy Act of 1954 (as amended) authorizes the NRC to issue 40-year initial licenses for commercial power reactors. The Act also allows the NRC to renew licenses. Under the NRC's current regulations, the agency can renew reactor licenses for 20 years at a time. Congress set the original 40-year term after considering economic and antitrust issues, as opposed to nuclear technology issues. Some parts of a reactor, however, may have been engineered based on an expected 40-year service life. These parts must be maintained and monitored during the additional period of operation, and licensees may choose to replace some components (see Figure 15: License Renewals Granted for Operating Nuclear Power Reactors).

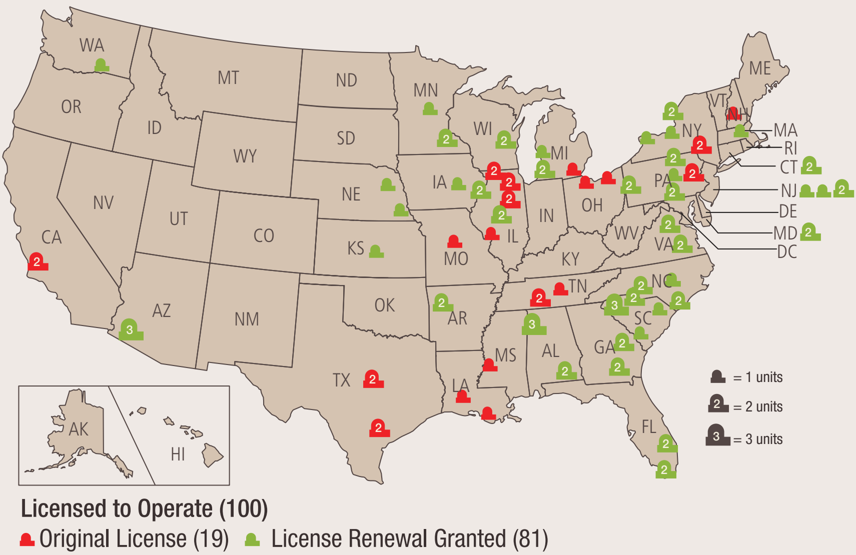
See Appendices F and G for power reactor operating licenses issued and expired by year.

For current reactors grouped by how long they have operated (see Figure 16: U.S. Commercial Nuclear Power Reactors—Years of Operation by the End of 2016). Nuclear power plant owners typically seek license renewal based on a plant's economic situation and on whether it can continue to meet NRC requirements in the future.

The NRC's license renewal reviews determine whether a plant can continue to operate safely beyond its current license period. The NRC reviews renewal applications for both safety issues and environmental impacts (see Figure 17: License Renewal Process). A plant owner must evaluate how the plant will address the aging of plant systems not already covered by NRC inspection and maintenance rules.
The plant owner must also report on the potential environmental impacts if the plant operates for up to an additional 20 years. The regulations are contained in 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," while the NRC's environmental review requirements for license renewal are found in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." If the NRC concludes extended operation will be safe, the staff verifies that safety evaluation through onsite inspections as the plant continues to operate.

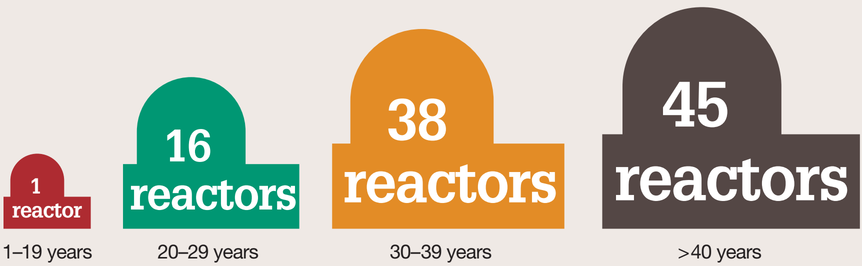
The NRC considered the environmental impacts of the continued storage of spent nuclear fuel during rulemaking activities and published its final Continued Storage Rule and supporting generic environmental impact statement in 2014. The rule addresses the environmental impacts of the continued storage of spent nuclear fuel beyond a reactor's licensed operating life before ultimate disposal (previously referred to as "waste confidence"). The environmental impacts of continued storage of spent nuclear fuel are incorporated into each environmental review for license renewal.

Figure 15. License Renewals Granted for Operating Nuclear Power Reactors



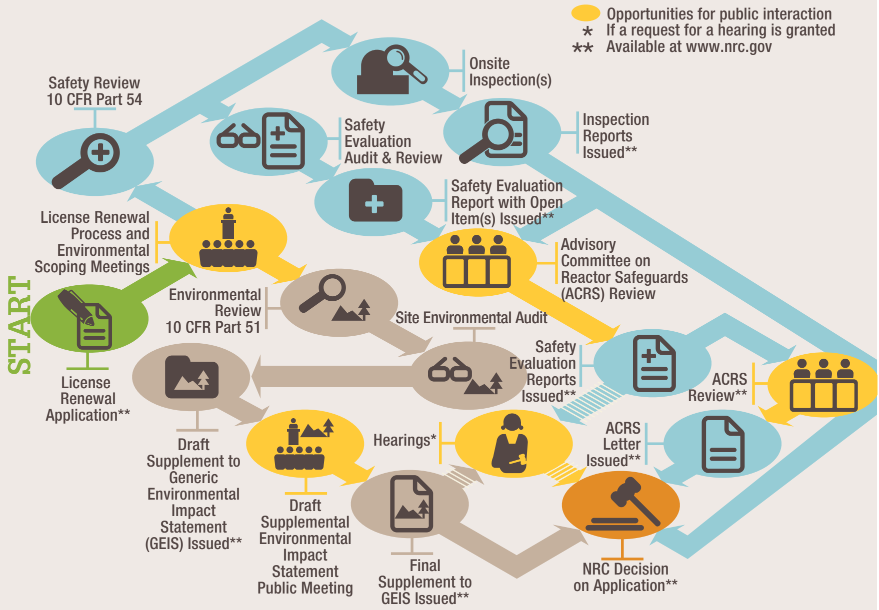
Note: Data is as of July 2016. For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Figure 16. U.S. Commercial Nuclear Power Reactors—Years of Operation by the End of 2016



Note: Ages have been rounded up to the end of the year. For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Figure 17. License Renewal Process



Public Involvement

The public plays an important role in the license renewal process. Members of the public have several opportunities to contribute to the environmental review. They can also discuss how aging will be managed if a plant operates beyond 40 years. The NRC shares information provided by the applicant and holds public meetings. The agency fully and publicly documents the results of its technical and environmental reviews. In addition, ACRS public meetings often discuss technical or safety issues related to reactor designs or a particular plant or site. Individuals or groups can raise legal arguments against a license renewal application in an Atomic Safety and Licensing Board (ASLB) hearing if they would be affected by the renewal and meet basic requirements for requesting a hearing. (For more information, see the Web Link Index.)

Research and Test Reactors

Nuclear research and test reactors (RTRs) support science and education in nuclear engineering, physics, chemistry, biology, anthropology, medicine, materials sciences, and related fields. These reactors do not produce electricity. Most U.S. research and test reactors are at universities or colleges.

The largest U.S. RTR (which produces 20 megawatts thermal [MWt]) is one-75th the size of the smallest U.S. commercial power nuclear reactor (which produces 1,500 MWt). The NRC regulates currently operating research and test reactors (see Figure 18: Size Comparison of Commercial and Research Reactors and Figure 19: U.S. Nuclear Research and Test Reactors). The U.S. Department of Energy uses research reactors, but they are not regulated by the NRC.

NRC inspectors visit each RTR facility at least once a year to conduct varying levels of oversight. RTRs licensed to produce 2 MWt or more receive a full NRC inspection every year. Those licensed to produce less than 2 MWt receive a full inspection every 2 years.

Figure 18. Size Comparison of Commercial and Research Reactors

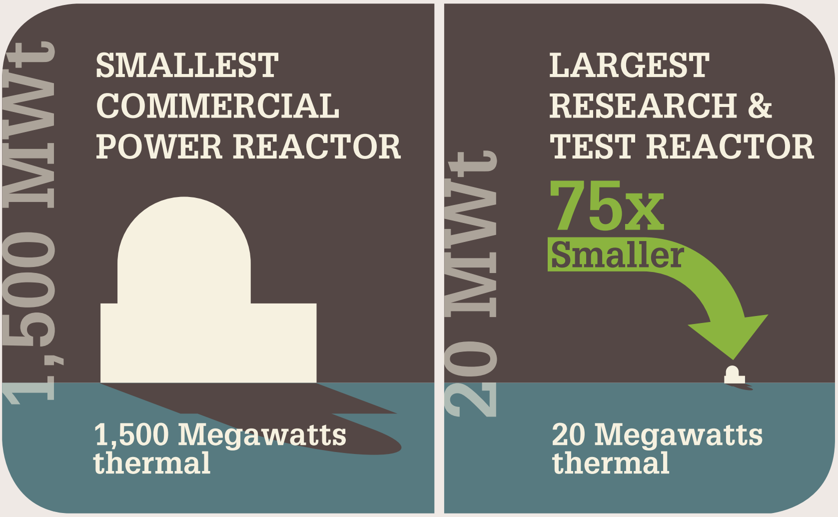
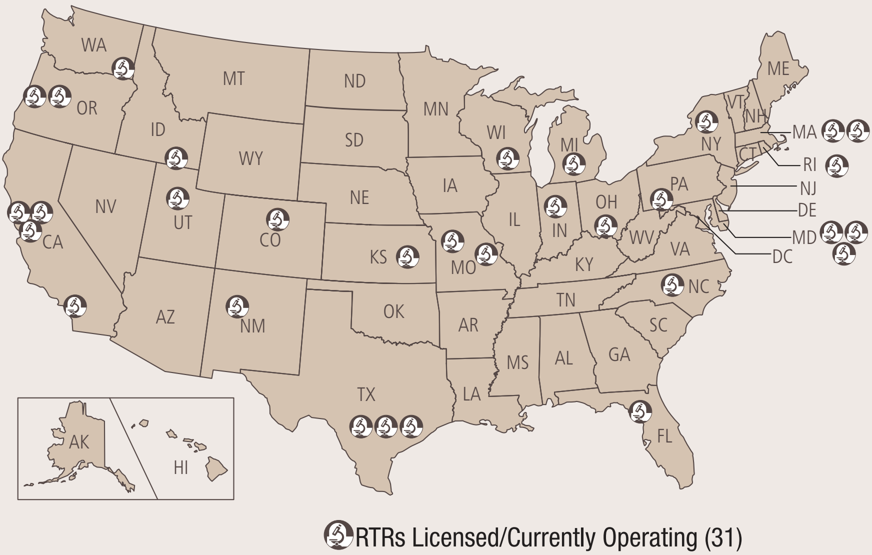


Figure 19. U.S. Nuclear Research and Test Reactors



Note: For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Principal Licensing and Inspection Activities

The NRC's RTR licensing and inspection activities include:

- licensing the operating sites, including license renewals and license amendments
- overseeing decommissioning
- licensing operators
- overseeing operator relicensing programs
- overseeing security programs
- conducting inspections each year, based on inspection frequency and procedures for operating RTRs

See Appendices I and J for a list of research and test reactors regulated by the NRC that are operating or are in the process of decommissioning.

New Commercial Nonpower Production and Utilization Facility Licensing

Doctors worldwide rely on a steady supply of molybdenum-99 (Mo-99), which is used in approximately 50,000 medical diagnostic procedures daily in the United States. The NRC supports the national policy objective of establishing a reliable, domestically available supply of this medical radioisotope by reviewing license applications for Mo-99 production facilities submitted in accordance with the provisions of Title 10 of the *Code of Federal Regulations*. Since 2013, the NRC staff has received two construction permit applications for nonpower production and utilization facilities from SHINE Medical Technologies, Inc. (SHINE) and Northwest Medical Isotopes, LLC. The proposed facilities would irradiate low-enriched uranium targets in utilization facilities, such as SHINE's proposed accelerator-driven subcritical operating assemblies, then separate Mo-99 from other fission products in hot cells contained within a production facility. The NRC approved the construction permit for SHINE in early 2016.

The NRC staff conducts safety and environmental reviews on these construction permit applications, which will also be the subject of both a mandatory hearing and an independent review by the Advisory Committee on Reactor Safeguards. If the NRC issues these construction permits, each facility must also submit an application for, and be granted, an operating license.

The NRC anticipates receiving additional construction permit applications, operating license applications, materials license applications, and license amendment requests in the coming years from other potential Mo-99 producers.

Ahead of the issuance of any permit or license, the NRC continues to develop necessary infrastructure programs for these facilities, including inspection procedures for construction and operation. The agency provides updates on the status of these licensing reviews through NRC-hosted public meetings, Commission meetings, and interactions with the White House Office of Science and Technology Policy Mo-99 Interagency Working Group.

A supply of molybdenum-99 (Mo-99), which is used in medical diagnostic procedures.

New Commercial Nuclear Power Reactor Licensing

New reactors are often considered to be any reactors proposed in addition to the current fleet of operating reactors.

See Appendix B for a list of new nuclear power plant license applications in the United States.

The NRC's current review of new power reactor license applications improves on the process used through the 1990s (see Figure 20: New Reactor Licensing Process). In 2012, the NRC issued the first combined construction permit and operating license (called a combined license or COL) under the new licensing process. The NRC continues to review applications submitted by prospective licensees, and (when appropriate) issues standard design certifications, early site permits (ESPs), limited work authorizations, construction permits, operating licenses, and combined licenses for facilities in a variety of projected locations throughout the United States. The NRC has implemented the Commission's policies on new reactor safety through rules, guidance, staff reviews, and inspection.

See Glossary for typical PWR and BWR design Illustrations.

The NRC's ongoing design certification, COL, and early site permit (ESP) reviews are incorporating lessons learned from the Fukushima accident. The environmental impacts of continued storage of spent nuclear fuel are incorporated into each environmental review for new reactor licensing. The NRC considered these impacts in a rulemaking and published its final Continued Storage Rule and supporting generic environmental impact statement in September 2014. The Continued Storage Rule is discussed in more detail in Section 5.

Combined License Applications—Construction and Operating

By issuing a combined license, the NRC authorizes the licensee to construct and (with specified conditions) operate a nuclear power plant at a specific site, in accordance with established laws and regulations. A COL's operating license portion is valid for 40 years from the date the Commission finds the acceptance criteria in the combined license are met. A COL can be renewed for additional 20-year terms (see Figure 21: Locations of New Nuclear Power Reactor Applications). For the current review schedule for the active licensing applications, consult the NRC's Web site (see the Web Link Index).

Figure 20. New Reactor Licensing Process

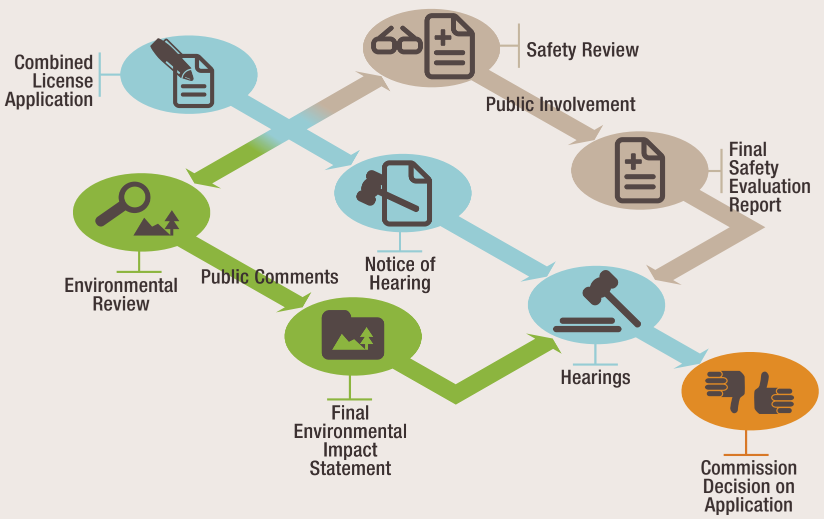
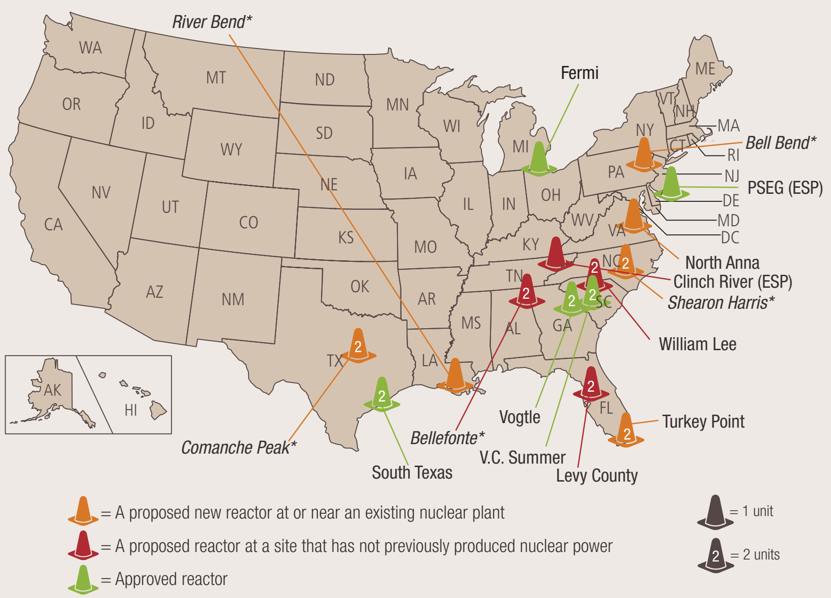


Figure 21. Locations of New Nuclear Power Reactor Applications



** Review suspended*

Note: Withdrawal was requested for Calvert Cliffs, Grand Gulf, Nine Mile Point, Victoria County, and Callaway (COL and ESP). NRC-abbreviated reactor names listed. Data is as of July 2016. For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Public Involvement

Even before the NRC receives an application, the agency holds a public meeting to talk to the community near the proposed reactor location. The agency explains the review process and outlines how the public may participate in the process. After the application is submitted, the NRC asks the public to comment on which factors should be considered in the agency's environmental review conducted under the National Environmental Policy Act. The NRC later posts a draft environmental evaluation on the agency's Web site and asks for public input. There is no formal opportunity for public comment on the staff's safety evaluation, but members of the public are welcome to attend public meetings and make comments. Individuals or groups can raise legal arguments against a new reactor application in an ASLB hearing if they would be affected by the new reactor and meet basic requirements for requesting a hearing. The NRC announces opportunities to request these hearings in press releases, in the *Federal Register,* and on the NRC's Web site.

Early Site Permits

An ESP review examines whether a piece of land is suitable for a nuclear power plant. The review covers site safety, environmental protection, and emergency preparedness. The ACRS reviews safety-related portions of an ESP application. As with COL reviews, the public participates in the environmental portion of the NRC's ESP review, and the public can challenge an application in a hearing.

Design Certifications

The NRC issues certifications for reactor designs that meet basic requirements for ensuring safe operation. Utilities can cite a certified design when applying for a nuclear power plant COL. The certification is valid for 15 years from the date issued and can be renewed for an additional 15 years. The new reactor designs under review incorporate new elements such as passive safety systems and simplified system designs. The five certified designs are:

- General Electric Nuclear Energy's Advanced Boiling-Water Reactor (ABWR)
- Westinghouse Electric Company's System 80+
- Westinghouse Electric Company's AP600
- Westinghouse Electric Company's AP1000
- General Electric-Hitachi Nuclear Energy's (GEH's) Economic Simplified Boiling-Water Reactor

The NRC is reviewing two applications for design certifications for the APR1400 and U.S. Advanced Pressurized-Water Reactor (US-APWR) designs.

Design Certification Renewals

The NRC is reviewing an application from General Electric-Hitachi (GEH) to renew the ABWR design certification. GEH submitted its application in 2010.

Advanced Reactor Designs

Several companies are considering advanced reactor designs and technologies and are conducting preapplication activities with the NRC. These technologies include light-water reactors a fraction of the size of today's designs. Other potential reactor designs are cooled by liquid metals or high-temperature gas. The NRC's advanced reactor efforts will ensure the agency has the resources and expertise to address these new technologies. While developing the regulatory framework for advanced reactor licensing, the NRC is also examining policy issues in areas such as security and emergency preparedness.

New Reactor Construction Inspections

NRC inspectors based in the agency's Region II office in Atlanta, GA, monitor reactor-construction activity. These expert staff members ensure licensees carry out construction according to NRC license specifications and related regulations.

The NRC staff examines the licensee's operational programs in areas such as security, radiation protection, and operator training and qualification. Inspections at a construction site verify a licensee has completed required inspections, tests, and analyses, and met associated acceptance criteria. The NRC's onsite resident construction inspectors oversee day-to-day licensee and contractor activities. In addition, specialists at NRC Region II's Center for Construction Inspection periodically visit the sites to ensure the facilities are being constructed using the approved design.

The NRC's Construction Reactor Oversight Process assesses all of these activities. Before the agency will allow a new reactor to start up, NRC inspectors must confirm the licensee has met all of the acceptance criteria in its COL.

The agency also inspects domestic and overseas factories and other vendor facilities. This ensures new U.S. reactors receive high-quality products and services that meet the NRC's regulatory requirements. The NRC's Web site has more information on new reactor licensing activities (see the Web Link Index).

Nuclear Regulatory Research

The NRC's research supports the agency's mission by providing technical advice, tools, methods, data, and information. This research can identify, explore, and resolve safety issues, as well as provide information supporting licensing decisions and new regulations and guidance. The NRC's research includes:

- independently confirming other parties' work through experiments and analyses
- developing technical support for agency safety decisions
- preparing for the future by evaluating the safety implications of new technologies and designs for nuclear reactors, materials, waste, and security

The research program focuses on the challenges of an evolving industry, as well as on retaining technical skills when experienced staff members retire. The NRC's research covers the light-water reactor technology developed in the 1960s and 1970s, today's advanced light-water reactor designs, and fuel cycle facilities. The agency has longer-term research plans for more exotic reactor concepts, such as those cooled by high-temperature gases or liquid metals. The NRC's research programs examine a broad range of subjects, such as:

- material performance (such as environmentally assisted degradation and cracking of metallic alloys, aging management of reactor components and materials, boric-acid corrosion, radiation effects on concrete, alkali-silica reaction in concretes, the use of high-density polyethylene material for buried piping, and embrittlement of reactor pressure vessel steels)
- events disrupting heat transfer from a reactor core, criticality safety, severe reactor accidents, how radioactive material moves through the environment, and how that material could affect human health (sometimes using NRC-developed computer codes for realistic simulations)
- computer codes used to analyze fire conditions in nuclear facilities, to examine how reactor fuel performs, and to assess nuclear power plant risk
- new and evolving technologies (such as the performance of mixed uranium plutonium, computerized instrumentation and control, and safety-critical software)
- experience gained from operating reactors
- digital instrumentation and controls (such as analyzing digital system components, security aspects of digital systems, and probabilistic assessment of digital system performance)
- enhanced risk-assessment methods, tools, and models to support the increased use of probabilistic risk assessment in regulatory applications
- earthquake and flooding hazards
- equipment performance under extreme conditions (e.g., heat, radiation, or humidity)

- ultrasonic testing (UT) and other nondestructive means of inspecting reactor components and dry cask storage systems and developing and accessing UT simulation tools to optimize examination procedure variables
- the human side of reactor operations, including safety culture, and computerization and automation of control rooms

See Appendix U for a list of the NRC's cooperative research agreements.

The Office of Nuclear Regulatory Research also plans, develops, and manages research on fire safety and risk, including modeling, and evaluates potential security vulnerabilities and possible solutions (see the Web Link Index for more information on specific NRC research projects and activities).

The NRC's research program involves about 6 percent of the agency's personnel and uses about 14 percent of its contracting funds. The NRC's $51 million research budget for (FY) 2016 includes contracts with national laboratories, universities, research organizations, and other Federal agencies (e.g., the National Institute of Standards and Technology, the U.S. Army Corps of Engineers, and the U.S. Geological Survey). NRC research funds support access to a broader group of experts and international research facilities. Figure 22: NRC Research Funding, FY 2016, illustrates the primary areas of research.

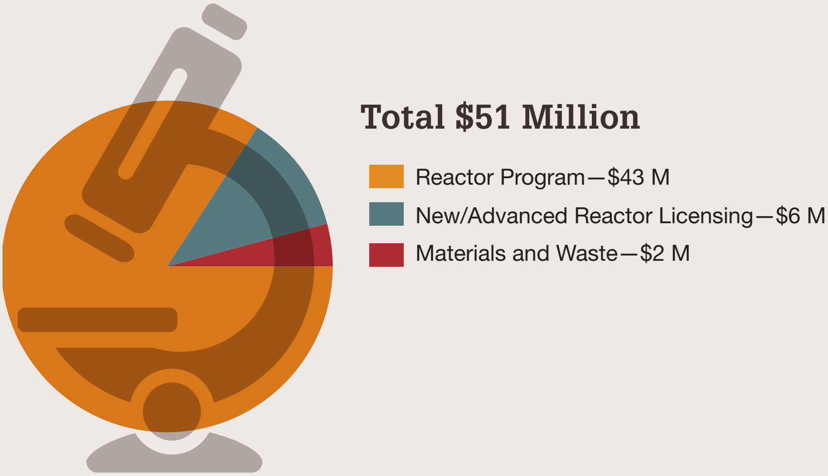
Universities and other academic institutions use nuclear materials in laboratory experiments while conducting research.

The majority of the NRC's research program supports maintaining operating reactor safety and security. The remaining research budget supports regulatory activities for new and advanced reactors, industrial and medical use of nuclear materials, and nuclear fuel cycle and radioactive waste programs. The NRC cooperates with universities and nonprofit organizations on research for the agency's specific interests.

The NRC's international cooperation in research areas leverages agency resources, facilitates work on advancing existing technologies, and determines any safety implications of new technologies. The NRC's leadership role in international organizations such as the International Atomic Energy Agency and the Nuclear Energy Agency helps guide the agency's collaborations.

The NRC maintains international cooperative research agreements with more than two dozen foreign governments. This work covers technical areas from severe accident research and computer code development to materials degradation, nondestructive examination, fire risk, and human-factors research. Cooperation under these agreements is more efficient than conducting research independently.

Figure 22. NRC Research Funding, FY 2016

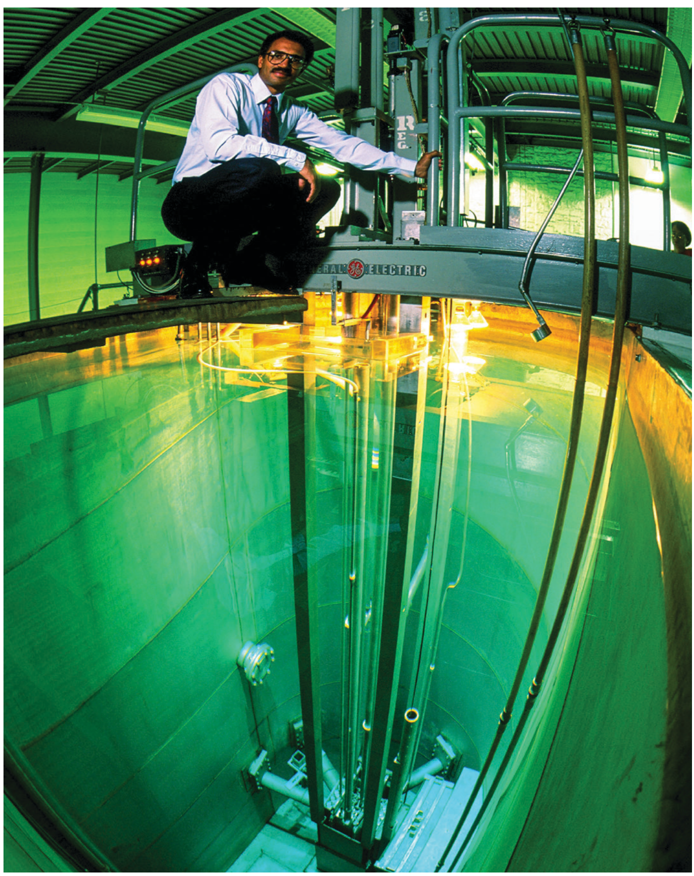


Note: Dollars are rounded to the nearest million.

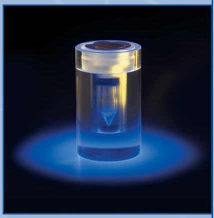
Photo courtesy: University of Wisconsin–Madison

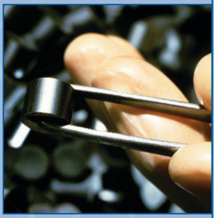
Universities and other academic institutions use nuclear materials in laboratory experiments while conducting health physics-related research.

Photo courtesy: University of Wisconsin–Madison



Professor Douglass Henderson of the University of Wisconsin-Madison standing above the pool of the University's TRIGA research reactor.





Nuclear Materials

The NRC regulates each phase of the nuclear fuel cycle—the steps needed to turn uranium ore into fuel for nuclear power plants—as well as storing and disposing of the fuel after it is used in a reactor. In some States, the NRC also regulates nuclear materials used for medical, industrial, and academic purposes. Our work includes reviewing applications for and issuing new licenses, license renewals, and amendments to existing licenses. The NRC also regularly conducts health, safety, and security inspections.

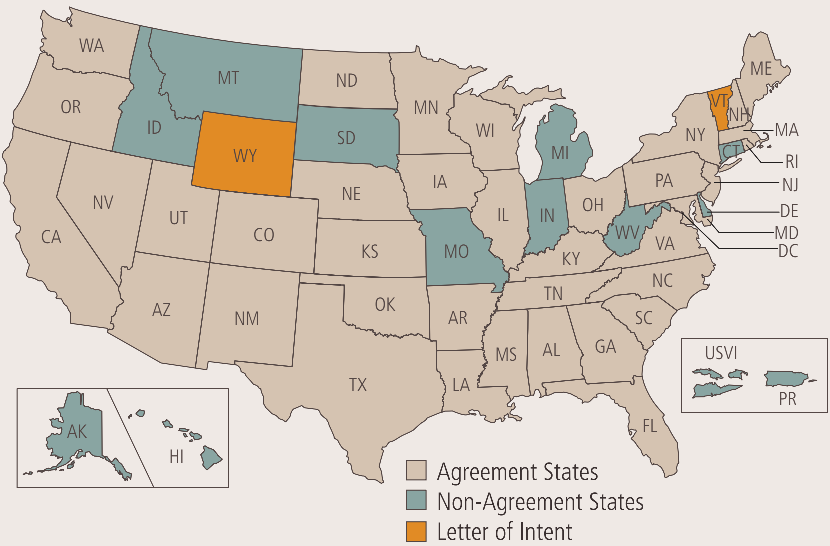
See Appendix L for a list of the number of materials licenses by State.

Materials Licenses

States have the option to regulate certain radioactive materials under agreements with the NRC. We call those that do Agreement States (see Figure 23: Agreement States). These States develop regulations and appoint officials to ensure nuclear materials are used safely and securely. Agreement States must adopt rules consistent with the NRC's. Only the NRC regulates nuclear reactors, fuel fabrication facilities, consumer product distribution, and certain amounts of what is called "special nuclear material"—that is, radioactive material that can fission or split apart.

Radioactive materials, or radionuclides, are used for many purposes. They are used in civilian and military industrial applications; basic and applied research; manufacture of consumer products; academic studies; and medical diagnosis, treatment, and research. They can be produced in a reactor or an accelerator—a machine that propels charged particles. The NRC does not regulate accelerators but does license the use of radioactive materials produced in accelerators.

Figure 23. Agreement States



Note: For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Medical and Academic

The NRC and Agreement States review the facilities, personnel, program controls, and equipment involved in using radioactive materials in medical and academic settings. These reviews ensure the safety of the public, patients, and workers who might be exposed to radiation from those materials. The NRC regulates only the use of radioactive material, which is why the NRC does not regulate x-ray machines or other devices that produce radiation without using radioactive materials.

Medical

The NRC and Agreement States license hospitals and physicians to use radioactive materials in medical treatments and diagnoses. The NRC also develops guidance and regulations for licensees. These regulations require licensees to have experience and special training, focusing on operating equipment safely, controlling the radioactive material, and keeping accurate records. To help the NRC stay current, the agency sponsors an Advisory Committee on the Medical Uses of Isotopes. This expert committee includes scientists, physicians, and other health care professionals who have experience with medical radionuclides.

Nuclear Medicine

Doctors use radioactive materials to diagnose or treat about one-third of all patients admitted to hospitals. This branch of medicine is known as nuclear medicine, and the radioactive materials are called radiopharmaceuticals.

Two types of radiopharmaceutical tests can diagnose medical problems. In vivo tests (within the living) administer radiopharmaceuticals directly to patients. In vitro tests (within the glass) add radioactive materials to lab samples taken from patients.

Photo courtesy: Sirtex

Photo courtesy: Nordion

Samples from two manufacturers of yttrium-90 (Y-90), SIR-Spheres® (left) TheraSphere® (right). Vial containing millions of Y-90 microspheres used to treat liver cancers.

Radiation Therapy

Doctors also use radioactive materials and radiation-producing devices to treat medical conditions. They can treat hyperthyroidism and some cancers, for example, and can also ease the pain caused by bone cancer. Radiation therapy aims to deliver an accurate radiation dose to a target site while protecting surrounding healthy tissue. To be most effective, treatments often require several exposures over a period of time. When used to treat malignant cancers, radiation therapy is often combined with surgery or chemotherapy.

There are three main categories of radiation therapy:

1. External beam therapy (also called teletherapy) is a beam of radiation directed to the target tissue. Several different types of machines are used in external beam therapy. Treatment machines regulated by the NRC contain high-activity radioactive sources (usually cobalt-60) that emit photons to treat the target site.
2. Brachytherapy treatments use sealed radioactive sources placed near or even directly in cancerous tissue. The radiation dose is delivered at a distance of up to an inch (up to 2.54 centimeters) from the target area.
3. Therapeutic radiopharmaceuticals deliver a large radiation dose inside the body. Different radioactive materials can be given to patients and will concentrate in different regions or organ systems.

Academic

The NRC issues licenses to academic institutions for education and research. For example, qualified instructors may use radioactive materials in classroom demonstrations. Scientists in many disciplines use radioactive materials for laboratory research.

Industrial

The NRC and Agreement States issue licenses that specify the type, quantity, and location of radioactive materials to be used. Radionuclides can be used in industrial radiography, gauges, well logging, and manufacturing. Radiography uses radiation sources to find structural defects in metal and welds. Gas chromatography uses low-energy radiation sources to identify the chemical elements in an unknown substance. This process can determine the components of complex mixtures, such as petroleum products, smog, and cigarette smoke. (It can also be used in biological and medical research to identify the parts that make up complex proteins and enzymes.) Well-logging devices use radioactive sources and detection equipment to make a record of geological formations from inside a well. This process is used extensively for oil, gas, coal, and mineral exploration.

Nuclear Gauges

Nuclear gauges are used to measure the physical properties of products and industrial processes nondestructively as a part of quality control. Gauges use radiation sources to determine the thickness of paper products, fluid levels in oil and chemical tanks, and the moisture and density of soils and material at construction sites. Gauges may be fixed or portable.

See Glossary for illustrations of fixed and portable gauges.

The radiation measurement indicates the thickness, density, moisture content, or some other property that is displayed on a gauge readout or on a computer monitor. The top of the gauge has shielding to protect the operator while the radioactive source is exposed. When the measuring process is completed, the source is retracted or a shutter closes, minimizing exposure from the source. A fixed gauge has a radioactive source shielded in a container. When the user opens the container's shutter, a beam of radiation hits the material or product being processed or controlled. A detector mounted opposite the source measures the radiation passing through the product. The gauge readout or computer monitor shows the measurement. The material and process being monitored dictate the type, energy, and strength of radiation used.

Fixed fluid gauges are used by the beverage, food, plastics, and chemical industries. Installed on a pipe or the side of a tank, these gauges measure the densities, flow rates, levels, thicknesses, and weights of a variety of materials and surfaces. A portable gauge uses both a shielded radioactive source and a detector. The gauge is placed on the object to be measured. Some gauges rely on radiation from the source to reflect back to the bottom of the gauge. Other gauges insert the source into the object. The detector in the gauge measures the radiation either directly from the inserted source or from the reflected radiation.

The moisture density gauge, shown at right, is a portable gauge that places a gamma source under the surface of the ground through a tube. Radiation is transmitted directly to the detector on the bottom of the gauge, allowing accurate measurements of compaction. Industry uses such gauges to monitor the structural integrity of roads, buildings, and bridges. Airport security uses nuclear gauges to detect explosives in luggage.

A moisture density gauge indicates whether a foundation is suitable for supporting a building or roadway.

Commercial Irradiators

The U.S. Food and Drug Administration and other agencies have approved the irradiation of food. Commercial irradiators expose food and spices, as well as products such as medical supplies, blood, and wood flooring, to gamma radiation. This process can be used to eliminate harmful germs and insects or for hardening or other purposes. The gamma radiation does not leave radioactive residue or make the treated products radioactive. The radiation can come from radioactive materials (e.g., cobalt-60), an x-ray tube, or an electron beam.

See Glossary for information and illustrations of commercial irradiators.

The NRC and Agreement States license about 50 commercial irradiators. Up to 10 million curies of radioactive material can be used in these types of irradiators. NRC regulations protect workers and the public from this radiation. Two main types of commercial irradiators are used in the United States: underwater and wet-source-storage panoramic models. Underwater irradiators use sealed sources (radioactive material encased inside a capsule) that remain in the water at all times, providing shielding for workers and the public. The product to be irradiated is placed in a watertight container, lowered into the pool, irradiated, and then removed. Wet-source-storage panoramic irradiators also store radioactive sealed sources in water. However, the sources are raised into the air to irradiate products that are automatically moved in and out of the room on a conveyor system. Sources are then lowered back into the pool. For this type of irradiator, thick concrete walls and ceilings or steel barriers protect workers and the public when the sources are lifted from the pool.

Transportation

More than 3 million packages of radioactive materials are shipped each year in the United States by road, rail, air, or water. This represents less than 1 percent of the Nation's yearly hazardous material shipments. The NRC and the U.S. Department of Transportation (DOT) share responsibility for regulating the safety of radioactive material shipments. The vast majority of these shipments consist of small amounts of radioactive materials used in industry, research, and medicine. The NRC requires such materials to be shipped in accordance with DOT's safety regulations.

Truck carries NAC LWT transport package.

Material Security

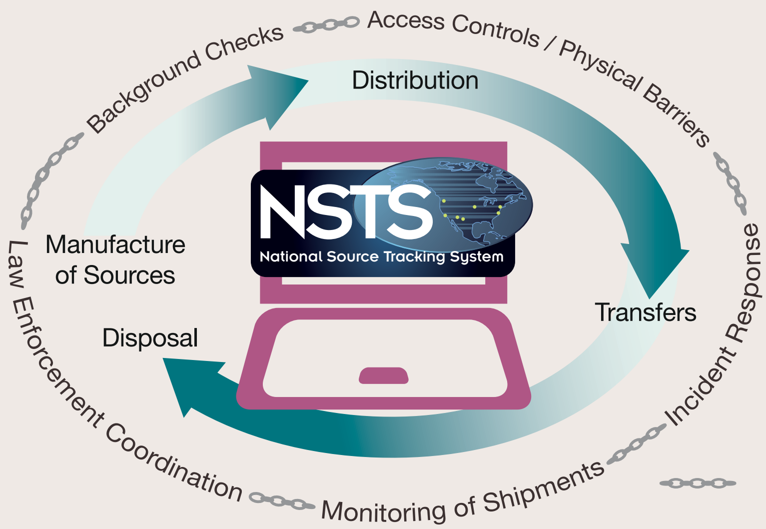
To monitor the manufacture, distribution, and ownership of the most high-risk sources, the NRC set up a National Source Tracking System (NSTS) in January 2009. Licensees use this secure Web-based system to enter information on the receipt or transfer of tracked radioactive sources (see Figure 24: Life-Cycle Approach to Source Security). The NRC and the Agreement States use the system to monitor where high-risk sources are made, shipped, and used.

Sources tracked in the system are known as Category 1 and Category 2 sources. They have the potential to cause permanent injury and even death if they are not handled safely and securely, in compliance with NRC requirements. The majority of these sources are cobalt-60.

See Glossary for definitions of the categories of radioactive sources.

The NRC and the Agreement States have increased controls on the most sensitive radioactive materials. Stronger physical-security requirements and stricter limits on who can access the materials give the NRC and the Agreement States added confidence in their security. The NRC has also joined with other Federal agencies, such as the U.S. Department of Homeland Security and U.S. Department of Energy's National Nuclear Security Administration, to set up an additional layer of voluntary protection. Together, these activities help make potentially dangerous radioactive sources even more secure and less vulnerable to malevolent uses.

Figure 24. Life-Cycle Approach to Source Security



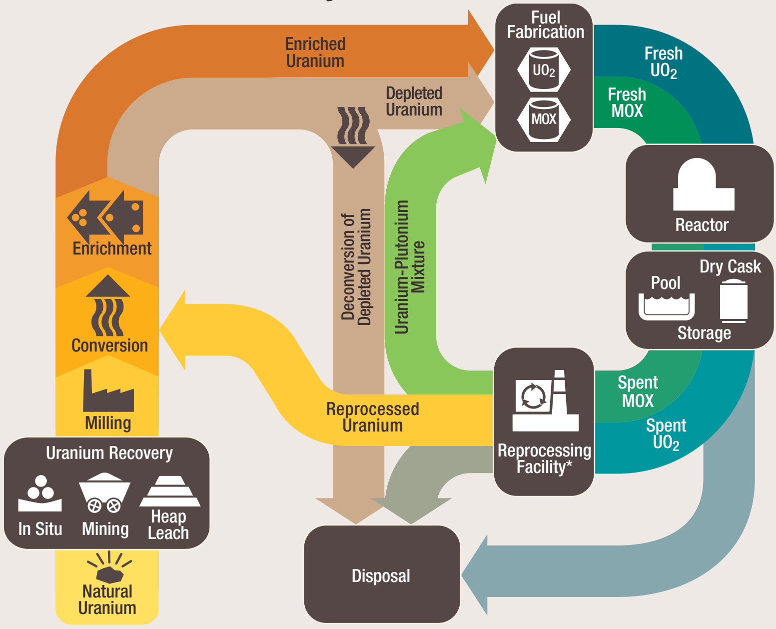
Nuclear Fuel Cycle

The typical nuclear fuel cycle uses uranium in different chemical and physical forms. Figure 25: The Nuclear Fuel Cycle illustrates the stages, which include uranium recovery, conversion, enrichment, and fabrication, to produce fuel for nuclear power plants. Uranium is recovered or extracted from ore, converted, and enriched. Then the enriched uranium is manufactured into pellets. These pellets are placed into fuel assemblies to power nuclear reactors.

Uranium Recovery

The NRC does not regulate conventional mining but does regulate the processing of uranium ore, known as milling. This processing can be done at three types of uranium recovery facilities: conventional mills, in situ recovery (ISR) facilities, and heap leach facilities. Once this processing is done, the uranium is in a powder form known as yellowcake, which is packed into 55-gallon drums and transported to a fuel cycle facility for further processing. The NRC has a well-established regulatory framework for uranium recovery facilities. This framework ensures they are licensed, operated, decommissioned, and monitored to protect the public and the environment.

Figure 25. The Nuclear Fuel Cycle



* Reprocessing of spent nuclear fuel, including mixed-oxide (MOX) fuel, is not practiced in the United States.
Note: The NRC has no regulatory role in mining uranium.

Conventional Uranium Mill

A conventional uranium mill is a chemical plant that extracts uranium from ore. Most conventional mills are located away from population centers and within about 30 miles (50 kilometers) of a uranium mine. In a conventional mill, the process of uranium extraction from ore begins when ore is hauled to the mill and crushed. Sulfuric acid dissolves and removes 90 to 95 percent of the uranium from the ore. The uranium is then separated from the solution, concentrated, and dried to form yellowcake.

In Situ Recovery

ISR is another way to extract uranium—in this case, directly from underground ore. In situ facilities recover uranium from ores that cannot be processed economically using other methods. In this process, a solution of native ground water, typically mixed with oxygen or hydrogen peroxide and sodium bicarbonate or carbon dioxide, is injected into the ore to dissolve the uranium. The solution is then pumped out of the rock and the uranium separated to form yellowcake (see Figure 26: The In Situ Uranium Recovery Process).

Heap Leach Facility

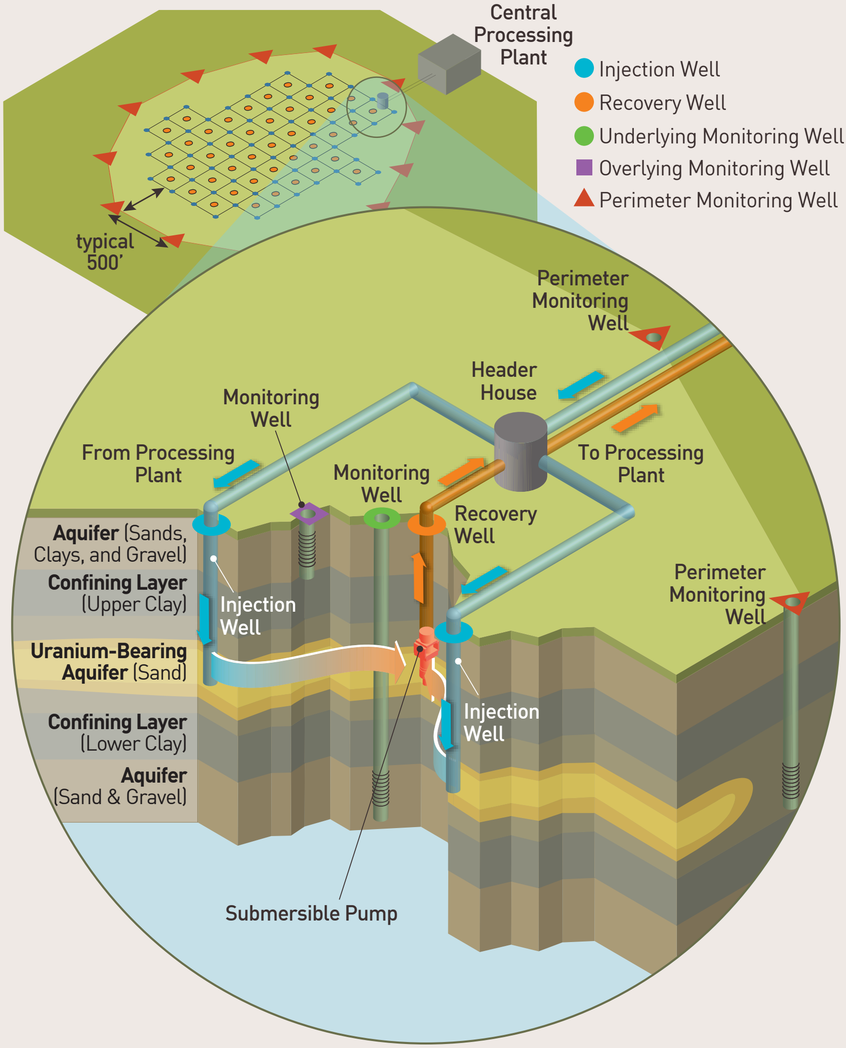
Heap leach facilities also extract uranium from ore. At these facilities, the ore is placed in piles or heaps on top of liners. The liners prevent uranium and other chemicals from moving into the ground. Sulfuric acid is dripped onto the heap and dissolves uranium as it moves through the ore. Uranium solution drains into collection basins, where it is piped to a processing plant. At the plant, uranium is extracted, concentrated, and dried to form yellowcake. The NRC does not currently license any heap leach facilities.

See Glossary for definition and illustration of heap leach recovery process.

Licensing Uranium Recovery Facilities

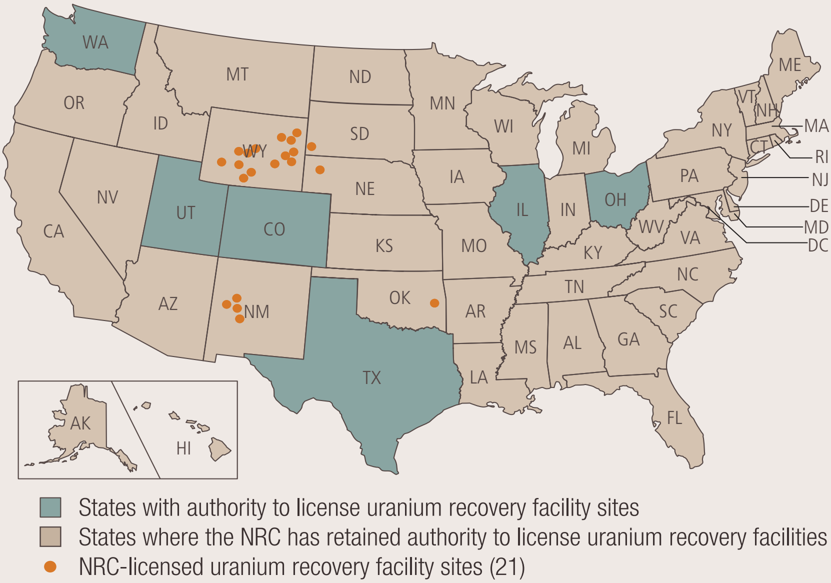
The NRC continues to receive applications to build new uranium recovery facilities and to expand or restart existing facilities. The current status of applications can be found on the NRC's Web site (see the Web Link Index on page 186). Existing facilities and new potential sites are located in Wyoming, New Mexico, Nebraska, South Dakota, and Oregon and in the Agreement States of Texas, Colorado, and Utah (see Figure 27: Locations of NRC-Licensed Uranium Recovery Facility Sites).

Figure 26. The In Situ Uranium Recovery Process



Injection wells ● pump a solution of native ground water, usually mixed with sodium bicarbonate and oxygen, into the aquifer (ground water) containing uranium ore. The solution dissolves the uranium from the deposit in the ground and is then pumped back to the surface through recovery wells ●, all controlled by the header house. From there, it is sent to the processing plant. Monitoring wells ● ■ ▲ are checked regularly to ensure that injection solution is not escaping from the wellfield. Confining layers keep ground water from moving from one aquifer to another.

Figure 27. Locations of NRC-Licensed Uranium Recovery Facility Sites



Note: For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

The NRC takes into account the views of stakeholders, including Native American Tribal governments, to address their concerns with licensing new uranium recovery facilities. The NRC is also responsible for the following actions:

- inspecting and overseeing both active and inactive uranium recovery facilities
- ensuring the safe management of mill tailings (waste) at facilities that the NRC requires to be located and designed to minimize radon release and disturbance by weather or seismic activity
- enforcing requirements to ensure cleanup of active and closed uranium recovery facilities
- applying stringent financial requirements to ensure funds are available for decommissioning
- making sure licensees follow requirements for underground disposal of mill tailings and provide liners for tailings impoundments
- monitoring to prevent ground water contamination
- monitoring and overseeing decommissioned facilities

See Glossary for more information on mill tailings.

Fuel Cycle Facilities

The NRC licenses all commercial fuel cycle facilities involved in conversion, enrichment, and fuel fabrication (see Figure 28: Locations of Fuel Cycle Facilities, and Figure 29: Simplified Fuel Fabrication Process).

See Glossary for more information on enrichment processes.

The NRC reviews applications for licenses, license amendments, and renewals, as well as licensees' safety and safeguard programs. The agency also routinely inspects their safety, safeguards, security, and environmental protection programs.

These facilities turn the uranium that has been removed from ore and made into yellowcake into fuel for nuclear reactors. In this process, the conversion facility converts yellowcake into uranium hexafluoride (UF_6). Next, an enrichment facility heats the solid UF_6 enough to turn it into a gas, which is "enriched," or processed to increase the concentration of the isotope uranium-235.

The enriched uranium gas is mechanically and chemically processed back into a solid uranium dioxide (UO_2) powder. The powder is blended, milled, pressed, and fused into ceramic fuel pellets about the size of a fingertip. The pellets are stacked into tubes or rods that are about 14 feet (4.3 meters) long and made of material such as zirconium alloys; this material is referred to as cladding. These fuel rods are made to maintain both their chemical and physical properties under the extreme conditions of heat and radiation present inside an operating reactor.

After careful inspection, the fuel rods are bundled into fuel assemblies for use in reactors. The assemblies are washed, inspected, and stored in a special rack until ready for shipment to a nuclear power plant. The NRC inspects this operation to ensure it is conducted safely.

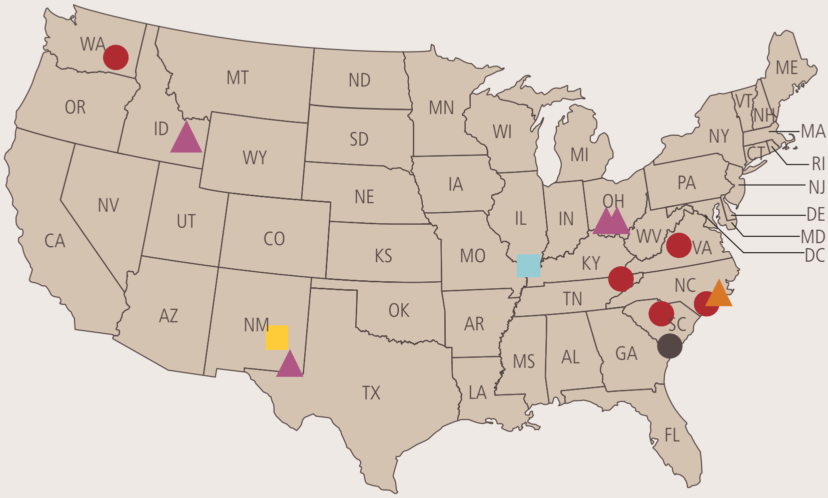
See Appendix M for major U.S. fuel cycle facility sites.

Domestic Safeguards Program

The NRC's domestic safeguards program for fuel cycle facilities and transportation is aimed at ensuring that special nuclear material (such as plutonium or enriched uranium) is not stolen and does not pose a risk to the public from sabotage or terrorism. Through licensing and inspections, the NRC verifies that licensees apply safeguards to protect special nuclear material.

The NRC and DOE developed the Nuclear Materials Management and Safeguards System (NMMSS) to track transfers and inventories of special nuclear material, source material from abroad, and other material. The NRC has issued licenses authorizing facilities to possess special nuclear material in quantities ranging from a single kilogram to multiple tons. These licensees verify and document their inventories in the NMMSS database. The NRC or Agreement States have licensed several hundred additional sites that possess special nuclear material in smaller quantities. Licensees possessing small amounts of special nuclear material must confirm their inventory annually in the NMMSS database.

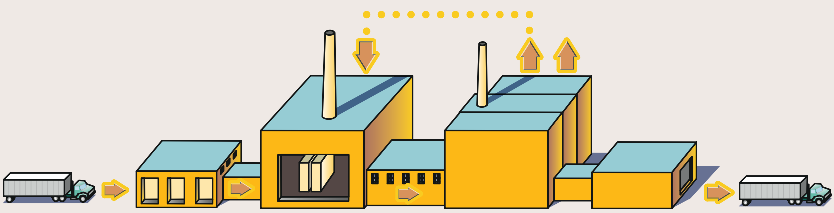
Figure 28. Locations of Fuel Cycle Facilities



Uranium Hexafluoride Conversion Facility (1)
Uranium Fuel Fabrication Facility (5)
Mixed-Oxide Fuel Fabrication Facility (1)
Gas Centrifuge Uranium Enrichment Facility (4)
Laser Separation Enrichment Facility (1)
Uranium Hexafluoride Deconversion Facility (1)

Note: There are no fuel cycle facilities in Alaska or Hawaii.
For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Figure 29. Simplified Fuel Fabrication Process



Fabrication of commercial light-water reactor fuel consists of the following three basic steps:

(1) the chemical conversion of UF_6 to UO_2 powder

(2) a ceramic process that converts UO_2 powder to small ceramic pellets

(3) a mechanical process that loads the fuel pellets into rods and constructs finished fuel assemblies

Photo courtesy: NAC International

Radioactive Waste

Low-Level Radioactive Waste Disposal

Low-level radioactive waste (LLW) includes items contaminated with radioactive material or exposed to neutron radiation. This waste typically consists of contaminated protective shoe covers and clothing, wiping rags, mops, filters, reactor water treatment residues, equipment and tools, medical waste, and laboratory animal carcasses and tissue. Some LLW is quite low in radioactivity—even as low as just above background levels found in nature. Some licensees, notably hospitals, store such waste on site until it has decayed and lost most of its radioactivity. Then it can be disposed of as ordinary trash. Other LLW, such as parts of a reactor vessel from a nuclear power plant, is more radioactive and requires special handling. Waste that does not decay fairly quickly is stored until amounts are large enough for shipment to an LLW disposal site in containers approved by DOT and the NRC.

Commercial LLW can be disposed of in facilities licensed by either the NRC or Agreement States. The facilities are designed, constructed, and operated to meet NRC safety standards. The facility operator analyzes how the facility will perform in the future based on the environmental characteristics of the site. Current LLW disposal uses shallow land disposal sites with or without concrete vaults (see Figure 30: Low-Level Radioactive Waste Disposal).

The NRC classifies LLW based on its potential hazards. It has specified disposal and waste requirements for three classes of waste—Class A, B, and C—with progressively higher concentrations of radioactive material. Class A waste, the least radioactive, accounts for approximately 96 percent of the total volume of LLW. Determination of the classification of waste is a complex process. A fourth class of LLW, called “greater-than-Class-C,” is not generally acceptable for near-surface disposal. Under the LLW Policy Amendments Act, DOE is responsible for disposal of greater-than-Class-C waste.

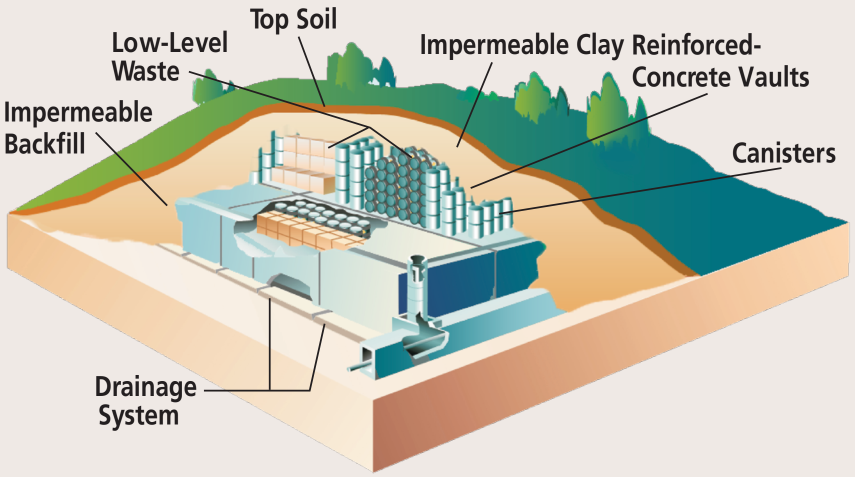
The volume and radioactivity of waste varies from year to year. Waste volumes currently include several million cubic feet each year from reactor facilities undergoing decommissioning and from cleanup of contaminated sites.

The Low-Level Radioactive Waste Policy Amendments Act of 1985 gave the States responsibility for LLW disposal. The Act authorized States to:

- form regional compacts, with each compact to provide for LLW disposal site access
- manage LLW import to, and export from, a compact
- exclude waste generated outside a compact

See Appendix P for regional compacts and closed LLW sites.

Figure 30. Low-Level Radioactive Waste Disposal



This LLW disposal site accepts waste from States participating in a regional disposal agreement.

The States have licensed four active LLW disposal facilities:

- EnergySolutions' Barnwell facility, located in Barnwell, SC—Previously, Barnwell accepted LLW waste from all U.S. generators of LLW. Barnwell now accepts waste only from the Atlantic Compact States of Connecticut, New Jersey, and South Carolina. The State of South Carolina licensed Barnwell to receive Class A, B, and C waste.
- EnergySolutions' Clive facility, located in Clive, UT—Clive accepts waste from all regions of the United States. The State of Utah licensed Clive for Class A waste only.
- US Ecology's Richland facility, located in Richland, WA, on the Hanford Nuclear Reservation—Richland accepts waste from the Northwest Compact States (Alaska, Hawaii, Idaho, Montana, Oregon, Utah, Washington, and Wyoming) and the Rocky Mountain Compact States (Colorado, Nevada, and New Mexico). The State of Washington licensed Richland to receive Class A, B, and C waste.
- Waste Control Specialists' Andrews facility, located in Andrews, TX—Andrews accepts waste from the Texas Compact, which consists of Texas and Vermont. It also accepts waste from out-of-the-compact generators on a case-by-case basis. The State of Texas licensed Andrews to receive Class A, B, and C waste.

High-Level Radioactive Waste Management

Spent Nuclear Fuel Storage

Commercial spent nuclear fuel, although highly radioactive, is stored safely and securely throughout the United States. Spent fuel is stored in pools and in dry casks at sites with operating nuclear power reactors. Several storage facilities do not have operating power reactors but are safely storing spent fuel. Waste can be stored safely in pools or casks for 100 years or more. The NRC licenses and regulates the storage of spent fuel, both at commercial nuclear power plants and at separate storage facilities.

See Appendices N and O for information about dry spent fuel storage and licensees.

Most reactor facilities were not designed to store the full amount of spent fuel that the reactors would generate during their operational lives. Facilities originally planned to store spent fuel temporarily in deep pools of continuously circulating water, which cools the spent fuel assemblies. After a few years, the facilities were expected to send the spent fuel to a reprocessing plant. However, in 1977, the Government declared a moratorium on reprocessing spent fuel in the United States. Although the Government later lifted the restriction, reprocessing has not resumed in the United States.

See Glossary for fuel reprocessing (recycling).

As a result, facilities expanded their storage capacity by using high-density storage racks in their spent fuel pools. To provide supplemental storage, some fuel assemblies are stored in dry casks on site (see Figure 31: Spent Fuel Generation and Storage after Use). These facilities are called independent spent fuel storage installations (ISFSIs) and are licensed by the NRC. These large casks are typically made of leak-tight, welded, and bolted steel and concrete surrounded by another layer of steel or concrete. The spent fuel sits in the center of the cask in an inert gas. Dry cask storage shields people and the environment from radiation and keeps the spent fuel inside dry and nonreactive (see Figure 32: Dry Storage of Spent Nuclear Fuel).

The NRC regulates facilities that store spent fuel in two different ways. The NRC may grant site-specific licenses after a safety review of the technical requirements and operating conditions for an ISFSI. The NRC has issued a general license authorizing nuclear power reactor licensees to store spent fuel on site in dry storage casks that the NRC has certified. Following a similar safety review, the NRC may issue a Certificate of Compliance and add the cask to a list of approved systems through a rulemaking. The agency issues licenses and certificates for terms not to exceed 40 years and that can be renewed for up to

The NRC holds public meetings around the country where NRC staff members provide information about the agency's role and mission and about the performance of area nuclear power plants.

an additional 40 years. (See Figure 33: Licensed and Operating Independent Spent Fuel Storage Installations by State.)

Public Involvement

The public can participate in decisions about spent fuel storage, as it can in many licensing and rulemaking decisions. The Atomic Energy Act of 1954, as amended, and the NRC's own regulations call for public hearings about site-specific licensing actions and allow the public to comment on certificate of compliance rulemakings. Members of the public may also file petitions for rulemaking. Additional information on ISFSIs is available on the NRC's Web site (see the Web Link Index).

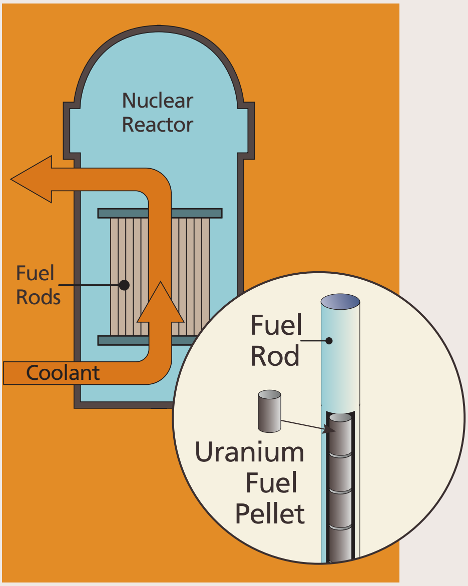
Spent Nuclear Fuel Disposal

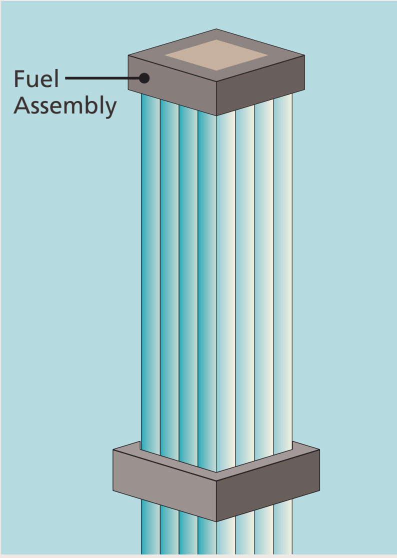
The current U.S. policy governing permanent disposal of high-level radioactive waste is defined by the Nuclear Waste Policy Act of 1982, as amended, and the Energy Policy Act of 1992. These acts specify that high-level radioactive waste will be disposed of underground in a deep geologic repository licensed by the NRC. Because the timing of repository availability is uncertain, the NRC looked at potential environmental impacts of storing spent fuel over three possible timeframes: the short term, which includes 60 years of continued storage after a reactor's operating license has expired; the medium term, or 160 years after license expiration; and indefinite, which assumes a repository never becomes available. The NRC's findings—that any environmental impacts can be managed—appear in the 2014 report NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel."

The NRC adopted those findings into NRC regulations in a continued storage rule. This rule provides an important basis for issuing new or renewed licenses for nuclear power plants and spent fuel storage facilities.

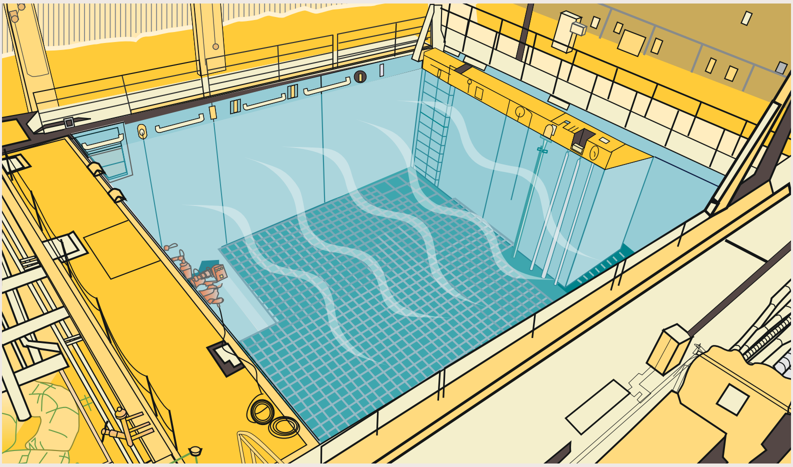
Figure 31. Spent Fuel Generation and Storage After Use

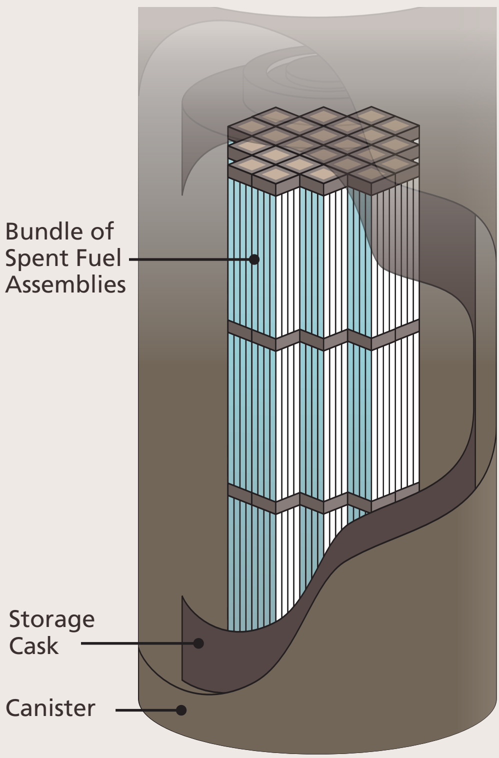
1 A nuclear reactor is powered by enriched uranium-235 fuel. Fission (splitting of atoms) generates heat, which produces steam that turns turbines to produce electricity. A reactor rated at several hundred megawatts may contain 100 or more tons of fuel in the form of bullet-sized pellets loaded into long metal rods that are bundled together into fuel assemblies. Pressurized-water reactors (PWRs) contain between 150 and 200 fuel assemblies. Boiling-water reactors (BWRs) contain between 370 and 800 fuel assemblies.





2 After 5–6 years, spent fuel assemblies (which are typically 14 feet [4.3 meters] long and which contain nearly 200 fuel rods for PWRs and 80–100 fuel rods for BWRs) are removed from the reactor and allowed to cool in storage pools. At this point, the 900-pound (409-kilogram) assemblies contain only about one-fifth the original amount of uranium-235.





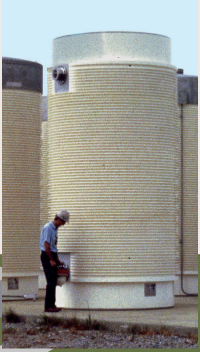
3 Commercial light-water nuclear reactors store spent radioactive fuel in a steel-lined, seismically designed concrete pool under about 40 feet (12.2 meters) of water that provides shielding from radiation. Water pumps supply continuously flowing water to cool the spent fuel. Extra water for the pool is provided by other pumps that can be powered from an onsite emergency diesel generator. Support features, such as water-level monitors and radiation detectors, are also in the pool. Spent fuel is stored in the pool until it is transferred to dry casks on site (as shown in Figure 32) or transported off site for interim storage or disposal.

Figure 32. Dry Storage of Spent Nuclear Fuel

At nuclear reactors across the country, spent fuel is kept on site, typically above ground, in systems basically similar to the ones shown here. The NRC reviews and approves the designs of these spent fuel storage systems before they can be used.

1 Once the spent fuel has sufficiently cooled, it is loaded into special canisters that are designed to hold nuclear fuel assemblies. Water and air are removed. The canister is filled with inert gas, welded shut, and rigorously tested for leaks. It is then placed in a cask for storage or transportation. The dry casks are then loaded onto concrete pads.

2 The canisters can also be stored in aboveground concrete bunkers, each of which is about the size of a one-car garage.



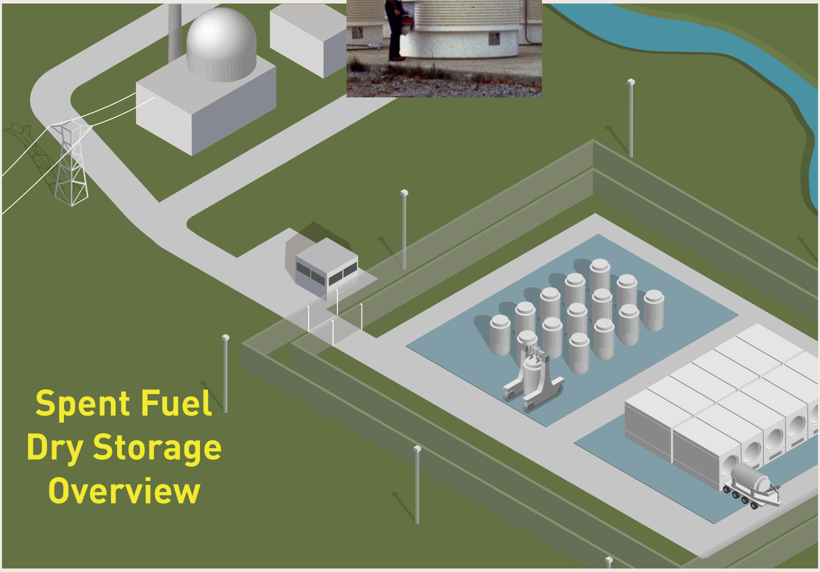
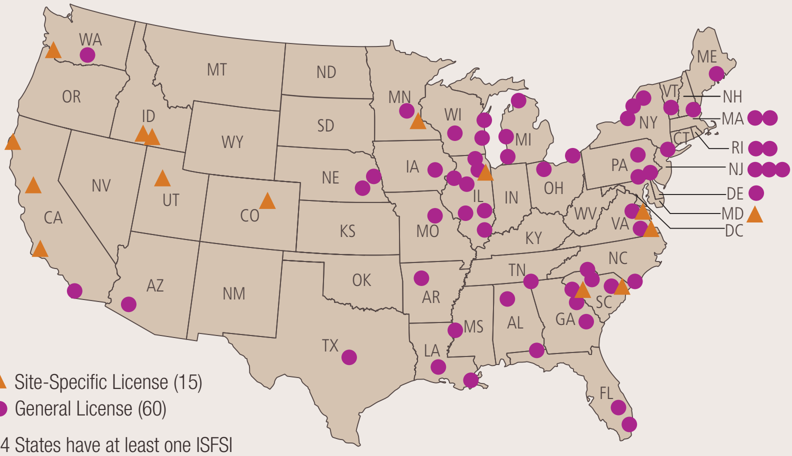


Figure 33. Licensed and Operating Independent Spent Fuel Storage Installations by State



▲ Site-Specific License (15)
● General License (60)

34 States have at least one ISFSI

ALABAMA
● Browns Ferry
● Farley

ARIZONA
● Palo Verde

ARKANSAS
● Arkansas Nuclear

CALIFORNIA
▲ Diablo Canyon
▲ Rancho Seco
● San Onofre
▲ Humboldt Bay

COLORADO
▲ Fort St. Vrain

CONNECTICUT
● Haddam Neck
● Millstone

FLORIDA
● St. Lucie
● Turkey Point

GEORGIA
● Hatch
● Vogtle

IDAHO
▲ DOE: TMI-2 (Fuel Debris)
▲ DOE: Idaho Spent Fuel Facility

ILLINOIS
● Braidwood
● Byron
▲ GE Hitachi Morris (Wet)
● Dresden
● La Salle
● Quad Cities
● Zion

IOWA
● Duane Arnold

LOUISIANA
● River Bend
● Waterford

MAINE
● Maine Yankee

MARYLAND
▲ Calvert Cliffs

MASSACHUSETTS
● Yankee Rowe
● Pilgrim

MICHIGAN
● Big Rock Point
● Palisades
● Cook
● Fermi

MINNESOTA
● Monticello
▲ Prairie Island

MISSISSIPPI
● Grand Gulf

MISSOURI
● Callaway

NEBRASKA
● Cooper
● Ft. Calhoun

NEW HAMPSHIRE
● Seabrook

NEW JERSEY
● Hope Creek
● Salem
● Oyster Creek

NEW YORK
● Indian Point
● FitzPatrick
● Ginna
● Nine Mile Point

NORTH CAROLINA
● Brunswick
● McGuire

OHIO
● Davis-Besse
● Perry

OREGON
▲ Trojan

PENNSYLVANIA
● Limerick
● Susquehanna
● Peach Bottom
● Beaver Valley

SOUTH CAROLINA
●▲ Oconee
●▲ Robinson
● Catawba

TENNESSEE
● Sequoyah

TEXAS
● Comanche Peak

UTAH
▲ Private Fuel Storage

VERMONT
● Vermont Yankee

VIRGINIA
●▲ Surry
●▲ North Anna

WASHINGTON
● Columbia

WISCONSIN
● Point Beach
● Kewaunee
● LaCrosse

Data as of July 2015. NRC-abbreviated site names listed. For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Transportation

The NRC is also involved in the transportation of spent nuclear fuel. The NRC establishes safety and security requirements in collaboration with DOT, certifies transportation cask designs, and conducts inspections to ensure that requirements are being met. Spent fuel transportation casks are designed to meet the following safety criteria under both normal and accident conditions:

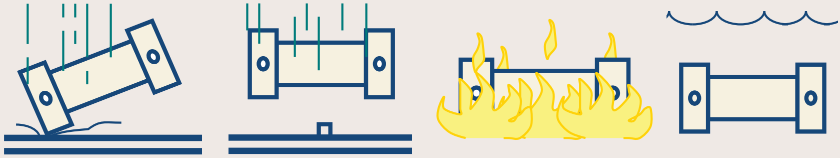
- prevent the loss or dispersion of radioactive contents
- shield everything outside the cask from the radioactivity of the contents
- dissipate the heat from the contents
- prevent nuclear criticality (a self-sustaining nuclear chain reaction) from occurring inside the cask

Transportation casks must be designed to survive a sequence of tests, including a 30-foot (9-meter) drop onto an unyielding surface, a puncture test, a fully engulfing fire at 1,475 degrees Fahrenheit (802 degrees Celsius) for 30 minutes, and immersion under water. This very severe test sequence, akin to the cask striking a concrete pillar along a highway at high speed and being engulfed in a severe and long-lasting fire, and then falling into a river, simulates conditions more severe than 99 percent of vehicle accidents (see Figure 34: Ensuring Safe Spent Fuel Shipping Containers).

To ensure the safe transportation of spent fuel and other nuclear materials, each year the NRC:

- conducts transportation safety inspections of fuel, reactor, and materials licensees
- reviews, evaluates, and certifies new, renewed, or amended transportation package design applications

Figure 34. Ensuring Safe Spent Fuel Shipping Containers



The impact (free drop and puncture), fire, and water immersion tests are considered in sequence to determine their cumulative effects on a given package.

- conducts inspections of cask vendors and manufacturers to ensure the quality of dry cask design and fabrication
- reviews and evaluates license applications for the export or import of nuclear materials

Additional information on materials transportation is available on the NRC's Web site (see the Web Link Index).

Decommissioning

See Appendices C, J, and Q for licensees undergoing decommissioning.

Decommissioning is the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property and termination of the license. NRC rules establish site-release criteria and provide for unrestricted and (under certain conditions) restricted release of a site. The NRC also requires all licensees to maintain financial assurance that funds will be available when needed for decommissioning.

The NRC regulates the decontamination and decommissioning of nuclear power plants, materials and fuel cycle facilities, research and test reactors, and uranium recovery facilities, with the ultimate goal of license termination (see Figure 35: Decommissioning Overview Timeline).

Figure 35. Decommissioning Overview Timeline

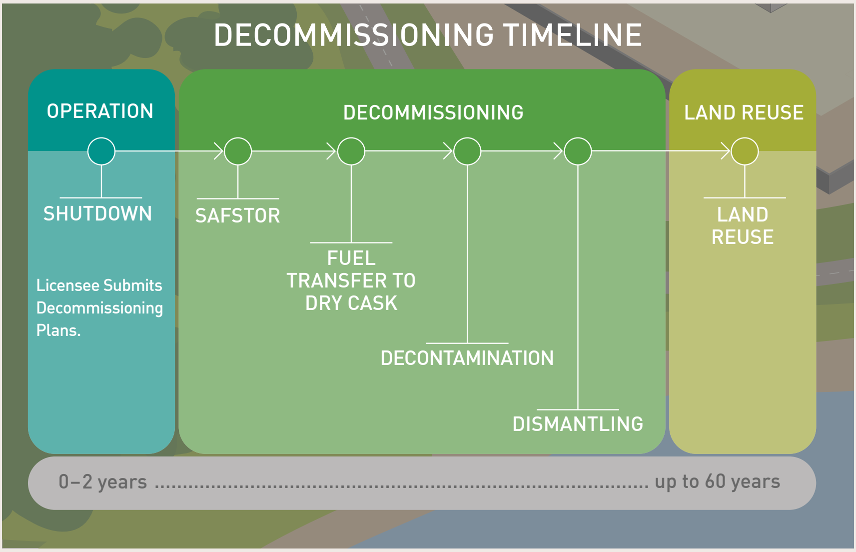
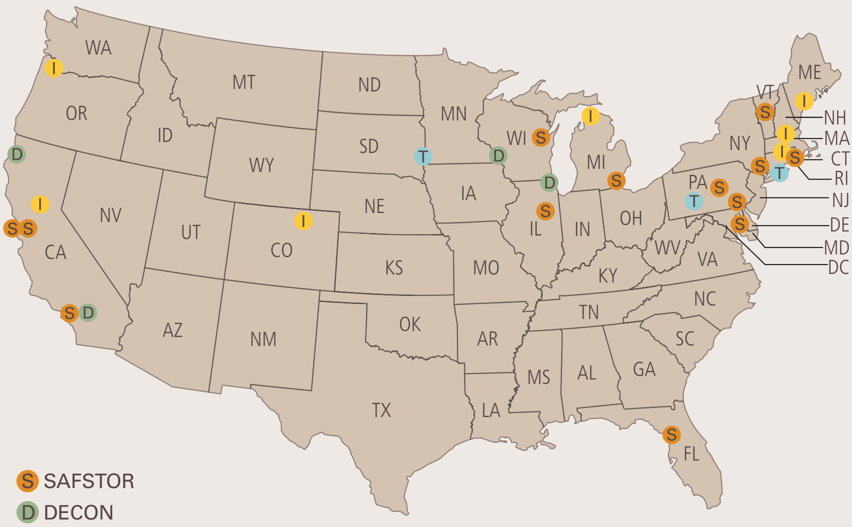


Figure 36. Power Reactor Decommissioning Status



S SAFSTOR

D DECON

I ISFSI (Independent Spent Fuel Storage Installation only)

T License Terminated

Decommissioning Completed

CALIFORNIA
- S GE EVESR
- S GE VBWR
- D Humboldt Bay 3
- I Rancho Seco
- S San Onofre 1
- D San Onofre 2 and 3

COLORADO
- I Fort St. Vrain

(DOE License)

CONNECTICUT
- S Millstone 1
- I Haddam Neck

FLORIDA
- S Crystal River 3

ILLINOIS
- S Dresden 1
- D Zion 1 and 2

MARYLAND
- S N.S. Savannah

MASSACHUSETTS
- I Yankee Rowe

MAINE
- I Maine Yankee

MICHIGAN
- S Fermi 1
- I Big Rock Point

NEW YORK
- S Indian Point 1
- T Shoreham

OREGON
- I Trojan

PENNSYLVANIA
- T Saxton
- S Peach Bottom 1
- S Three Mile Island 2

SOUTH DAKOTA
- T Pathfinder

VERMONT
- S Vermont Yankee

WISCONSIN
- D LaCrosse
- S Kewaunee

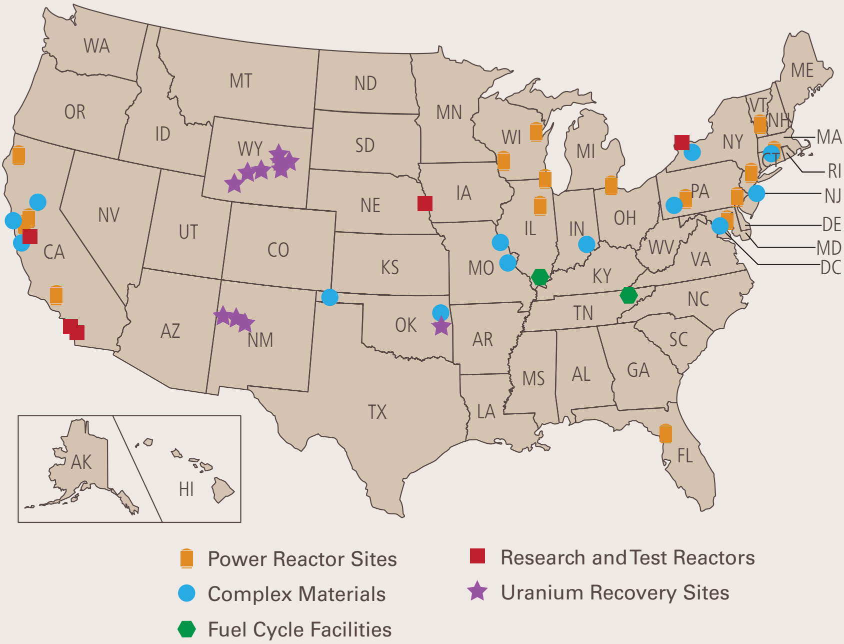
Notes: GE Bonus, Hallam, and Piqua decommissioned reactor sites are part of the DOE nuclear legacy. For more information, visit DOE's Office of Legacy Management LM Sites Web page at http://energy.gov/lm/sites/lm-sites. CVTR, Elk River, and Shippingport decommissioned reactor sites were either decommissioned before the formation of the NRC or were not licensed by the NRC. NRC-abbreviated reactor names are listed. For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

For commercial power reactors that have ceased operations, the decommissioning process may take up to 60 years. This may include extended periods of inactivity (called SAFSTOR), during which residual radioactivity is allowed to decay, making eventual cleanup easier and more efficient. A facility is said to be in DECON when active demolition and decontamination is underway. Active decommissioning of a nuclear power plant takes about 10 years on average.

The NRC terminates approximately 150 materials licenses each year. Most of these license terminations are routine, and the sites require little or no cleanup to meet the NRC's criteria for unrestricted access. The decommissioning program focuses on the termination of licenses for sites involving more complex decommissioning activities. (See Figure 36: Power Reactor Decommissioning Status, and Figure 37: Locations of NRC-Regulated Sites Undergoing Decommissioning.)

The "Status of the Decommissioning Program 2015 Annual Report" contains additional information on the decommissioning programs of the NRC and Agreement States. More information is on the NRC's Web site (see the Web Link Index).

Figure 37. Locations of NRC-Regulated Sites Undergoing Decommissioning



Note: For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/

Security and Emergency Preparedness

Overview

Nuclear security is a high priority for the NRC. For decades, effective NRC regulation and strong partnerships with Federal, State, Tribal, and local authorities have ensured effective implementation of security programs at nuclear facilities and radioactive materials sites across the country. In fact, nuclear power plants are likely the best-protected private sector facilities in the United States. However, given today's threat environment, the agency recognizes the need for continued vigilance and high levels of security.

In recent years, the NRC has made many enhancements to the security of nuclear power plants. Because nuclear power plants are inherently robust structures, these additional security upgrades (see Figure 38: Security Components) largely focus on:

- well-trained and armed security officers
- high-tech equipment and physical barriers
- greater standoff distances for vehicle checks
- intrusion detection and surveillance systems
- tested emergency preparedness and response plans
- restrictive site-access control, including background checks and fingerprinting of workers

The NRC also coordinates and shares threat information with the U.S. Departments of Homeland Security and Defense, the Federal Bureau of Investigation, intelligence agencies, and local law enforcement.

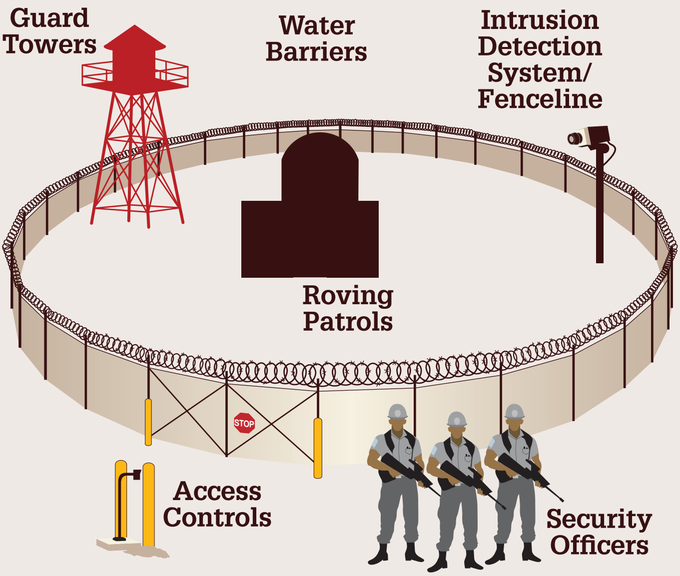
Facility Security

Under NRC regulations, nuclear power plants and fuel facilities that handle highly enriched uranium must be able to defend successfully against a set of threats the agency calls the design-basis threat (DBT). This includes threats to a plant's or facility's physical security, personnel security, and cyber security. The NRC does not make details of the DBT public because of security concerns. However, the agency continuously evaluates this set of threats against real-world intelligence to ensure the DBT remains current. To test the adequacy of a facility's defenses against the DBT, the NRC conducts rigorous force-on-force inspections at each facility every 3 years.

See Glossary for definitions of the categories of special nuclear material.

During these inspections, a highly trained mock adversary force "attacks" a nuclear facility. Beginning in 2004, the NRC made these exercises more realistic, more challenging, and more frequent.

Figure 38. Security Components



Protecting nuclear facilities requires all of the security features to come together and work as one.

The NRC inspects security at nuclear power plants and fuel fabrication facilities every year and conducts force-on-force inspections every 3 years. Publicly available portions of security-related inspection reports are on the NRC's Web site (see the Web Link Index). For security reasons, inspection reports are not available for the NRC-licensed fuel facilities that handle highly enriched uranium.

Cyber Security

Nuclear facilities use digital and analog systems to monitor, control, and run various types of equipment, as well as to obtain and store vital information. Protecting these systems and the information they contain from sabotage or malicious use is called cyber security. The reactor control systems of nuclear plants are isolated from the Internet, but for added security, all nuclear power plants licensed by the NRC must have a cyber security program.

In 2013, the NRC began regular cyber security inspections of nuclear power plants under new regulations designed to guard against the cyber threat. The experience that the NRC gained in developing the cyber security requirements for nuclear power plants provided a basis for developing similar cyber security requirements for nonreactor licensees and other nuclear facilities.

The NRC's cyber security team includes technology and threat experts who constantly evaluate and identify emerging cyber-related issues that could possibly endanger plant systems. The team also makes recommendations to other NRC offices and programs on cyber security issues. In October 2014, the NRC joined other independent regulatory agencies to create the Cyber Security Forum for Independent and Executive Branch Regulators. According to its mission statement, the forum aims to "increase the overall effectiveness and consistency of regulatory authorities' cyber security efforts pertaining to U.S. critical infrastructure, much of which is operated by industry and overseen by a number of federal regulatory authorities."

Materials Security

Radioactive materials must be secured to reduce the possibility that terrorists could use them to make a radiological dispersal device, sometimes called an RDD or a dirty bomb. The NRC has established rules to provide the requirements for the physical protection of certain types and quantities of radioactive material. Additionally, the NRC works with the Agreement States, other Federal agencies, the IAEA, and licensees to protect radioactive materials from theft and malicious use. In 2009, the NRC deployed the National Source Tracking System, designed to track the most risk-sensitive radioactive materials in sources. Other improvements allow U.S. Customs and Border Protection agents to promptly validate whether radioactive materials coming into the United States are properly licensed by the NRC or an Agreement State. In addition, the agency improved and upgraded the joint NRC-DOE database tracking the movement and location of certain forms and quantities of special nuclear material.

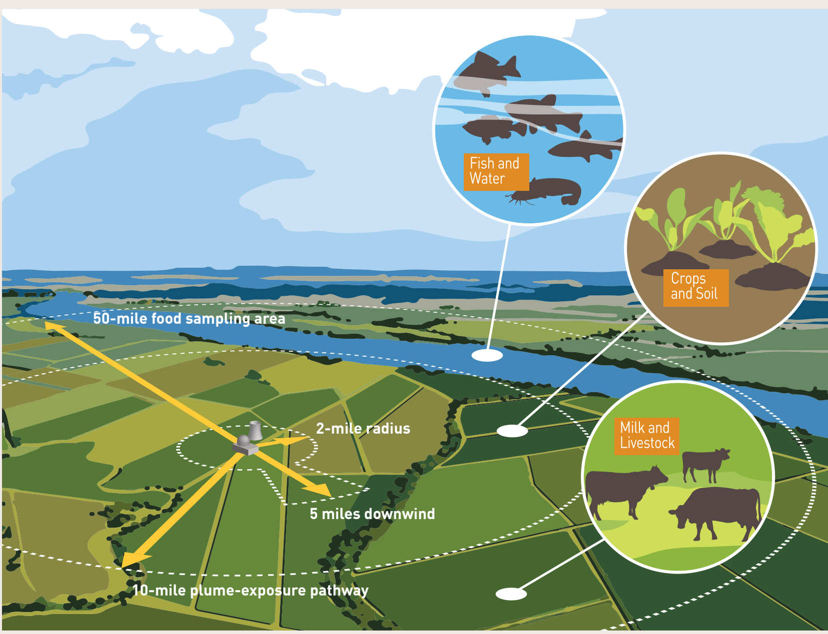
Emergency Preparedness

Operators of nuclear facilities are required to develop and maintain effective emergency plans and procedures to protect the public in the unlikely event of an emergency. Emergency preparedness plans include public information, preparations for evacuation, instructions for sheltering, and other actions to protect the residents near nuclear power plants in the event of a serious incident. The NRC includes emergency preparedness in its inspections and monitors performance indicators associated with emergency preparedness. Nuclear power plant operators must conduct full-scale exercises with the NRC, the Federal Emergency Management Agency (FEMA), and State and local officials at least once every 2 years. Some of these exercises include security and terrorism-based scenarios. These exercises test and maintain the skills of the emergency responders and identify any areas that need to be addressed. Nuclear power plant operators also conduct their own emergency response drills.

Emergency Planning Zones

The NRC defines two emergency planning zones (EPZs) around each nuclear power plant. The exact size and configuration of the zones vary from plant to plant, based on local emergency response needs and capabilities, population, land characteristics, access routes, and jurisdictional boundaries. The zone boundaries are flexible, and the NRC may expand these zones during an emergency if circumstances warrant. For a typical EPZ around a nuclear plant, see Figure 39: Emergency Planning Zones. The two types of EPZs are the plume-exposure pathway and ingestion pathway. The plume-exposure pathway covers a radius of about 10 miles (16 kilometers) from the plant and is the area of greatest concern about the public's exposure to and inhalation of airborne radioactive contamination. Research has shown the most significant impacts of an accident would be expected in the immediate vicinity of a plant, and any initial protective actions, such as evacuations or sheltering in place, should be focused there. The ingestion pathway, or food safety sampling area, extends to a radius of about 50 miles (80 kilometers) from the plant and is the area of greatest concern about the ingestion of food and liquid contaminated by radioactivity.

Figure 39. Emergency Planning Zones



Note: A 2-mile ring around the plant is identified for evacuation, along with a 5-mile zone downwind of the projected release path.

Protective Actions

During an actual nuclear power plant accident, the NRC would use radiation-dose projection models to predict the nature and extent of a radiation release. The dose calculations would account for weather conditions to project the extent of radiation exposure to the nearby population. The NRC would confer with appropriate State and county governments on its assessment results. Plant personnel would also provide assessments. State and local officials in communities within the EPZ have detailed plans to protect the public during a radiation release. These officials make their protective action decisions, including decisions to order evacuations, based on these and other assessments.

Evacuation, Sheltering, and the Use of Potassium Iodide

Protective actions considered for a radiological emergency include evacuation, sheltering, and the preventive use of potassium iodide (KI) supplements to protect the thyroid from radioactive iodine, which can cause thyroid cancer.

Under certain conditions, it may be preferable to evacuate the public away from further exposure to radioactive material. However, a complete evacuation of the 10-mile (16-kilometer) zone around a nuclear power plant is not likely to be needed in most cases. The release of radioactive material from a plant during a major incident would move with the wind, not in all directions surrounding the plant. The release would also expand and become less concentrated as it traveled away from a plant. For these reasons, evacuations can be planned based on the anticipated path of the release. Under some conditions, people may be instructed to take shelter in their homes, schools, or office buildings. Depending on the type of structure, sheltering can significantly reduce someone's dose when compared to staying outside. In certain situations, KI may be used as a supplement to sheltering. It may be appropriate to shelter when the release of radioactive material is known to be short term or is controlled by the nuclear power plant operator.

The risk of an offsite radiological release is significantly lower and the types of possible accidents significantly fewer at a nuclear power reactor that has permanently ceased operations and removed fuel from the reactor vessel.

Nuclear power plants that have begun decommissioning may therefore apply for exemptions from these FEMA and NRC emergency planning requirements. Once the exemptions are granted, State and local agencies may apply their comprehensive emergency plans—known as all-hazard plans—to respond to incidents at the plant. Additional information on emergency preparedness is available on the NRC's Web site (see Web Link Index).

During an exercise in the agency's Headquarters Operations Center, NRC protective measures team members look at simulated projected radiation doses to the public.

Incident Response

Quick communication among the NRC, other Federal and State agencies, and the nuclear industry is critical when responding to any incident. The NRC staff supports several Federal incident response centers where officials can coordinate assessments of event-related information. The NRC Headquarters Operations Center, located in the agency's headquarters in Rockville, MD, is staffed around the clock to disseminate information and coordinate response activities. The NRC also reviews intelligence reports and assesses suspicious activity to keep licensees and other agencies up to date on current threats. The NRC works within the National Response Framework to respond to events. The framework guides the Nation in its response to complex events that might involve a variety of agencies and hazards. Under this framework, the NRC retains its independent authority and ability to respond to emergencies involving NRC-licensed facilities or materials. The NRC may request support from DHS in responding to an emergency at an NRC-licensed facility or involving NRC-licensed materials. DHS may lead and manage the overall Federal response to an event, according to Homeland Security Presidential Directive 5, "Management of Domestic Incidents." In this case, the NRC would provide technical expertise and help share information among the various organizations and licensees. In response to an incident involving possible radiation releases, the NRC activates its incident response program at its Headquarters Operations Center and one of its four Regional Incident Response Centers. Teams of specialists at these centers evaluate event information, independently assess the potential impact on public health and safety, and evaluate possible recovery strategies.

The NRC staff provides expert consultation, support, and assistance to State and local public safety officials and keeps the public informed of agency actions. Meanwhile, other NRC experts evaluate the effectiveness of protective actions the licensee has recommended to State and local officials. If needed, the NRC will dispatch a team of technical experts from the responsible regional office to the site. This team would assist the NRC's resident inspectors, who work at the plant. The Headquarters Operations Center would continue to provide around-the-clock communications, logistical support, and technical analysis throughout the response.

Emergency Classifications

Emergencies at nuclear facilities are classified according to the risk posed to the public. These classifications help guide first responders on the actions necessary to protect the population near the site. Nuclear power plants use these four emergency classifications:

Notification of Unusual Event: Events that indicate a potential degradation in the level of safety of the plant are in progress or have occurred. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs.

Alert: Events that involve an actual or potential substantial degradation in the level of plant safety are in progress or have occurred. Any releases of radioactive material are expected to be limited to a small fraction of the limits set forth by the U.S. Environmental Protection Agency (EPA).

Site Area Emergency: Events that may result in actual or likely major failures of plant functions needed to protect the public are in progress or have occurred. Any releases of radioactive material are not expected to exceed the limits set forth by the EPA except near the site boundary.

General Emergency: Events that involve actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity are in progress or have occurred. Radioactive releases can be expected to exceed the limits set forth by the EPA for more than the immediate site area.

Nuclear materials and fuel cycle facility licensees use these emergency classifications:

Alert: Events that could lead to a release of radioactive materials are in progress or have occurred. The release is not expected to require a response by an offsite response organization to protect residents near the site.

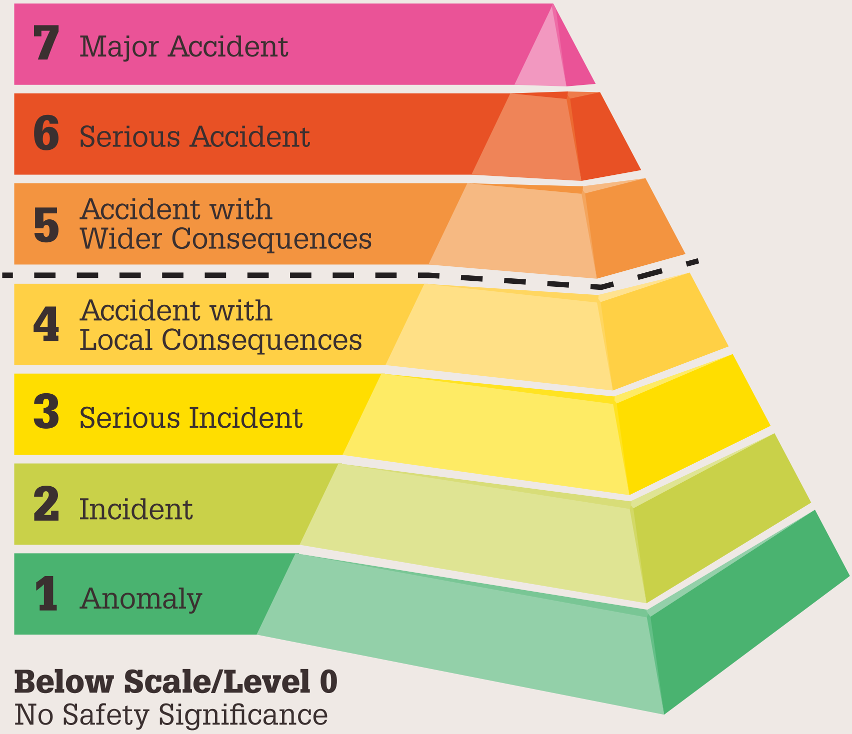
Site Area Emergency: Events that could lead to a significant release of radioactive materials are in progress or have occurred. The release could require a response by offsite response organizations to protect residents near the site.

International Emergency Classifications

The IAEA uses the International Nuclear and Radiological Event Scale (INES) as a tool for promptly and consistently communicating to the public the safety significance of reported nuclear and radiological incidents and accidents worldwide (see Figure 40: The International Nuclear and Radiological Event Scale).

The scale can be applied to any event associated with nuclear facilities, as well as to the transport, storage, and use of radioactive material and radiation sources. Licensees are not required to classify events or provide offsite notifications using the INES scale. But the NRC has a commitment to transmit to the IAEA an INES-based rating for an applicable event occurring in the United States rated at Level 2 or above, or events attracting international public interest.

Figure 40. The International Nuclear and Radiological Event Scale



INES events are classified on the scale at 7 levels. Levels 1–3 are called incidents and Levels 4–7 accidents. The scale is designed so that the severity of an event is about 10 times greater for each increase in level on the scale. Events without safety significance are called deviations and are classified as Below Scale or at Level 0.

NRC

Appendices

This edition of the Digest provides a snapshot of data; for the most current information and data collection, please visit the NRC Web site Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

Abbreviations

ABWR advanced boiling-water reactor
AC Allis Chalmers
ACRS Advisory Committee on Reactor Safeguards
ADAMS Agencywide Documents Access and Management System
ADR Alternative Dispute Resolution
AEC Atomic Energy Commission (U.S.)
AEP American Electric Power Company
AGN solid homogeneous core (Aerojet-General Nucleonics)
ASLB Atomic Safety and Licensing Board
B&R Burns & Roe
B&W Babcock & Wilcox
BALD Baldwin Associates
BECH Bechtel
BRRT Brown & Root
BWR boiling-water reactor
CE Combustion Engineering
CFR *Code of Federal Regulations*
CO Commission order
Co company
COL combined license
Comm. Op. date of commercial operation
Con Type containment type
  DRYAMB dry, ambient pressure
  DRYSUB dry, subatmospheric
  ICECND wet, ice condenser
    MARK 1 *wet, Mark I*
    MARK 2 *wet, Mark II*
    MARK 3 *wet, Mark III*
CP civil penalty
CP Issued date of construction permit issuance
CRGR Committee To Review Generic Requirements
CVP civil penalties
CVTR Carolinas-Virginia Tube Reactor
CWE Commonwealth Edison Company
DANI Daniel International
DBDB Duke & Bechtel
DBT design-basis threat
DC design certification
DHS Department of Homeland Security (U.S.)
DOE Department of Energy (U.S.)
DOT Department of Transportation (U.S.)
DUKE Duke Power Company
EBSO Ebasco
EIA Energy Information Administration (DOE)
EIS environmental impact statement
EPA Environmental Protection Agency (U.S.)
EPR Evolutionary Power Reactor
EPZ emergency planning zone
ERO emergency response organization
ESBWR Economic Simplified Boiling-Water Reactor
ESP early site permit
EVESR ESADA (Empire States Atomic Development Associates) Vallecitos Experimental Superheat Reactor
Exp. Date expiration date of operating license
FBR fast breeder reactor
FEMA Federal Emergency Management Agency
FERC Federal Energy Regulatory Commission
FLUR Fluor Pioneer
FOIA Freedom of Information Act
FTE full-time equivalent
FW Foster Wheeler
FY fiscal year
G&H Gibbs & Hill
GA General Atomic
GCR gas-cooled reactor
GE General Electric
GEH General Electric-Hitachi Nuclear Energy
GEIS generic environmental impact statement
GETR General Electric Test Reactor
GHDR Gibbs & Hill & Durham & Richardson
GIL Gilbert Associates
GL general license
GPC Georgia Power Company
GW gigawatt
GWh gigawatts hours
HTG high-temperature gas (reactor)
HWR heavy-water reactor
IAEA International Atomic Energy Agency
INES International Nuclear Event Scale
ISFSI independent spent fuel storage installation
ISR in situ recovery
KAIS Kaiser Engineers
KI potassium iodide
kW kilowatt(s)
LLP B&W lowered loop
LLW low-level radioactive waste
LMFB liquid metal fast breeder (reactor)
LR Issued license renewal issued
LWGR light-water-cooled graphite-moderated reactor
MOX mixed-oxide
MW megawatt(s)
MWe megawatt(s) electric
MWh megawatt-hour(s)
MWt megawatt(s) thermal
NIAG Niagara Mohawk Power Corporation

NEA	Nuclear Energy Agency
NMMSS	Nuclear Material Management and Safeguards System
NOV	notice(s) of violation
NOVF	notice(s) of violation associated with inspection findings
NOVSL	notice(s) of violation for severity level
NRC	Nuclear Regulatory Commission (U.S.)
NSP	Northern States Power Company
NSSS	nuclear steam system supplier and design type
GE 2	*GE Type 2*
GE 3	*GE Type 3*
GE 4	*GE Type 4*
GE 5	*GE Type 5*
GE 6	*GE Type 6*
WEST 2LP	*Westinghouse Two-Loop*
WEST 3LP	*Westinghouse Three-Loop*
WEST 4LP	*Westinghouse Four-Loop*
NSTS	National Source Tracking System
OECD	Organisation for Economic Co-operation and Development
OL	operating license
OL Issued	date of latest full power operating license
PG&E	Pacific Gas & Electric Company
PRA	probabilistic risk assessment
PRIS	Power Reactor Information System
PSEG	Public Service Electric and Gas Company
PHWR	pressurized heavy water reactor
PWR	pressurized-water reactor
RIC	Regulatory Information Conference
RLP	B&W raised loop
ROP	Reactor Oversight Process
RTR	research and test reactor
S&L	Sargent & Lundy
S&W	Stone & Webster
SAMG	Severe Accident Management Guidance
SCF	sodium-cooled fast (reactor)
SDP	significance determination process
SGEC	architect for Vogtle
SHINE	SHINE Medical Technologies, Inc.
SI	système internationale (d'unités) (International System of Units)
SL	severity level
SOARCA	State-of-the-Art Reactor Consequence Analysis
SSI	Southern Services Incorporated
STARS	Strategic Teaming and Resource Sharing Group
STP	South Texas Project
TMI-2	Three Mile Island Unit 2
Sv	sievert
TRIGA	Training Reactor and Isotopes Production, General Atomics
TVA	Tennessee Valley Authority
UE&C	United Engineers & Constructors
USEC	U.S. Enrichment Corporation
US-APWR	United States [version of] Advanced Pressurized-Water Reactor
VBWR	Vallecitos Boiling-Water Reactor
WDCO	Westinghouse Development Corporation
WEST	Westinghouse Electric
WNA	World Nuclear Association

Alabama	AL	Kentucky	KY	Ohio	OH
Alaska	AK	Louisiana	LA	Oklahoma	OK
Arizona	AZ	Maine	ME	Oregon	OR
Arkansas	AR	Maryland	MD	Pennsylvania	PA
California	CA	Massachusetts	MA	Puerto Rico	PR
Colorado	CO	Michigan	MI	Rhode Island	RI
Connecticut	CT	Minnesota	MN	South Carolina	SC
Delaware	DE	Mississippi	MS	South Dakota	SD
District of Columbia	DC	Missouri	MO	Tennessee	TN
Florida	FL	Montana	MT	Texas	TX
Georgia	GA	Nebraska	NE	Utah	UT
Guam	GU	Nevada	NV	Vermont	VT
Hawaii	HI	New Hampshire	NH	Virgin Islands	VI
Idaho	ID	New Jersey	NJ	Virginia	VA
Illinois	IL	New Mexico	NM	Washington	WA
Indiana	IN	New York	NY	West Virginia	WV
Iowa	IA	North Carolina	NC	Wisconsin	WI
Kansas	KS	North Dakota	ND	Wyoming	WY

QUICK-REFERENCE METRIC CONVERSION TABLES

SPACE AND TIME

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Length	mi (statute)	km	1.609347
	yd	m	*0.9144
	ft (int)	m	*0.3048
	in	cm	*2.54
Area	mi^2	km^2	2.589998
	acre	m^2	4,046.873
	yd^2	m^2	0.8361274
	ft^2	m^2	*0.09290304
	in^2	cm^2	*6.4516
Volume	acre foot	m^3	1,233.489
	yd^3	m^3	0.7645549
	ft^3	m^3	0.02831685
	ft^3	L	28.31685
	gal	L	3.785412
	fl oz	mL	29.57353
	in^3	cm^3	16.38706
Velocity	mi/h	km/h	1.609347
	ft/s	m/s	*0.3048
Acceleration	ft/s^2	m/s^2	*0.3048

NUCLEAR REACTION AND IONIZING RADIATION

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Activity (of a radionuclide)	curie (Ci)	MBq	*37,000.0
	dpm	becquerel (Bq)	0.016667
Absorbed dose	rad	gray (Gy)	*0.01
	rad	cGy (centigray)	*1.0
Dose equivalent	rem	sievert (Sv)	*0.01
	rem	mSv	*10.0
	mrem	mSv	*0.01
	mrem	µSv (microsivert)	*10.0
Exposure (X-rays and gamma rays)	roentgen (R)	C/kg (coulomb)	0.000258

HEAT

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Thermodynamic temperature	°F	K	*K = (°F + 459.67)/1.8
Celsius temperature	°F	°C	*°C = (°F–32)/1.8
Linear expansion coefficient	1/°F	1/K or 1/°C	*1.8
Thermal conductivity	(Btu • in)/(ft^2 • h • °F)	W/(m • °C)	0.1442279
Coefficient of heat transfer	Btu / (ft^2 • h • °F)	W/(m^2 • °C)	5.678263
Heat capacity	Btu/°F	kJ/°C	1.899108
Specific heat capacity	Btu/(lb • °F)	kJ/(kg • °C)	*4.1868

QUICK-REFERENCE METRIC CONVERSION TABLES

HEAT (continued)

Entropy	Btu/°F	kJ/°C	1.899108
Specific entropy	Btu/(lb • °F)	kJ/(kg • °C)	*4.1868
Specific internal energy	Btu/lb	kJ/kg	*2.326

MECHANICS

Quantity	From Inch-Pound Units	To Metric Units	Multiply by
Mass (weight)	ton (short)	t (metric ton)	*0.90718474
	lb (avdp)	kg	*0.45359237
Moment of mass	lb • ft	kg • m	0.138255
Density	ton (short)/yd^3	t/m^3	1.186553
	lb/ft^3	g/m^3	16.01846
Concentration (mass)	lb/gal	g/L	119.8264
Momentum	lb • ft/s	kg • m/s	0.138255
Angular momentum	lb • ft^2/s	kg • m^2/s	0.04214011
Moment of inertia	lb • ft^2	kg • m^2	0.04214011
Force	kip (kilopound)	kN (kilonewton)	4.448222
	lbf	N (newton)	4.448222
Moment of force, torque	lbf • ft	N • m	1.355818
	lbf • in	N • m	0.1229848
Pressure	atm (std)	kPa (kilopascal)	*101.325
	bar	kPa	*100.0
	lbf/in^2 (formerly psi)	kPa	6.894757
	inHg (32 °F)	kPa	3.38638
	ftH_2O (39.2 °F)	kPa	2.98898
	inH_2O (60 °F)	kPa	0.24884
	mmHg (0 °C)	kPa	0.133322
Stress	kip/in^2 (formerly ksi)	MPa	6.894757
	lbf/in^2 (formerly psi)	MPa	0.006894757
	lbf/in^2 (formerly psi)	kPa	6.894757
	lbf/ft2	kPa	0.04788026
Energy, work	kWh	MJ	*3.6
	cal^{th}	J (joule)	*4.184
	Btu	kJ	1.055056
	ft • lbf	J	1.355818
	therm (US)	MJ	105.4804
Power	Btu/s	kW	1.055056
	hp (electric)	kW	*0.746
	Btu/h	W	0.2930711

* Exact conversion factors

Note: The information contained in this table is intended to familiarize readers with commonly used International System of Units (SI) units and provide a quick reference to aid understanding of documents containing SI units. The conversion factors listed here have not been approved as NRC guidelines for the development of licensing actions, regulations, or policy.

To convert from metric units to inch-pound units, divide the metric unit by the conversion factor.

Sources: Federal Standard 376B, “Preferred Metric Units for General Use by the Federal Government,” and International Commission on Radiation Units and Measurements, ICRU Report 33, “Radiation Quantities and Units," issued 1980.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Arkansas Nuclear One, Unit 1 Entergy Operations, Inc. London, AR (6 miles NW of Russellville, AR) 05000313 www.nrc.gov/info-finder/reactors/ano1.html	IV	PWR-DRYAMB B&W LLP BECH BECH	2,568	12/06/1968 05/21/1974 12/19/1974 06/20/2001 05/20/2034	99 90 87 102 56 98
Arkansas Nuclear One, Unit 2 Entergy Operations, Inc. London, AR (6 miles NW of Russellville, AR) 05000368 www.nrc.gov/info-finder/reactors/ano2.html	IV	PWR-DRYAMB CE BECH BECH	3,026	12/06/1972 09/01/1978 03/26/1980 06/30/2005 07/17/2038	90 97 90 93 91 85
Beaver Valley Power Station, Unit 1 FirstEnergy Nuclear Operating Co. Shippingport, PA (17 miles W of McCandless, PA) 05000334 www.nrc.gov/info-finder/reactors/bv1.html	I	PWR-DRYAMB WEST 3LP S&W S&W	2,900	06/26/1970 07/02/1976 10/01/1976 11/05/2009 01/29/2036	92 91 101 92 86 86
Beaver Valley Power Station, Unit 2 FirstEnergy Nuclear Operating Co. Shippingport, PA (17 miles W of McCandless, PA) 05000412 www.nrc.gov/info-finder/reactors/bv2.html	I	PWR-DRYAMB WEST 3LP S&W S&W	2,900	05/03/1974 08/14/1987 11/17/1987 11/05/2009 05/27/2047	87 84 102 91 97 98
Braidwood Station, Unit 1 Exelon Generation Co., LLC Braceville, IL (20 miles SW of Joliet, IL) 05000456 www.nrc.gov/info-finder/reactors/brai1.html	III	PWR-DRYAMB WEST 4LP S&L CWE	3,645	12/31/1975 07/02/1987 07/29/1988 N/A 10/17/2026	95 89 101 91 95 103
Braidwood Station, Unit 2 Exelon Generation Co., LLC Braceville, IL (20 miles SW of Joliet, IL) 05000457 www.nrc.gov/info-finder/reactors/brai2.html	III	PWR-DRYAMB WEST 4LP S&L CWE	3,645	12/31/1975 05/20/1988 10/17/1988 N/A 12/18/2027	93 99 93 93 98 96
Browns Ferry Nuclear Plant, Unit 1 Tennessee Valley Authority Athens (Limestone County), AL (32 miles W of Huntsville, AL) 05000259 www.nrc.gov/info-finder/reactors/bf1.html	II	BWR-MARK 1 GE 4 TVA TVA	3,458	05/10/1967 12/20/1973 08/01/1974 05/04/2006 12/20/2033	94 86 91 88 94 90

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Browns Ferry Nuclear Plant, Unit 2 Tennessee Valley Authority Athens (Limestone County), AL (32 miles W of Huntsville, AL) 05000260 www.nrc.gov/info-finder/reactors/bf2.html	II	BWR-MARK 1 GE 4 TVA TVA	3,458	05/10/1967 06/28/1974 03/01/1975 05/04/2006 06/28/2034	94 91 80 99 79 98
Browns Ferry Nuclear Plant, Unit 3 Tennessee Valley Authority Athens (Limestone County), AL (32 miles W of Huntsville, AL) 05000296 www.nrc.gov/info-finder/reactors/bf3.html	II	BWR-MARK 1 GE 4 TVA TVA	3,458	07/31/1968 07/02/1976 03/01/1977 05/04/2006 07/02/2036	95 81 87 83 89 88
Brunswick Steam Electric Plant, Unit 1 Duke Energy Progress, Inc. Southport, NC (30 miles S of Wilmington, NC) 05000325 www.nrc.gov/info-finder/reactors/bru1.html	II	BWR-MARK 1 GE 4 UE&C BRRT	2,923	02/07/1970 09/08/1976 03/18/1977 06/26/2006 09/08/2036	98 83 100 77 92 89
Brunswick Steam Electric Plant, Unit 2 Duke Energy Progress, Inc. Southport, NC (30 miles S of Wilmington, NC) 05000324 www.nrc.gov/info-finder/reactors/bru2.html	II	BWR-MARK 1 GE 4 UE&C BRRT	2,923	02/07/1970 12/27/1974 11/03/1975 06/26/2006 12/27/2034	80 99 79 98 73 98
Byron Station, Unit 1 Exelon Generation Co., LLC Byron, IL (17 miles SW of Rockford, IL) 05000454 www.nrc.gov/info-finder/reactors/byro1.html	III	PWR-DRYAMB WEST 4LP S&L CWE	3,645	12/31/1975 02/14/1985 09/16/1985 N/A 10/31/2024	94 101 88 88 96 97
Byron Station, Unit 2 Exelon Generation Co., LLC Byron, IL (17 miles SW of Rockford, IL) 05000455 www.nrc.gov/info-finder/reactors/byro2.html	III	PWR-DRYAMB WEST 4LP S&L CWE	3,645	12/31/1975 01/30/1987 08/02/1987 N/A 11/06/2026	102 96 93 94 86 94
Callaway Plant Union Electric Co. Fulton, MO (25 miles NE of Jefferson City, MO) 05000483 www.nrc.gov/info-finder/reactors/call.html	IV	PWR-DRYAMB WEST 4LP BECH DANI	3,565	04/16/1976 10/18/1984 12/19/1984 03/06/2015 10/18/2044	98 86 90 103 77 89

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Calvert Cliffs Nuclear Power Plant, Unit 1 Calvert Cliffs Nuclear Power Plant, LLC Exelon Generation Co., LLC Lusby, MD (40 miles S of Annapolis, MD) 05000317 www.nrc.gov/info-finder/reactors/calv1.html	I	PWR-DRYAMB CE BECH BECH	2,737	07/07/1969 07/31/1974 05/08/1975 03/23/2000 07/31/2034	98 90 101 81 97 91
Calvert Cliffs Nuclear Power Plant, Unit 2 Calvert Cliffs Nuclear Power Plant, LLC Exelon Generation Co., LLC Lusby, MD (40 miles S of Annapolis, MD) 05000318 www.nrc.gov/info-finder/reactors/calv2.html	I	PWR-DRYAMB CE BECH BECH	2,737	07/07/1969 08/13/1976 04/01/1977 03/23/2000 08/13/2036	93 97 92 101 81 100
Catawba Nuclear Station, Unit 1 Duke Energy Carolinas, LLC York, SC (18 miles S of Charlotte, NC) 05000413 www.nrc.gov/info-finder/reactors/cat1.html	II	PWR-ICECND WEST 4LP DUKE DUKE	3,411	08/07/1975 01/17/1985 06/29/1985 12/05/2003 12/05/2043	91 100 89 89 96 86
Catawba Nuclear Station, Unit 2 Duke Energy Carolinas, LLC York, SC (18 miles S of Charlotte, NC) 05000414 www.nrc.gov/info-finder/reactors/cat2.html	II	PWR-ICECND WEST 4LP DUKE DUKE	3,411	08/07/1975 05/15/1986 08/19/1986 12/05/2003 12/05/2043	90 92 101 92 86 100
Clinton Power Station, Unit 1 Exelon Generation Co., LLC Clinton, IL (23 miles SSE of Bloomington, IL) 05000461 www.nrc.gov/info-finder/reactors/clin.html	III	BWR-MARK 3 GE 6 S&L BALD	3,473	02/24/1976 04/17/1987 11/24/1987 N/A 09/29/2026	97 92 93 100 82 97
Columbia Generating Station Energy Northwest Benton County, WA (12 miles NW of Richland, WA) 05000397 www.nrc.gov/info-finder/reactors/wash2.html	IV	BWR-MARK 2 GE 5 B&R BECH	3,486	03/19/1973 04/13/1984 12/13/1984 05/22/2012 12/20/2043	67 95 50 97 80 98
Comanche Peak Nuclear Power Plant, Unit 1 Luminant Generation Co., LLC Glen Rose, TX (40 miles SW of Fort Worth, TX) 05000445 www.nrc.gov/info-finder/reactors/cp1.html	IV	PWR-DRYAMB WEST 4LP G&H BRRT	3,612	12/19/1974 04/17/1990 08/13/1990 N/A 02/08/2030	100 91 91 98 94 85

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Comanche Peak Nuclear Power Plant, Unit 2 Luminant Generation Company, LLC Glen Rose, TX (40 miles SW of Fort Worth, TX) 05000446 www.nrc.gov/info-finder/reactors/cp2.html	IV	PWR-DRYAMB WEST 4LP BECH BRRT	3,612	12/19/1974 04/06/1993 08/03/1993 N/A 02/02/2033	94 104 92 91 99 93
Cooper Nuclear Station Nebraska Public Power District Brownville, NE (23 miles S of Nebraska City, NE) 05000298 www.nrc.gov/info-finder/reactors/cns.html	IV	BWR-MARK 1 GE 4 B&R B&R	2,419	06/04/1968 01/18/1974 07/01/1974 11/29/2010 01/18/2034	72 100 86 87 97 88
Davis-Besse Nuclear Power Station, Unit 1 FirstEnergy Nuclear Operating Co. Oak Harbor, OH (21 miles ESE of Toledo, OH) 05000346 www.nrc.gov/info-finder/reactors/davi.html	III	PWR-DRYAMB B&W RLP BECH B&W	2,817	03/24/1971 04/22/1977 07/31/1978 N/A 04/22/2017	99 66 81 91 95 74
Diablo Canyon Nuclear Power Plant, Unit 1 Pacific Gas & Electric Co. Avila Beach, CA (12 miles SW of San Luis Obispo, CA) 05000275 www.nrc.gov/info-finder/reactors/diab1.html	IV	PWR-DRYAMB WEST 4LP PG&E PG&E	3,411	4/23/1968 11/02/1984 05/07/1985 N/A 11/02/2024	84 88 100 84 95 87
Diablo Canyon Nuclear Power Plant, Unit 2 Pacific Gas & Electric Co. Avila Beach, CA (12 miles SW of San Luis Obispo, CA) 05000323 www.nrc.gov/info-finder/reactors/diab2.html	IV	PWR-DRYAMB WEST 4LP PG&E PG&E	3,411	12/09/1970 08/26/1985 03/13/1986 N/A 08/26/2025	84 100 89 97 82 86
Donald C. Cook Nuclear Plant, Unit 1 Indiana Michigan Power Co. Bridgman, MI (13 miles S of Benton Harbor, MI) 05000315 www.nrc.gov/info-finder/reactors/cook1.html	III	PWR-ICECND WEST 4LP AEP AEP	3,304	03/25/1969 10/25/1974 08/28/1975 08/30/2005 10/25/2034	3 88 87 104 78 94
Donald C. Cook Nuclear Plant, Unit 2 Indiana Michigan Power Co. Bridgman, MI (13 miles S of Benton Harbor, MI) 05000316 www.nrc.gov/info-finder/reactors/cook2.html	III	PWR-ICECND WEST 4LP AEP AEP	3,468	03/25/1969 12/23/1977 07/01/1978 08/30/2005 12/23/2037	87 84 104 91 85 101

APPENDIX A
Commercial Nuclear Power Reactors
Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Dresden Nuclear Power Station, Unit 2	III	BWR-MARK 1	2,957	01/10/1966	91
Exelon Generation Co., LLC		GE 3		02/20/1991[A]	102
Morris, IL		S&L		06/09/1970	95
(25 miles SW of Joliet, IL)		UE&C		10/28/2004	104
05000237				12/22/2029	85
www.nrc.gov/info-finder/reactors/dres2.html					98
Dresden Nuclear Power Station, Unit 3	III	BWR-MARK 1	2,957	10/14/1966	97
Exelon Generation Co., LLC		GE 3		01/12/1971	90
Morris, IL		S&L		11/16/1971	99
(25 miles SW of Joliet, IL)		UE&C		10/28/2004	91
05000249				01/12/2031	89
www.nrc.gov/info-finder/reactors/dres3.html					95
Duane Arnold Energy Center	III	BWR-MARK 1	1,912	06/22/1970	92
NextEra Energy Duane Arnold, LLC		GE 4		02/22/1974	89
Palo, IA		BECH		02/01/1975	99
(8 miles NW of Cedar Rapids, IA)		BECH		12/16/2010	83
05000331				02/21/2034	89
www.nrc.gov/info-finder/reactors/duan.html					79
Edwin I. Hatch Nuclear Plant, Unit 1	II	BWR-MARK 1	2,804	09/30/1969	94
Southern Nuclear Operating Co.		GE 4		10/13/1974	85
Baxley, GA		BECH		12/31/1975	98
(20 miles S of Vidalia, GA)		GPC		01/15/2002	89
05000321				08/06/2034	94
www.nrc.gov/info-finder/reactors/hat1.html					89
Edwin I. Hatch Nuclear Plant, Unit 2	II	BWR-MARK 1	2,804	12/27/1972	67
Southern Nuclear Operating Co., Inc.		GE 4		06/13/1978	96
Baxley, GA		BECH		09/05/1979	78
(20 miles S of Vidalia, GA)		GPC		01/15/2002	98
05000366				06/13/2038	89
www.nrc.gov/info-finder/reactors/hat2.html					99
Fermi, Unit 2	III	BWR-MARK 1	3,486	09/26/1972	75
DTE Electric Company		GE 4		07/15/1985	80
Newport, MI		S&L		01/23/1988	94
(25 miles NE of Toledo, OH)		DANI		N/A	54
05000341				03/20/2025	62
www.nrc.gov/info-finder/reactors/ferm2.html					82
Fort Calhoun Station, Unit 1	IV	PWR-DRYAMB	1,500	06/07/1968	100
Omaha Public Power District		CE		08/09/1973	102
Ft. Calhoun, NE		GHDR		09/26/1973	28
(19 miles N of Omaha, NE)		GHDR		11/04/2003	0
05000285				08/09/2033	1
www.nrc.gov/info-finder/reactors/fcs.html					100

A: The Atomic Energy Commission (AEC) issued a provisional Operating License (OL) on 12/22/1969, allowing commercial operation. The NRC issued a full-term OL on 02/20/1991.

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Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Grand Gulf Nuclear Station, Unit 1 Entergy Operations, Inc. Port Gibson, MS (20 miles S of Vicksburg, MS) 05000416 www.nrc.gov/info-finder/reactors/gg1.html	IV	BWR-MARK 3 GE 6 BECH BECH	4,408	09/04/1974 11/01/1984 07/01/1985 N/A 11/01/2024	100 88 94 70 86 82
H.B. Robinson Steam Electric Plant, Unit 2 Duke Energy Progress, Inc. Hartsville, SC (26 miles NW of Florence, SC) 05000261 www.nrc.gov/info-finder/reactors/rob2.html	II	PWR-DRYAMB WEST 3LP EBSO EBSO	2,339	04/13/1967 07/31/1970 03/07/1971 04/19/2004 07/31/2030	104 57 100 85 85 86
Hope Creek Generating Station, Unit 1 PSEG Nuclear, LLC Hancocks Bridge, NJ (18 miles SE of Wilmington, DE) 05000354 www.nrc.gov/info-finder/reactors/hope.html	I	BWR-MARK 1 GE 4 BECH BECH	3,840	11/04/1974 07/25/1986 12/20/1986 07/20/2011 04/11/2046	95 93 103 93 80 102
Indian Point Nuclear Generating, Unit 2 Entergy Nuclear Indian Point 2, LLC Buchanan, NY (24 miles N of New York, NY) 05000247 www.nrc.gov/info-finder/reactors/ip2.html	I	PWR-DRYAMB WEST 4LP UE&C WDCO	3,216	10/14/1966 09/28/1973 08/01/1974 N/A 09/28/2013	98 82 98 90 77 93
Indian Point Nuclear Generating, Unit 3 Entergy Nuclear Indian Point 3, LLC Buchanan, NY (24 miles N of New York, NY) 05000286 www.nrc.gov/info-finder/reactors/ip3.html	I	PWR-DRYAMB WEST 4LP UE&C WDCO	3,216	08/13/1969 12/12/1975 08/30/1976 N/A 12/12/2015	85 99 90 100 94 98
James A. FitzPatrick Nuclear Power Plant Entergy Nuclear FitzPatrick, LLC Scriba, NY (6 miles NE of Oswego, NY) 05000333 www.nrc.gov/info-finder/reactors/fitz.html	I	BWR-MARK 1 GE 4 S&W S&W	2,536	05/20/1970 10/17/1974 07/28/1975 09/08/2008 10/17/2034	99 85 97 84 89 79
Joseph M. Farley Nuclear Plant, Unit 1 Southern Nuclear Operating Co. Columbia, AL (18 miles E of Dothan, AL) 05000348 www.nrc.gov/info-finder/reactors/far1.html	II	PWR-DRYAMB WEST 3LP SSI DANI	2,775	08/16/1972 06/25/1977 12/01/1977 05/12/2005 06/25/2037	90 88 101 91 90 102

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Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Joseph M. Farley Nuclear Plant, Unit 2 Southern Nuclear Operating Co. Columbia, AL (18 miles E of Dothan, AL) 05000364 www.nrc.gov/info-finder/reactors/far2.html	II	PWR-DRYAMB WEST 3LP SSI BECH	2,775	08/16/1972 03/31/1981 07/30/1981 05/12/2005 03/31/2041	96 88 89 104 91 89
LaSalle County Station, Unit 1 Exelon Generation Co., LLC Marseilles, IL (11 miles SE of Ottawa, IL) 05000373 www.nrc.gov/info-finder/reactors/lasa1.html	III	BWR-MARK 2 GE 5 S&L CWE	3,546	09/10/1973 04/17/1982 01/01/1984 N/A 04/17/2022	99 94 101 97 95 93
LaSalle County Station, Unit 2 Exelon Generation Co., LLC Marseilles, IL (11 miles SE of Ottawa, IL) 05000374 www.nrc.gov/info-finder/reactors/lasa2.html	III	BWR-MARK 2 GE 5 S&L CWE	3,546	09/10/1973 12/16/1983 10/19/1984 N/A 12/16/2023	93 101 96 103 88 95
Limerick Generating Station, Unit 1 Exelon Generation Co., LLC Limerick, PA (21 miles NW of Philadelphia, PA) 05000352 www.nrc.gov/info-finder/reactors/lim1.html	I	BWR-MARK 2 GE 4 BECH BECH	3,515	06/19/1974 08/08/1985 02/01/1986 N/A 10/26/2024	101 91 96 85 101 91
Limerick Generating Station, Unit 2 Exelon Generation Co., LLC Limerick, PA (21 miles NW of Philadelphia, PA) 05000353 www.nrc.gov/info-finder/reactors/lim2.html	I	BWR-MARK 2 GE 4 BECH BECH	3,515	06/19/1974 08/25/1989 01/08/1990 N/A 06/22/2029	94 99 90 95 94 99
McGuire Nuclear Station, Unit 1 Duke Energy Carolinas, LLC Huntersville, NC (17 miles N of Charlotte, NC) 05000369 www.nrc.gov/info-finder/reactors/mcg1.html	II	PWR-ICECND WEST 4LP DUKE DUKE	3,411	02/23/1973 07/08/1981 12/01/1981 12/05/2003 06/12/2041	104 92 94 105 82 82
McGuire Nuclear Station, Unit 2 Duke Energy Carolinas, LLC Huntersville, NC (17 miles N of Charlotte, NC) 05000370 www.nrc.gov/info-finder/reactors/mcg2.html	II	PWR-ICECND WEST 4LP DUKE DUKE	3,411	02/23/1973 05/27/1983 03/01/1984 12/05/2003 03/03/2043	94 104 91 82 95 94

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Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Millstone Power Station, Unit 2	I	PWR-DRYAMB	2,700	12/11/1970	81
Dominion Nuclear Connecticut, Inc.		CE		09/26/1975	97
Waterford, CT		BECH		12/26/1975	87
(3.2 miles SW of New London, CT)		BECH		11/28/2005	83
05000336				07/31/2035	95
www.nrc.gov/info-finder/reactors/mill2.html					85
Millstone Power Station, Unit 3	I	PWR-DRYSUB	3,650	08/09/1974	105
Dominion Nuclear Connecticut, Inc.		WEST 4LP		01/31/1986	86
Waterford, CT		S&W		04/23/1986	87
(3.2 miles SW of New London, CT)		S&W		11/28/2005	100
05000423				11/25/2045	87
www.nrc.gov/info-finder/reactors/mill3.html					87
Monticello Nuclear Generating Plant, Unit 1	III	BWR-MARK 1	2,004	06/19/1967	83
Northern States Power Company-Minnesota		GE 3		01/09/1981[B]	94
Monticello, MN		BECH		06/30/1971	69
(30 miles NW of Minneapolis, MN)		BECH		11/08/2006	101
05000263				09/08/2030	50
www.nrc.gov/info-finder/reactors/mont.html					78
Nine Mile Point Nuclear Station, Unit 1	I	BWR-MARK 1	1,850	04/12/1965	92
Nine Mile Point Nuclear Station, LLC		GE 2		12/26/1974[C]	97
Scriba, NY		NIAG		12/01/1969	84
(6 miles NE of Oswego, NY)		S&W		10/31/2006	87
05000220				08/22/2029	88
www.nrc.gov/info-finder/reactors/nmp1.html					98
Nine Mile Point Nuclear Station, Unit 2	I	BWR-MARK 2	3,988	06/24/1974	99
Nine Mile Point Nuclear Station, LLC		GE 5		07/02/1987	89
Scriba, NY		S&W		03/11/1988	95
(6 miles NE of Oswego, NY)		S&W		10/31/2006	83
05000410				10/31/2046	99
www.nrc.gov/info-finder/reactors/nmp2.html					87
North Anna Power Station, Unit 1	II	PWR-DRYSUB	2,940	02/19/1971	92
Virginia Electric & Power Co.		WEST 3LP		04/01/1978	86
Mineral (Louisa County), VA		S&W		06/06/1978	78
(40 miles NW of Richmond, VA)		S&W		03/20/2003	89
05000338				04/01/2038	89
www.nrc.gov/info-finder/reactors/na1.html					100

B: The AEC issued a provisional OL on 09/08/1970, allowing commercial operation. The NRC issued a full-term OL on 01/09/1981.

C: The AEC issued a provisional OL on 08/22/1969, allowing commercial operation. The NRC issued a full-term OL on 12/26/1974.

APPENDIX A
Commercial Nuclear Power Reactors
Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
North Anna Power Station, Unit 2 Virginia Electric & Power Co. Mineral (Louisa County), VA (40 miles NW of Richmond, VA) 05000339 www.nrc.gov/info-finder/reactors/na2.html	II	PWR-DRYSUB WEST 3LP S&W S&W	2,940	02/19/1971 08/21/1980 12/14/1980 03/20/2003 08/21/2040	100 100 76 99 85 92
Oconee Nuclear Station, Unit 1 Duke Energy Carolinas, LLC Seneca, SC (30 miles W of Greenville, SC) 05000269 www.nrc.gov/info-finder/reactors/oco1.html	II	PWR-DRYAMB B&W LLP DBDB DUKE	2,568	11/06/1967 02/06/1973 07/15/1973 05/23/2000 02/06/2033	85 100 79 90 91 91
Oconee Nuclear Station, Unit 2 Duke Energy Carolinas, LLC Seneca, SC (30 miles W of Greenville, SC) 05000270 www.nrc.gov/info-finder/reactors/oco2.html	II	PWR-DRYAMB B&W LLP DBDB DUKE	2,568	11/06/1967 10/06/1973 09/09/1974 05/23/2000 10/06/2033	103 91 93 102 82 101
Oconee Nuclear Station, Unit 3 Duke Energy Carolinas, LLC Seneca, SC (30 miles W of Greenville, SC) 05000287 www.nrc.gov/info-finder/reactors/oco3.html	II	PWR-DRYAMB B&W LLP DBDB DUKE	2,568	11/06/1967 07/19/1974 12/16/1974 05/23/2000 07/19/2034	94 91 103 86 97 92
Oyster Creek Nuclear Generating Station Exelon Generation Co., LLC Forked River, NJ (9 miles S of Toms River, NJ) 05000219 www.nrc.gov/info-finder/reactors/oc.html	I	BWR-MARK 1 GE 2 B&R B&R	1,930	12/15/1964 07/02/1991[D] 12/23/1969 04/08/2009 04/09/2029	92 85 98 88 106 90
Palisades Nuclear Plant Entergy Nuclear Operations, Inc. Covert, MI (5 miles S of South Haven, MI) 05000255 www.nrc.gov/info-finder/reactors/pali.html	III	PWR-DRYAMB CE BECH BECH	2,565.4	03/14/1967 02/21/1991[E] 12/31/1971 01/17/2007 03/24/2031	90 92 96 74 85 86
Palo Verde Nuclear Generating Station, Unit 1 Arizona Public Service Company Wintersburg, AZ (50 miles W of Phoenix, AZ) 05000528 www.nrc.gov/info-finder/reactors/palo1.html	IV	PWR-DRYAMB CE 80-2L BECH BECH	3,990	05/25/1976 06/01/1985 01/28/1986 04/21/2011 06/01/2045	101 81 83 100 85 90

D: The AEC issued a provisional OL on 04/09/1969, allowing commercial operation. The NRC issued a full-term OL on 07/02/1991.

E: The AEC issued a provisional OL on 03/24/1971, allowing commercial operation. The NRC issued a full-term OL on 02/21/1991.

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Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Palo Verde Nuclear Generating Station, Unit 2 Arizona Public Service Company Wintersburg, AZ (50 miles W of Phoenix, AZ) 05000529 www.nrc.gov/info-finder/reactors/palo2.html	IV	PWR-DRYAMB CE80-2L BECH BECH	3,990	05/25/1976 04/24/1986 09/19/1986 04/21/2011 04/24/2046	83 101 91 90 91 90
Palo Verde Nuclear Generating Station, Unit 3 Arizona Public Service Company Wintersburg, AZ (50 miles W of Phoenix, AZ) 05000530 www.nrc.gov/info-finder/reactors/palo3.html	IV	PWR-DRYAMB CE80-2L BECH BECH	3,990	05/25/1976 11/25/1987 01/08/1988 04/21/2011 11/25/2047	83 89 97 88 79 101
Peach Bottom Atomic Power Station, Unit 2 Exelon Generation Co., LLC Delta, PA (17.9 miles S of Lancaster, PA) 05000277 www.nrc.gov/info-finder/reactors/pb2.html	I	BWR-MARK 1 GE 4 BECH BECH	3,514	01/31/1968 10/25/1973 07/05/1974 05/07/2003 08/08/2033	102 92 101 88 100 88
Peach Bottom Atomic Power Station, Unit 3 Exelon Generation Co., LLC Delta, PA (17.9 miles S of Lancaster, PA) 05000278 www.nrc.gov/info-finder/reactors/pb3.html	I	BWR-MARK 1 GE 4 BECH BECH	3,514	01/31/1968 07/02/1974 12/23/1974 05/07/2003 07/02/2034	89 100 90 103 85 103
Perry Nuclear Power Plant, Unit 1 FirstEnergy Nuclear Operating Co. Perry, OH (35 miles NE of Cleveland, OH) 05000440 www.nrc.gov/info-finder/reactors/perr1.html	III	BWR-MARK 3 GE 6 GIL KAIS	3,758	05/03/1977 11/13/1986 11/18/1987 N/A 03/18/2026	67 98 79 92 73 96
Pilgrim Nuclear Power Station Entergy Nuclear Operations, Inc. Plymouth, MA (38 miles SE of Boston, MA) 05000293 www.nrc.gov/info-finder/reactors/pilg.html	I	BWR-MARK 1 GE 3 BECH BECH	2,028	08/26/1968 06/08/1972 12/01/1972 05/29/2012 06/08/2032	90 99 85 98 74 97
Point Beach Nuclear Plant, Unit 1 NextEra Energy Point Beach, LLC Two Rivers, WI (13 miles NW of Manitowoc, WI) 05000266 www.nrc.gov/info-finder/reactors/poin1.html	III	PWR-DRYAMB WEST 2LP BECH BECH	1,800	07/19/1967 10/05/1970 12/21/1970 12/22/2005 10/05/2030	98 88 79 100 84 90

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Point Beach Nuclear Plant, Unit 2 NextEra Energy Point Beach, LLC Two Rivers, WI (13 miles NW of Manitowoc, WI) 05000301 www.nrc.gov/info-finder/reactors/poin2.html	III	PWR-DRYAMB WEST 2LP BECH BECH	1,800	07/25/1968 03/08/1973[F] 10/01/1972 12/22/2005 03/08/2033	84 96 67 89 93 90
Prairie Island Nuclear Generating Plant, Unit 1 Northern States Power Co.—Minnesota Welch, MN (28 miles SE of Minneapolis, MN) 05000282 www.nrc.gov/info-finder/reactors/prai1.html	III	PWR-DRYAMB WEST 2LP FLUR NSP	1,677	06/25/1968 04/05/1974[G] 12/16/1973 06/27/2011 08/09/2033	97 96 91 81 90 84
Prairie Island Nuclear Generating Plant, Unit 2 Northern States Power Co.—Minnesota Welch, MN (28 miles SE of Minneapolis, MN) 05000306 www.nrc.gov/info-finder/reactors/prai2.html	III	PWR-DRYAMB WEST 2LP FLUR NSP	1,677	06/25/1968 10/29/1974 12/21/1974 06/27/2011 10/29/2034	75 86 99 74 59 101
Quad Cities Nuclear Power Station, Unit 1 Exelon Generation Co., LLC Cordova, IL (20 miles NE of Moline, IL) 05000254 www.nrc.gov/info-finder/reactors/quad1.html	III	BWR-MARK 1 GE 3 S&L UE&C	2,957	02/15/1967 12/14/1972 02/18/1973 10/28/2004 12/14/2032	82 99 92 102 85 103
Quad Cities Nuclear Power Station, Unit 2 Exelon Generation Co., LLC Cordova, IL (20 miles NE of Moline, IL) 05000265 www.nrc.gov/info-finder/reactors/quad2.html	III	BWR-MARK 1 GE 3 S&L UE&C	2,957	02/15/1967 12/14/1972 03/10/1973 10/28/2004 12/14/2032	91 92 104 92 91 90
River Bend Station, Unit 1 Entergy Nuclear Operations, Inc. St. Francisville, LA (24 miles NW of Baton Rouge, LA) 05000458 www.nrc.gov/info-finder/reactors/rbs1.html	IV	BWR-MARK 3 GE 6 S&W S&W	3,091	03/25/1977 11/20/1985 06/16/1986 N/A 08/29/2025	113 98 90 91 84 96

F: AEC issued a provisional OL on 11/18/1971. The NRC issued a full-term OL on 03/08/1973.

G: AEC issued a provisional OL on 08/09/1973. The NRC issued a full-term OL on 04/05/1974.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
R.E. Ginna Nuclear Power Plant	I	PWR-DRYAMB	1,775	04/25/1966	91
R.E. Ginna Nuclear Power Plant, LLC		WEST 2LP		09/19/1969	97
Ontario, NY		GIL		07/01/1970	84
(20 miles NE of Rochester, NY)		BECH		05/19/2004	90
05000244				09/18/2029	93
www.nrc.gov/info-finder/reactors/ginn.html					91
St. Lucie Plant, Unit 1	II	PWR-DRYAMB	3,020	07/01/1970	100
Florida Power & Light Co.		CE		03/01/1976	72
Jensen Beach, FL		EBSO		12/21/1976	85
(10 miles SE of Ft. Pierce, FL)		EBSO		10/02/2003	72
05000335				03/01/2036	74
www.nrc.gov/info-finder/reactors/stl1.html					101
St. Lucie Plant, Unit 2	II	PWR-DRYAMB	3,020	05/02/1977	80
Florida Power & Light Co.		CE		06/10/1983	100
Jensen Beach, FL		EBSO		08/08/1983	66
(10 miles SE of Ft. Pierce, FL)		EBSO		10/02/2003	68
05000389				04/06/2043	91
www.nrc.gov/info-finder/reactors/stl2.html					82
Salem Nuclear Generating Station, Unit 1	I	PWR-DRYAMB	3,459	09/25/1968	99
PSE&G Nuclear, LLC		WEST 4LP		12/01/1976	85
Hancocks Bridge, NJ		PSEG		06/30/1977	86
(18 miles SE of Wilmington, DE)		UE&C		06/30/2011	97
05000272				08/13/2036	88
www.nrc.gov/info-finder/reactors/salm1.html					86
Salem Nuclear Generating Station, Unit 2	I	PWR-DRYAMB	3,459	09/25/1968	93
PSE&G Nuclear, LLC		WEST 4LP		05/20/1981	98
Hancocks Bridge, NJ		PSEG		10/13/1981	89
(18 miles SE of Wilmington, DE)		UE&C		06/30/2011	88
05000311				04/18/2040	100
www.nrc.gov/info-finder/reactors/salm2.html					73
Seabrook Station, Unit 1	I	PWR-DRYAMB	3,648	07/07/1976	81
NextEra Energy Seabrook, LLC		WEST 4LP		03/15/1990	100
Seabrook, NH		UE&C		08/19/1990	77
(13 miles S of Portsmouth, NH)		UE&C		N/A	75
05000443				03/15/2030	100
www.nrc.gov/info-finder/reactors/seab1.html					93
Sequoyah Nuclear Plant, Unit 1	II	PWR-ICECND	3,455	05/27/1970	89
Tennessee Valley Authority		WEST 4LP		09/17/1980	84
Soddy-Daisy, TN		TVA		07/01/1981	98
(16 miles NE of Chattanooga, TN)		TVA		N/A	89
05000327				09/17/2020	83
www.nrc.gov/info-finder/reactors/seq1.html					100

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Sequoyah Nuclear Plant, Unit 2 Tennessee Valley Authority Soddy-Daisy, TN (16 miles NE of Chattanooga, TN) 05000328 www.nrc.gov/info-finder/reactors/seq2.html	II	PWR-ICECND WEST 4LP TVA TVA	3,455	05/27/1970 09/15/1981 06/01/1982 N/A 09/15/2021	89 97 89 77 90 90
Shearon Harris Nuclear Power Plant, Unit 1 Duke Energy Progress, Inc. New Hill, NC (20 miles SW of Raleigh, NC) 05000400 www.nrc.gov/info-finder/reactors/har1.html	II	PWR-DRYAMB WEST 3LP EBSO DANI	2,900	01/27/1978 10/24/1986 05/02/1987 12/17/2008 10/24/2046	94 90 103 90 83 99
South Texas Project, Unit 1 STP Nuclear Operating Co. Bay City, TX (90 miles SW of Houston, TX) 05000498 www.nrc.gov/info-finder/reactors/stp1.html	IV	PWR-DRYAMB WEST 4LP BECH EBSO	3,853	12/22/1975 03/22/1988 08/25/1988 N/A 08/20/2027	90 101 94 93 91 81
South Texas Project, Unit 2 STP Nuclear Operating Co. Bay City, TX (90 miles SW of Houston, TX) 05000499 www.nrc.gov/info-finder/reactors/stp2.html	IV	PWR-DRYAMB WEST 4LP BECH EBSO	3,853	12/22/1975 03/28/1989 06/19/1989 N/A 12/15/2028	101 88 88 72 59 103
Surry Power Station, Unit 1 Virginia Electric and Power Co. Surry, VA (17 miles NW of Newport News, VA) 05000280 www.nrc.gov/info-finder/reactors/sur1.html	II	PWR-DRYSUB WEST 3LP S&W S&W	2,587	06/25/1968 05/25/1972 12/22/1972 03/20/2003 05/25/2032	94 89 101 92 91 99
Surry Power Station, Unit 2 Virginia Electric and Power Co. Surry, VA (17 miles NW of Newport News, VA) 05000281 www.nrc.gov/info-finder/reactors/sur2.html	II	PWR-DRYSUB WEST 3LP S&W S&W	2,587	06/25/1968 01/29/1973 05/01/1973 03/20/2003 01/29/2033	92 100 76 91 101 95
Susquehanna Steam Electric Station, Unit 1 Susquehanna Nuclear, LLC Berwick, PA (70 miles NE of Harrisburg, PA) 05000387 www.nrc.gov/info-finder/reactors/susq1.html	I	BWR-MARK 2 GE 4 BECH BECH	3,952	11/03/1973 07/17/1982 06/08/1983 11/24/2009 07/17/2042	101 80 86 70 87 83

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Susquehanna Steam Electric Station, Unit 2 PPL Susquehanna, LLC Berwick, PA (70 miles NE of Harrisburg, PA) 05000388 www.nrc.gov/info-finder/reactors/susq2.html	I	BWR-MARK 2 GE 4 BECH BECH	3,952	11/03/1973 03/23/1984 02/12/1985 11/24/2009 03/23/2044	90 96 72 83 80 88
Three Mile Island Nuclear Station, Unit 1 Exelon Generation Co., LLC Middletown, PA (10 miles SE of Harrisburg, PA) 05000289 www.nrc.gov/info-finder/reactors/tmi1.html	I	PWR-DRYAMB B&W LLP GIL UE&C	2,568	05/18/1968 04/19/1974 09/02/1974 10/22/2009 04/19/2034	86 94 92 100 78 104
Turkey Point Nuclear Generating, Unit 3 Florida Power & Light Co. Homestead, FL (20 miles S of Miami, FL) 05000250 www.nrc.gov/info-finder/reactors/tp3.html	II	PWR-DRYAMB WEST 3LP BECH BECH	2,644	04/27/1967 07/19/1972 12/14/1972 06/06/2002 07/19/2032	86 88 96 40 81 84
Turkey Point Nuclear Generating, Unit 4 Florida Power & Light Co. Homestead, FL (20 miles S of Miami, FL) 05000251 www.nrc.gov/info-finder/reactors/tp4.html	II	PWR-DRYAMB WEST 3LP BECH BECH	2,644	04/27/1967 04/10/1973 09/07/1973 06/06/2002 04/10/2033	99 98 84 85 70 88
Virgil C. Summer Nuclear Station, Unit 1 South Carolina Electric & Gas Co. Jenkinsville, SC (26 miles NW of Columbia, SC) 05000395 www.nrc.gov/info-finder/reactors/sum.html	II	PWR-DRYAMB WEST 3LP GIL DANI	2,900	03/21/1973 11/12/1982 01/01/1984 04/23/2004 08/06/2042	81 100 88 86 93 81
Vogtle Electric Generating Plant, Unit 1 Southern Nuclear Operating Co., Inc. Waynesboro, GA (26 miles SE of Augusta, GA) 05000424 www.nrc.gov/info-finder/reactors/vog1.html	II	PWR-DRYAMB WEST 4LP SBEC GPC	3,625.6	06/28/1974 03/16/1987 06/01/1987 06/03/2009 01/16/2047	91 102 92 91 101 87
Vogtle Electric Generating Plant, Unit 2 Southern Nuclear Operating Co., Inc. Waynesboro, GA (26 miles SE of Augusta, GA) 05000425 www.nrc.gov/info-finder/reactors/vog2.html	II	PWR-DRYAMB WEST 4LP SBEC GPC	3,625.6	06/28/1974 03/31/1989 05/20/1989 06/03/2009 02/09/2049	101 93 94 102 87 92

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors (continued)

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued OL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Waterford Steam Electric Station, Unit 3 Entergy Operations, Inc. Killona, LA (25 miles W of New Orleans, LA) 05000382 www.nrc.gov/info-finder/reactors/wat3.html	IV	PWR-DRYAMB COMB CE EBSO EBSO	3,716	11/14/1974 03/16/1985 09/24/1985 N/A 12/18/2024	87 100 82 77 89 90
Watts Bar Nuclear Plant, Unit 1 Tennessee Valley Authority Spring City, TN (60 miles SW of Knoxville, TN) 05000390 www.nrc.gov/info-finder/reactors/wb1.html	II	PWR-ICECND WEST 4LP TVA TVA	3,459	01/23/1973 02/07/1996 05/27/1996 N/A 11/09/2035	94 99 84 87 90 89
Wolf Creek Generating Station, Unit 1 Wolf Creek Nuclear Operating Corp. Burlington (Coffey County), KS (28 miles SE of Emporia, KS) 05000482 www.nrc.gov/info-finder/reactors/wc.html	IV	PWR-DRYAMB WEST 4LP BECH DANI	3,565	05/17/1977 06/04/1985[H] 09/03/1985 11/20/2008 03/11/2045	86 86 72 80 65 83

H: The original OL (NPF-32) was issued on 03/11/1985. The license was superseded by OL (NPF-42), issued on 06/04/1985.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX A

Commercial Nuclear Power Reactors

Operating Reactors Under Active Construction or Deferred Policy

Plant Name, Unit Number Licensee Location Docket Number NRC Web Page Address	NRC Region	Con Type NSSS Architect Engineer Constructor	Licensed MWt	CP Issued COL Issued Comm. Op. LR Issued Exp. Date	2009–2014* Capacity Factor (Percent)
Bellefonte Nuclear Power Station, Unit 1** Tennessee Valley Authority (6 miles NE of Scottsboro, AL) 05000438	II	PWR-DRYAMB B&W 205 TVA TVA	3,763	12/24/1974	N/A
Bellefonte Nuclear Power Station, Unit 2** Tennessee Valley Authority (6 miles NE of Scottsboro, AL) 05000439	II	PWR-DRYAMB B&W 205 TVA TVA	3,763	12/24/1974	N/A
Watts Bar Nuclear Plant, Unit 2*** Tennessee Valley Authority Spring City, TN (60 miles SW of Knoxville, TN) 05000391 www.nrc.gov/info-finder/reactors/wb/watts-bar.html	II	PWR-ICECND WEST 4LP TVA TVA	3,411	01/23/1973	N/A
Virgil C. Summer Nuclear Station, Unit 2 South Carolina Electric & Gas Co. South Carolina Public Service Auth. Jenkinsville (Fairfield County), SC (26 miles NW of Columbia, SC) 0500027	II	PWR AP1000 WEST SHAW	3,400	 03/30/2012	N/A
Virgil C. Summer Nuclear Station, Unit 3 South Carolina Electric & Gas Co. South Carolina Public Service Auth. Jenkinsville (Fairfield County), SC (26 miles NW of Columbia, SC) 05200028	II	PWR AP1000 WEST SHAW	3,400	 03/30/2012	N/A
Vogtle Electric Generating Plant, Unit 3 Southern Nuclear Operating Co., Inc. Waynesboro (Burke County), GA (26 miles SE of Augusta, GA) 05200025	II	PWR AP1000 WEST SHAW	3,400	 02/10/2012	N/A
Vogtle Electric Generating Plant, Unit 4 Southern Nuclear Operating Co., Inc. Waynesboro, (Burke County), GA (26 miles SE of Augusta, GA) 05200026	II	PWR AP1000 WEST SHAW	3,400	 02/10/2012	N/A
Fermi, Unit 3 DTE Electric Company Newport, MI (25 miles NE of Toledo, OH) 05200033	III	ESBWR GEH	4,500	 05/01/2015	N/A

* Average capacity factor is listed in year order starting with 2009.
** Bellefonte Units 1 and 2 are under the Commission Policy Statement on Deferred Plants (52 FR 38077; October 14, 1987).
*** Watts Bar Unit 2 is currently performing startup testing, anticipated to begin commercial operation Fall 2016.
Note: Plant names and data are as identified on the license as of August 2015, and the next printed update will be August 2017.
Source: NRC, with some data compiled from EIA/DOE.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX B

New Nuclear Power Plant Licensing Applications

Applicant	Docket Number	Type	Submittal Date	Design	Site	State	Existing Plant?	Date Accepted	Status
Combined Operating License									
Nuclear Innovation North America, LLC (NINA)	05200012 & 05200013	COL	9/20/07	ABWR	South Texas Project, Units 3 and 4	TX	Yes	11/29/07	Scheduled
Tennessee Valley Authority (TVA)	05200014 & 05200015	COL	10/30/07	AP1000	Bellefonte, Units 3 and 4	AL	No	1/18/08	Suspended–09/29/2010
Dominion Virginia Power	05200017	COL	11/27/07	ESBWR	North Anna, Unit 3	VA	Yes	01/28//08	Scheduled
Duke Energy Carolinas	05200018 & 05200019	COL	12/13/07	AP1000	Lee Nuclear Station, Units 3 and 4	SC	No	2/25/08	Scheduled
Progressive Energy	05200022 & 05200023	COL	2/19/08	AP1000	Shearon Harris, Units 2 and 3	NC	Yes	4/17/08	Suspended–05/02/2013
Southern Nuclear Operating Co.	05200025 & 05200026	COL	3/31/08	AP1000	Vogtle, Units 3 and 4	GA	Yes	5/30/08	COL Issued 02/10/2012
South Carolina Electric and Gas	05200027 & 05200028	COL	3/31/08	AP1000	V.C. Summer, Units 2 and 3	SC	Yes	7/31/08	COL Issued 03/30/2012
AmerenUE	05200037	COL	7/24/08	U.S. EPR	Callaway, Unit 2	MO	Yes	12/12/08	Suspended
Duke Energy Florida	05200029 & 05200030	COL	7/30/08	AP1000	Levy County, Units 1 and 2	FL	No	10/6/08	Scheduled
DTE Electric Company	05200033	COL	9/18/08	ESBWR	Fermi, Unit 3	MI	Yes	11/25/08	COL Issued 05/01/2015
Luminant Generation Co.	05200034 & '05200035	COL	9/19/08	US-APWR	Comanche Peak, Units 3 and 4	TX	Yes	12/2/08	Suspended–03/31/2014
Entergy	05200036	COL	9/25/08	ESBWR	River Bend, Unit 3	LA	Yes	12/4/08	Suspended–01/09/2009
PPL Bell Bend	05200039	COL	10/10/08	U.S. EPR	Bell Bend (1 Unit)	PA	Yes	12/19/08	Safety Review On Hold; Environmental Review Scheduled
Florida Power and Light	05200040 & 05200041	COL	6/30/09	AP1000	Turkey Point, Units 6 and 7	FL	Yes	9/4/09	Scheduled
Design Certification									
AREVA NP	05200020	DC	12/11/07	U.S. EPR	N/A	N/A	N/A	2/25/08	Suspended – 03/27/2015
Mitsubishi Heavy Industries	05200021	DC	12/31/07	US-APWR	N/A	N/A	N/A	2/29/08	Applicant Delayed –Not Scheduled
Korea Electric Power Company and Korea Hydro and Nuclear Power	05200046	DC	12/23/14	APR 1400	N/A	N/A	N/A	3/4/15	Scheduled
Toshiba Corporation	05200044	DC	10/27/10	ABWR	N/A	N/A	N/A	12/14/10	Applicant Delayed –Not Scheduled
GE-Hitachi Nuclear Energy	05200045	DC	12/7/10	ABWR	N/A	N/A	N/A	2/14/11	Applicant Delayed –Not Scheduled
Early Site Permit									
PSEG Site	05200043	ESP	5/25/10	Not yet announced	PSEG Site	NJ	Yes	8/4/10	Scheduled

Note: Data as of July 2015, and the next printed update will be August 2017.

Withdrawal was requested for Calvert Cliffs, Grand Gulf, Nine Mile Point, Victoria County, and Callaway (COL and ESP). NRC-abbreviated reactor names listed.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX C

Commercial Nuclear Power Reactors Undergoing Decommissioning and Permanently Shut Down Formerly Licensed To Operate

Unit Location Docket Number	Reactor Type MWt	NSSS Vendor	OL Issued Shut Down OL Terminated Closure Date Est.	Decommissioning Alternative Selected Current License Status
Big Rock Point Charlevoix, MI 05000155	BWR 240	GE	05/01/1964 08/29/1997 01/08/2007	DECON DECON Completed
Crystal River 3 Crystal River, FL 05000302	PWR 2,609	B&W LLP	12/03/1976 02/20/2013 2074	SAFSTOR SAFSTOR in Progress
Dresden 1 Morris, IL 05000010	BWR 700	GE	09/28/1959 10/31/1978 2036	SAFSTOR SAFSTOR
GE EVESR Sunol, CA 05000183	Experimental Superheat Reactor 12.5	GE	11/12/1963 2/1/1967 4/15/1970 1/1/2019	SAFSTOR Possession-only License Expires 1/2016
GE VBWR (Vallecitos) Sunol, CA 05000018	BWR 50	GE	08/31/1957 12/09/1963 2019	SAFSTOR SAFSTOR
Fermi 1 Newport, MI 05000016	SCF 200	CE	05/10/1963 09/22/1972 2032	SAFSTOR DECON
Fort St. Vrain Platteville, CO 05000267	HTG 842	GA	12/21/1973 08/18/1989 08/08/1997	DECON DECON Completed
Haddam Neck Meriden, CT 05000213	PWR 1,825	WEST	12/27/1974 12/05/1996 11/26/2007	DECON DECON Completed
Humboldt Bay 3 Eureka, CA 05000133	BWR 200	GE	08/28/1962 07/02/1976 2015	DECON DECON in Progress
Indian Point 1 Buchanan, NY 05000003	PWR 615	B&W	03/26/1962 10/31/1974 2026	SAFSTOR SAFSTOR

APPENDIX C

Commercial Nuclear Power Reactors Undergoing Decommissioning and Permanently Shut Down Formerly Licensed To Operate (continued)

Unit Location Docket Number	Reactor Type MWt	NSSS Vendor	OL Issued Shut Down OL Terminated Closure Date Est.	Decommissioning Alternative Selected Current License Status
Kewaunee Carlton, WI 05000305	PWR 1,772	WEST 2LP	12/21/1973 05/07/2013 2073	SAFSTOR SAFSTOR
La Crosse Genoa, WI 05000409	BWR 165	AC	07/03/1967 04/30/1987 TBD	DECON DECON in Progress
Maine Yankee Wiscasset, ME 05000309	PWR 2,700	CE	06/29/1973 12/06/1996 09/30/2005	DECON DECON Completed
Millstone 1 Waterford, CT 05000245	BWR 2,011	GE	10/31/1970 07/21/1998 12/31/2056	SAFSTOR SAFSTOR
Pathfinder Sioux Falls, SD 05000130	BWR 190	AC	03/12/1964 09/16/1967 07/27/2007	DECON DECON Completed
Peach Bottom 1 Delta, PA 05000171	HTG 115	GA	01/24/1966 10/31/1974 12/31/2034	SAFSTOR SAFSTOR
Rancho Seco Herald, CA 05000312	PWR 2,772	B&W	08/16/1974 06/07/1989 09/25/2009	DECON DECON Completed
San Onofre 1* San Clemente, CA 05000206	PWR 1,347	WEST	03/27/1967 11/30/1992 12/30/2030	DECON SAFSTOR
San Onofre 2* San Clemente, CA 05000361	PWR CE 3,438	CE	02/16/1982 06/12/2013 2030	DECON DECON in Progress
San Onofre 3 San Clemente, CA 05000362	PWR CE 3,438	CE	11/15/1982 06/12/2013 2030	DECON DECON in Progress

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX C

Commercial Nuclear Power Reactors Undergoing Decommissioning and Permanently Shut Down Formerly Licensed To Operate (continued)

Unit Location Docket Number	Reactor Type MWt	NSSS Vendor	OL Issued Shut Down OL Terminated Closure Date Est.	Decommissioning Alternative Selected Current License Status
Savannah, N.S. Baltimore, MD 05000238	PWR 74	B&W	08/1965 11/1970 12/01/2031	SAFSTOR SAFSTOR
Saxton Saxton, PA 05000146	PWR 23.5	WEST	11/15/1961 05/01/1972 11/07/2005	DECON DECON Completed
Shoreham Wading River, NY 05000322	BWR 2,436	GE	04/21/1989 06/28/1989 04/11/1995	DECON DECON Completed
Three Mile Island 2 Middletown, PA 05000320	PWR 2,770	B&W	02/08/1978 03/28/1979 12/31/2036	(1)
Trojan Rainier, OR 05000344	PWR 3,411	WEST	11/21/1975 11/09/1992 05/23/2005	DECON DECON Completed
Yankee-Rowe Rowe, MA 05000029	PWR 600	WEST	12/24/1963 10/01/1991 08/10/2007	DECON DECON Completed
Vermont Yankee Vernon, VT 05000271	BWR-Mark 1 1,912	GE 4	03/21/1972 12/29/2014 2073	SAFSTOR SAFSTOR in Progress
Zion 1 Zion, IL 05000295	PWR 3,250	WEST	10/19/1973 02/21/1997	DECON DECON in Progress
Zion 2 Zion, IL 05000304	PWR 3,250	WEST	11/14/1973 09/19/1996 2020	DECON DECON in Progress

* Site has been dismantled and decontaminated with the exception of the reactor vessel in long-term storage.

Notes: GE Bonus, Hallam, and Piqua decommissioned reactor sites are part of the DOE nuclear legacy. For more information, visit DOE's Legacy Management Web site at http://energy.gov/lm/sites/lm-sites. CVTR, Elk River, and Shippingport decommissioned reactor sites were either decommissioned prior to the formation of the NRC or were not licensed by the NRC.
See the Glossary for definitions of decommissioning alternatives (DECON, SAFSTOR).

(1) Three Mile Island Unit 2 has been placed in a postdefueling monitored storage mode until Unit 1 permanently ceases operation, at which time both units are planned to be decommissioned.

Source: DOE "Integrated Database for 1990, U.S. Spent Fuel and Radioactive Waste, Inventories, Projections, and Characteristics" (DOE/RW-0006, Rev. 6), and NRC, "Nuclear Power Plants in the World," Edition 6.

Data as of July 2015. Next publish release date August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX D

Canceled Commercial Nuclear Power Reactors

Part 50—Domestic Licensing of Production and Utilization Facilities

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status Docket Number
Allens Creek 1 Houston Lighting & Power Company 4 miles NW of Wallis, TX	BWR 1,150	1982 Under CP Review 05000466
Allens Creek 2 Houston Lighting & Power Company 4 miles NW of Wallis, TX	BWR 1,150	1976 Under CP Review 05000467
Atlantic 1 & 2 Public Service Electric & Gas Company Floating plants off the coast of NJ	PWR 1,150	1978 Under CP Review 05000477 & 478
Bailly 1 Northern Indiana Public Service Company 12 miles NNE of Gary, IN	BWR 645	1981 With CP 05000367
Barton 1 & 2 Alabama Power & Light 15 miles SE of Clanton, AL	BWR 1,159	1977 Under CP Review 05000524 & 525
Barton 3 & 4 Alabama Power & Light 15 miles SE of Clanton, AL	BWR 1,159	1975 Under CP Review 05000526 & 527
Black Fox 1 & 2 Public Service Company of Oklahoma 3.5 miles S of Inola, OK	BWR 1,150	1982 Under CP Review 05000556 & 557
Blue Hills 1 & 2 Gulf States Utilities Company SW tip of Toledo Bend Reservoir, TX	PWR 918	1978 Under CP Review 05000510 & 511
Callaway 2 Union Electric Company 25 miles ENE of Jefferson City, MO	PWR 1,150	1981 With CP 05000486
Cherokee 1 Duke Power Company 6 miles SSW of Blacksburg, SC	PWR 1,280	1983 With CP 05000491
Cherokee 2 & 3 Duke Power Company 6 miles SSW of Blacksburg, SC	PWR 1,280	1982 With CP 05000492 & 493
Clinch River Project Management Corp., DOE, TVA 23 miles W of Knoxville, in Oak Ridge, TN	LMFB 350	1983 Under CP Review 05000537
Clinton 2 Illinois Power Company 6 miles E of Clinton, IL	BWR 933	1983 With CP 05000462

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX D

Canceled Commercial Nuclear Power Reactors

Part 50—Domestic Licensing of Production and Utilization Facilities (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status Docket Number
Davis-Besse 2 & 3 Toledo Edison Company 21 miles ESE of Toledo, OH	PWR 906	1981 Under CP Review 05000500 & 501
Douglas Point 1 & 2 Potomac Electric Power Company Charles County, MD	BWR 1,146	1977 Under CP Review 05000448 & 449
Erie 1 & 2 Ohio Edison Company Berlin, OH	PWR 1,260	1980 Under CP Review 05000580 & 581
Forked River 1 Jersey Central Power & Light Company 2 miles S of Forked River, NJ	PWR 1,070	1980 With CP 05000363
Fort Calhoun 2 Omaha Public Power District 19 miles N of Omaha, NE	PWR 1,136	1977 Under CP Review 05000548
Fulton 1 & 2 Philadelphia Electric Company 17 miles S of Lancaster, PA	HTG 1,160	1975 Under CP Review 05000463 & 464
Grand Gulf 2 Entergy Nuclear Operations, Inc. 20 miles SW of Vicksburg, MS	BWR 1,250	1990 With CP 05000417
Greene County Power Authority of the State of NY 20 miles N of Kingston, NY	PWR 1,191	1980 Under CP Review 05000549
Greenwood 2 & 3 Detroit Edison Company Greenwood Township, MI	PWR 1,200	1980 Under CP Review 05000452 & 453
Hartsville A1 & A2 Tennessee Valley Authority 5 miles SE of Hartsville, TN	BWR 1,233	1984 With CP 05000518 & 519
Hartsville B1 & B2 Tennessee Valley Authority 5 miles SE of Hartsville, TN	BWR 1,233	1982 With CP 05000520 & 521
Haven 1 (formerly Koshkonong) Wisconsin Electric Power Company 4.2 miles SSW of Fort Atkinson, WI	PWR 900	1980 Under CP Review 05000502
Haven 2 (formerly Koshkonong) Wisconsin Electric Power Company 4.2 miles SSW of Fort Atkinson, WI	PWR 900	1978 Under CP Review 05000503

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX D

Canceled Commercial Nuclear Power Reactors

Part 50—Domestic Licensing of Production and Utilization Facilities (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status Docket Number
Hope Creek 2 Public Service Electric & Gas Company 18 miles SE of Wilmington, DE	BWR 1,067	1981 With CP 05000355
Jamesport 1 & 2 Long Island Lighting Company 65 miles E of New York City, NY	PWR 1,150	1980 With CP 05000516 & 517
Marble Hill 1 & 2 Public Service of Indiana 6 miles NE of New Washington, IN	PWR 1,130	1985 With CP 05000546 & 547
Midland 1 Consumers Power Company S of City of Midland, MI	PWR 492	1986 With CP 05000329
Midland 2 Consumers Power Company S of City of Midland, MI	PWR 818	1986 With CP 05000330
Montague 1 & 2 Northeast Nuclear Energy Company 1.2 miles SSE of Turners Falls, MA	BWR 1,150	1980 Under CP Review 05000496 & 497
New England 1 & 2 New England Power Company 8.5 miles E of Westerly, RI	PWR 1,194	1979 Under CP Review 05000568 & 569
New Haven 1 & 2 New York State Electric & Gas Corporation 3 miles NW of New Haven, NY	PWR 1,250	1980 Under CP Review 05000596 & 597
North Anna 3 Virginia Electric & Power Company 40 miles NW of Richmond, VA	PWR 907	1982 With CP 05000404
North Anna 4 Virginia Electric & Power Company 40 miles NW of Richmond, VA	PWR 907	1980 With CP 05000405
North Coast 1 Puerto Rico Water Resources Authority 4.7 miles ESE of Salinas, PR	PWR 583	1978 Under CP Review 05000376
Palo Verde 4 & 5 Arizona Public Service Company 36 miles W of Phoenix, AZ	PWR 1,270	1979 Under CP Review 05000592 & 593
Pebble Springs 1 & 2 Portland General Electric Company 55 miles WSW of Tri-Cities (Kenewick-Pasco-Richland, WA), OR	PWR 1,260	1982 Under CP Review 05000514 & 515

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX D

Canceled Commercial Nuclear Power Reactors

Part 50—Domestic Licensing of Production and Utilization Facilities (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status Docket Number
Perkins 1, 2, & 3 Duke Power Company 10 miles N of Salisbury, NC	PWR 1,280	1982 Under CP Review 05000488 & 489 & 490
Perry 2 Cleveland Electric Illuminating Co. 35 miles NE of Cleveland, OH	BWR 1,205	1994 Under CP Review 05000441
Phipps Bend 1 & 2 Tennessee Valley Authority 15 miles SW of Kingsport, TN	BWR 1,220	1982 With CP 05000553 & 554
Pilgrim 2 Boston Edison Company 4 miles SE of Plymouth, MA	PWR 1,180	1981 Under CP Review 05000471
Pilgrim 3 Boston Edison Company 4 miles SE of Plymouth, MA	PWR 1,180	1974 Under CP Review 05000472
Quanicassee 1 & 2 Consumers Power Company 6 miles E of Essexville, MI	PWR 1,150	1974 Under CP Review 05000475 & 476
River Bend 2 Gulf States Utilities Company 24 miles NNW of Baton Rouge, LA	BWR 934	1984 With CP 05000459
Seabrook 2 Public Service Co. of New Hampshire 13 miles S of Portsmouth, NH	PWR 1,198	1988 With CP 05000444
Shearon Harris 2 Carolina Power & Light Company 20 miles SW of Raleigh, NC	PWR 900	1983 With CP 05000401
Shearon Harris 3 & 4 Carolina Power & Light Company 20 miles SW of Raleigh, NC	PWR 900	1981 With CP 05000402 & 403
Skagit/Hanford 1 & 2 Puget Sound Power & Light Company 23 miles SE of Bellingham, WA	PWR 1,277	1983 Under CP Review 05000522 & 523
Sterling Rochester Gas & Electric Corporation 50 miles E of Rochester, NY	PWR 1,150	1980 With CP 05000485
Summit 1 & 2 Delmarva Power & Light Company 15 miles SSW of Wilmington, DE	HTG 1,200	1975 Under CP Review 05000450 & 451

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX D

Canceled Commercial Nuclear Power Reactors

Part 50—Domestic Licensing of Production and Utilization Facilities (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status Docket Number
Sundesert 1 & 2 San Diego Gas & Electric Company 16 miles SW of Blythe, CA	PWR 974	1978 Under CP Review 05000582 & 583
Surry 3 & 4 Virginia Electric & Power Company 17 miles NW of Newport News, VA	PWR 882	1977 With CP 05000434 & 435
Tyrone 1 Northern States Power Company 8 miles NE of Durond, WI	PWR 1,150	1981 Under CP Review 05000484
Tyrone 2 Northern States Power Company 8 miles NE of Durond, WI	PWR 1,150	1974 With CP 05000487
Vogtle 3 & 4 Georgia Power Company 26 miles SE of Augusta, GA	PWR 1,113	1974 With CP 050000426 & 427
Washington Nuclear 1 (WPPSS) Energy Northwest 10 miles E of Aberdeen, WA	PWR 1,266	1995 With CP 05000460
Washington Nuclear 3 (WPPSS) Energy Northwest 16 miles E of Aberdeen, WA	PWR 1,242	1995 With CP 05000508
Washington Nuclear 4 (WPPSS) Energy Northwest 10 miles E of Aberdeen, WA	PWR 1,218	1982 With CP 05000513
Washington Nuclear 5 (WPPSS) Energy Northwest 16 miles E of Aberdeen, WA	PWR 1,242	1982 With CP 05000509
Yellow Creek 1 & 2 Tennessee Valley Authority 15 miles E of Corinth, MS	BWR 1,285	1984 With CP 05000566 & 567
Zimmer 1 Cincinnati Gas & Electric Company 25 miles SE of Cincinnati, OH	BWR 810	1984 With CP 05000358

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX D

Canceled Commercial Nuclear Power Reactors

Part 50—Domestic Licensing of Production and Utilization Facilities (continued)

Unit Utility Location	Con Type MWe per Unit	Canceled Date Status Docket Number
Calvert Cliffs, Unit 3 LLC and UniStar Nuclear Operating Services, LLC Near Lusby in Calvert County, Maryland	U.S. EPR 4,500	July 17, 2015 Withdrawn during COL Review 05200016
Victoria County Station, Units 1 and 2 Exelon Nuclear Texas Holdings, LLC near Victoria City in Victoria County, Texas	ESBWR 4,500	June 11, 2010 Withdrawn during COL Review 05200031 & 05200032
Grand Gulf, Unit 3 Entergy Operations, Inc. (EOI) near Port Gibson in Claiborne County, Mississippi	ESBWR 4,500	January 9, 2009 Withdrawn during COL Review 05200024
Nine Mile Point, Unit 3 LLC and UniStar Nuclear Operating Services, LLC 25 miles SE of Cincinnati, OH	ESBWR 4,500	January 9, 2009 Withdrawn during COL Review 05000358

Notes:

Cancelation is defined as public announcement of cancellation or written notification to the NRC. Only NRC-docketed applications are included. "Status" is the status of the application at the time of cancellation.

Data as of July 2015, and the next printed update will be August 2017.

Withdrawal was requested for Calvert Cliffs, Grand Gulf, Nine Mile Point, Victoria County, and Callaway (COL and ESP). NRC-abbreviated reactor names listed.

Source: DOE/EIA Commercial Nuclear Power 1991 (DOE/EIA-0438), Appendix E (page 105), and the NRC.

APPENDIX E
Commercial Nuclear Power Reactors by Parent Company

Utility	NRC-Abbreviated Reactor Unit Name
AmerenUE www.ameren.com	Callaway*
Arizona Public Service Company www.aps.com	Palo Verde 1, 2, & 3*
DTE Electric Company www.dteenergy.com	Fermi 2
Dominion Generation www.dom.com	Millstone 2 & 3 North Anna 1 & 2 Surry 1 & 2
Duke Energy www.duke-energy.com	Brunswick 1 & 2 Catawba 1 & 2 Harris 1 McGuire 1 & 2 Oconee 1, 2, & 3 Robinson 2
Energy Northwest www.energy-northwest.com	Columbia
Entergy Nuclear Operations, Inc. www.entergy-nuclear.com	Arkansas Nuclear One 1 & 2 FitzPatrick Grand Gulf 1 Indian Point 2 & 3 Palisades Pilgrim 1 River Bend 1 Waterford 3
Exelon Corporation, LLC www.exeloncorp.com	Braidwood 1 & 2 Byron 1 & 2 Calvert Cliffs 1 & 2 Clinton Dresden 2 & 3 Ginna LaSalle 1 & 2 Limerick 1 & 2 Nine Mile Point 1 & 2 Oyster Creek Peach Bottom 2 & 3 Quad Cities 1 & 2 Three Mile Island 1
First Energy Nuclear Operating Company www.firstenergycorp.com	Beaver Valley 1 & 2 Davis-Besse Perry 1

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX E

Commercial Nuclear Power Reactors by Parent Company (continued)

Utility	NRC-Abbreviated Reactor Unit Name
NextEra Energy, Inc. with principal subsidiaries Florida Power & Light Co. and NextEra Energy Resources, LLC www.fplgroup.com	Duane Arnold Point Beach 1 & 2 Seabrook 1 St. Lucie 1 & 2 Turkey Point 3 & 4
Indiana Michigan Power Company www.indianamichiganpower.com	Cook 1 & 2
Luminant Generation Company, LLC www.luminant.com	Comanche Peak 1 & 2*
Nebraska Public Power District www.nppd.com	Cooper
Northern States Power Company Minnesota doing business as Xcel Energy www.xcelenergy.com	Monticello Prairie Island 1 & 2
Omaha Public Power District www.oppd.com	Fort Calhoun
Pacific Gas & Electric Company www.pge.com	Diablo Canyon 1 & 2*
Talen Energy Corp. www.talenenergy.com	Susquehanna 1 & 2
PSEG Nuclear, LLC www.pseg.com	Hope Creek 1 Salem 1 & 2
South Carolina Electric & Gas Company www.sceg.com	Summer
Southern Nuclear Operating Company www.southerncompany.com	Hatch 1 & 2 Farley 1 & 2 Vogtle 1 & 2
STP Nuclear Operating Company www.stpegs.com	South Texas Project 1 & 2*
Tennessee Valley Authority www.tva.gov	Browns Ferry 1, 2, & 3 Sequoyah 1 & 2 Watts Bar 1
Wolf Creek Nuclear Operating Corporation www.wcnoc.com	Wolf Creek 1*

* These plants have a joint program called the Strategic Teaming and Resource Sharing group. They share resources for refueling outages and develop some shared licensing applications.

Note: Data as of July 2015, and the next printed update will be August 2017.

APPENDIX F

Commercial Nuclear Power Reactor Operating Licenses— Issued by Year

1969	Dresden 2
	Ginna
	Nine Mile Point 1
	Oyster Creek
1970	Point Beach 1
	Robinson 2
1971	Dresden 3
	Monticello
1972	Palisades
	Pilgrim
	Quad Cities 1
	Quad Cities 2
	Surry 1
	Turkey Point 3
1973	Browns Ferry 1
	Fort Calhoun
	Indian Point 2
	Oconee 1
	Oconee 2
	Peach Bottom 2
	Point Beach 2
	Surry 2
	Turkey Point 4
1974	Arkansas Nuclear 1
	Browns Ferry 2
	Brunswick 2
	Calvert Cliffs 1
	Cooper
	Cook 1
	Duane Arnold
	FitzPatrick
	Hatch 1
	Oconee 3
	Peach Bottom 3
	Prairie Island 1
	Prairie Island 2
	Three Mile Island 1
1975	Millstone 2
1976	Beaver Valley 1
	Browns Ferry 3
	Brunswick 1
	Calvert Cliffs 2
	Indian Point 3
	Salem 1
	St. Lucie 1
1977	Davis-Besse
	D.C. Cook 2
	Farley 1
1978	Arkansas Nuclear 2
	Hatch 2
	North Anna 1
1980	North Anna 2
	Sequoyah 1
1981	Farley 2
	McGuire 1
	Salem 2
	Sequoyah 2
1982	LaSalle 1
	Summer
	Susquehanna 1
1983	McGuire 2
	St. Lucie 2
1984	Callaway
	Columbia
	Diablo Canyon 1
	Grand Gulf 1
	LaSalle 2
	Susquehanna 2
1985	Byron 1
	Catawba 1
	Diablo Canyon 2
	Fermi 2
	Limerick 1
	Palo Verde 1
	River Bend 1
	Waterford 3
	Wolf Creek 1
1986	Catawba 2
	Hope Creek 1
	Millstone 3
	Palo Verde 2
	Perry 1
1987	Beaver Valley 2
	Braidwood 1
	Byron 2
	Clinton
	Harris 1
	Nine Mile Point 2
	Palo Verde 3
	Vogtle 1
1988	Braidwood 2
	South Texas Project 1
1989	Limerick 2
	South Texas Project 2
	Vogtle 2
1990	Comanche Peak 1
	Seabrook 1
1993	Comanche Peak 2
1996	Watts Bar 1

Note: This list is limited to reactors licensed to operate. Year is based on the date the initial full-power operating license was issued. NRC-abbreviated reactor names are listed. Data as of July 2015, and the next printed update will be August 2017.

APPENDIX G

Commercial Nuclear Power Reactor Operating Licenses— Expiration by Year, 2013–2049

2013	Indian Point 2
2015	Indian Point 3
2017	Davis-Besse
2020	Sequoyah 1
2021	Sequoyah 2
2022	LaSalle 1
2023	LaSalle 2
2024	Byron 1
	Diablo Canyon 1
	Grand Gulf 1
	Limerick 1
	Waterford 3
2025	Diablo Canyon 2
	Fermi 2
	River Bend 1
2026	Braidwood 1
	Byron 2
	Clinton
	Perry
2027	Braidwood 2
	South Texas Project 1
2028	South Texas Project 2
2029	Dresden 2
	Ginna
	Limerick 2
	Nine Mile Point 1
	Oyster Creek
2030	Comanche Peak 1
	Monticello
	Point Beach 1
	Robinson 2
	Seabrook
2031	Dresden 3
	Palisades
2032	Pilgrim
	Quad Cities 1
	Quad Cities 2
	Surry 1
	Turkey Point 3
2033	Browns Ferry 1
	Comanche Peak 2
	Fort Calhoun
	Oconee 1
	Oconee 2
	Peach Bottom 2
	Point Beach 2
	Prairie Island 1
	Surry 2
	Turkey Point 4
2034	Arkansas Nuclear 1
	Browns Ferry 2
	Brunswick 2
	Calvert Cliffs 1
	Cook 1
	Cooper
	Duane Arnold
	Hatch 1
	FitzPatrick
	Oconee 3
	Peach Bottom 3
	Prairie Island 2
	Three Mile Island 1
2035	Millstone 2
	Watts Bar 1
2036	Beaver Valley 1
	Browns Ferry 3
	Brunswick 1
	Calvert Cliffs 2
	St. Lucie 1
	Salem 1
2037	Cook 2
	Farley 1
2038	Arkansas Nuclear 2
	Hatch 2
	North Anna 1
2040	North Anna 2
	Salem 2
2041	Farley 2
	McGuire 1
2042	Summer
	Susquehanna 1
2043	Catawba 1
	Catawba 2
	Columbia
	McGuire 2
	St. Lucie 2
2044	Susquehanna 2
	Callaway
2045	Millstone 3
	Palo Verde 1
	Wolf Creek 1
2046	Nine Mile Point 2
	Harris 1
	Hope Creek
	Palo Verde 2
2047	Beaver Valley 2
	Palo Verde 3
	Vogtle 1
2049	Vogtle 2

Note: This list includes Indian Point 2, which entered timely renewal on Sept. 29, 2013. Limited to reactors licensed to operate. NRC-abbreviated reactor names listed. Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

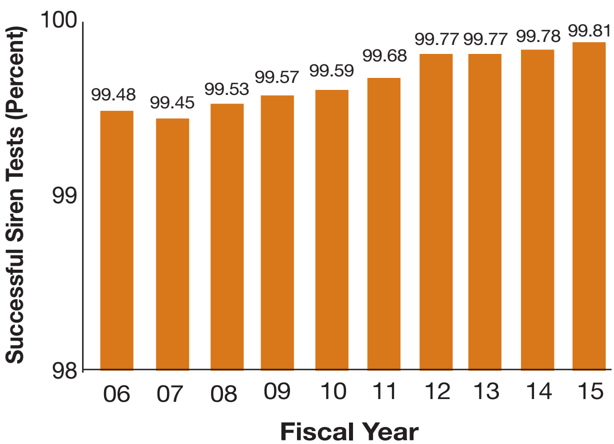
APPENDIX H

Industry Performance Indicators: Industry Averages, FYs 2006–2015

Indicator	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Alert and Notification	99.48	99.45	99.53	99.57	99.59	99.68	99.77	99.77	99.78	99.81
Automatic Scrams	0.32	0.48	0.29	0.36	0.44	0.45	0.30	0.38	0.39	0.38
Collective Radiation Exposure	93	109	96	87	91	90	72	77	70	68
Drill/Exercise Performance	96.06	96.19	96.22	97.06	96.89	97.30	97.51	97.47	97.86	98.21
Equipment-Forced Outage Rate	0.10	0.11	0.08	0.09	0.10	0.09	0.09	0.08	0.10	0.08
ERO Drill Participation	97.89	97.55	98.16	98.65	98.77	99.43	99.33	99.46	99.71	99.84
Forced Outage Rate	1.47	1.41	1.34	2.21	1.74	1.80	2.77	2.98	1.27	1.1
Safety System Actuations	0.22	0.25	0.14	0.23	0.18	0.19	0.17	0.29	0.20	0.15
Safety System Failures	0.60	0.66	0.71	0.71	0.88	0.90	0.85	0.93	0.85	0.92
Significant Events	0.03	0.02	0.03	0.02	0.10	0.13	0.10	0.07	0.03	0.01

Note: Data as of July 2015, and the next printed update will be August 2017.

Alert and Notification System (ANS) Reliability



This figure shows the percentage of ANS sirens that successfully operated during periodic tests in the previous year. The result is an indicator of the reliability of the ANS to alert the public in an emergency.

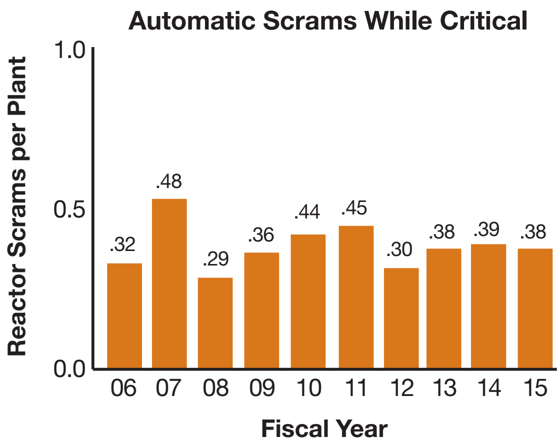
Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX H

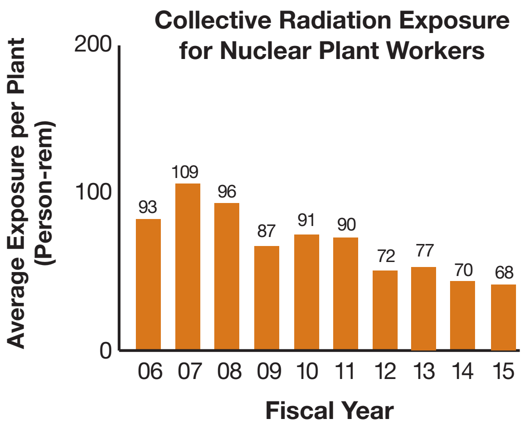
Industry Performance Indicators: Industry Averages, FYs 2006–2015 (continued)



A reactor is considered "critical" when it achieves a self-sustaining nuclear chain reaction, such as when the reactor is operating. The sudden shutting down of a nuclear reactor by the rapid insertion of control rods, either automatically or manually by the reactor operator, is referred to as a "scram." This indicator measures the number of unplanned automatic scrams that occurred while the reactor was critical.

Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC



This indicator monitors the total radiation dose accumulated by plant personnel.

Further Explanation:
In 2015, those workers receiving a measurable dose of radiation received an average of about 0.1 rem. For comparison purposes, the average U.S. citizen receives 0.3 rem of radiation each year from natural sources (i.e., the everyday environment). See the definition of "exposure" in the Glossary.

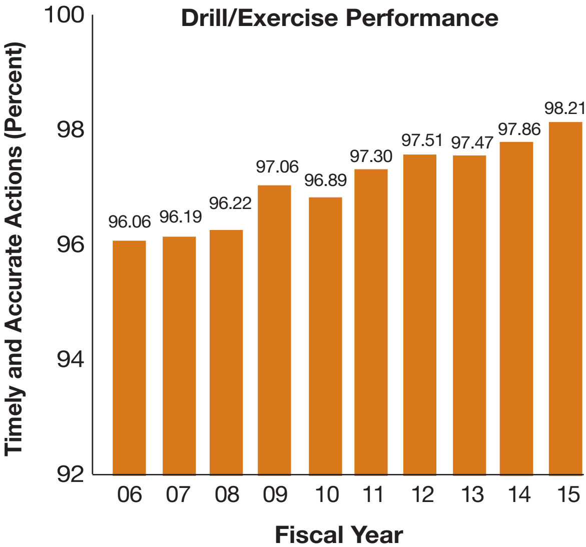
Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX H

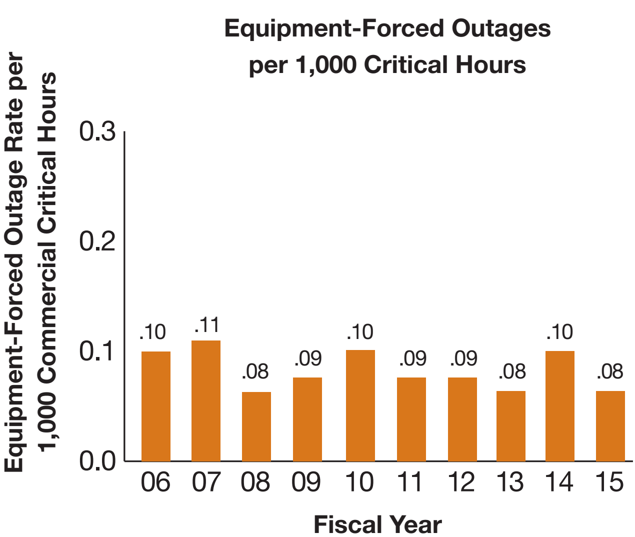
Industry Performance Indicators: Industry Averages, FYs 2006–2015 (continued)



This indicator is the percentage of timely and accurate actions taken by plant personnel (emergency classifications, protective action recommendations, and notification to offsite authorities) in drills and actual events during the previous 2 years.

Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC



This indicator is the number of times the plant is forced to shut down because of equipment failures for every 1,000 hours that the plant is in operation and transmitting electricity.

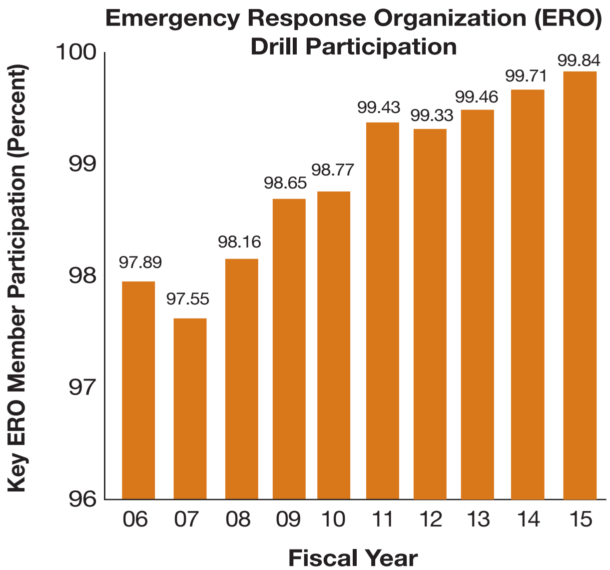
Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX H

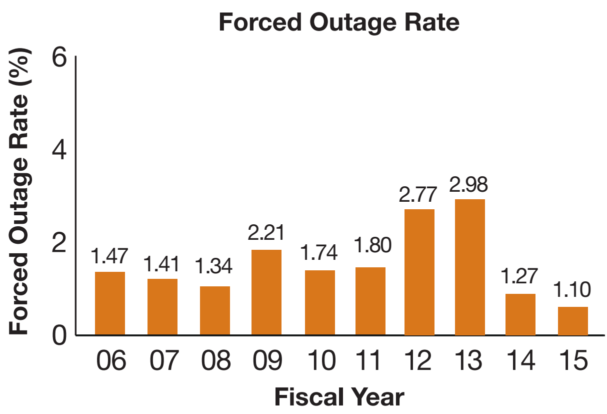
Industry Performance Indicators: Industry Averages, FYs 2006–2015 (continued)



This indicator is the percentage of participation by key plant personnel in drills or actual events in the previous 2 years, indicating proficiency and readiness to respond to emergencies.

Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC



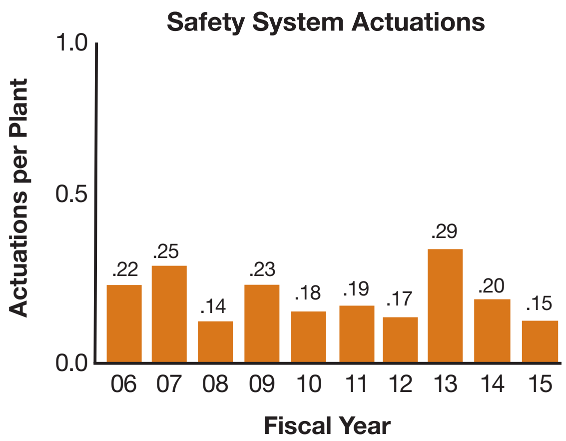
The forced outage rate is the number of hours that the plant is unable to operate (forced outage hours) divided by the sum of the hours that the plant is generating and transmitting electricity (unit service hours) and the hours that the plant is unable to operate (forced outage hours).

Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC

APPENDIX H

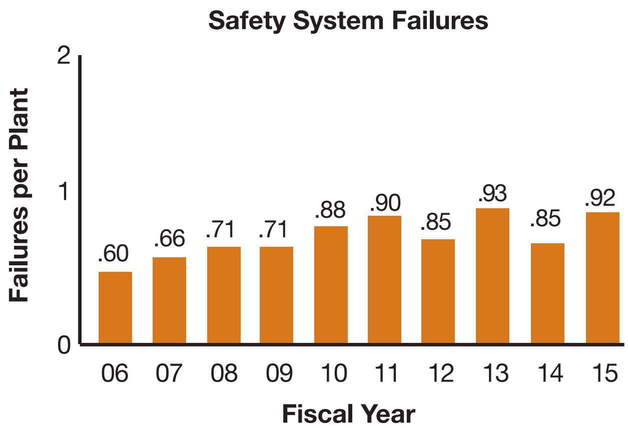
Industry Performance Indicators: Industry Averages, FYs 2006–2015 (continued)



Safety system actuations are certain manual or automatic actions taken to start emergency core cooling systems or emergency power systems. These systems are specifically designed to either remove heat from the reactor fuel rods if the normal core cooling system fails or to provide emergency electrical power if the normal electrical systems fail.

Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC



Safety system failures are any actual failures, events, or conditions that could prevent a system from performing its required safety function.

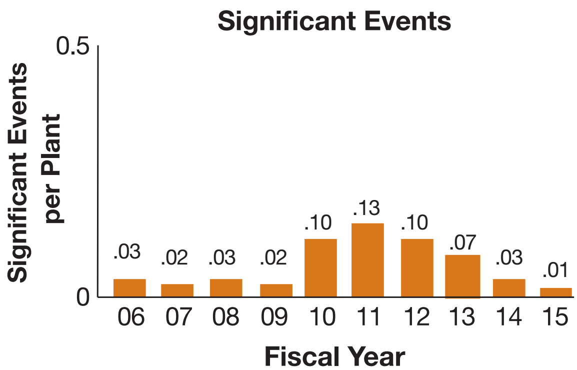
Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX H

Industry Performance Indicators: Industry Averages, FYs 2006–2015 (continued)



Significant events are events that meet specific NRC criteria—for example, degradation of safety equipment, a sudden reactor shutdown with complications, or an unexpected response to a sudden degradation of fuel or pressure boundaries. The NRC staff identifies significant events through detailed screening and evaluation of operating experience.

Note: Data represents annual industry averages for operating reactors. The data is continuously updated to incorporate recent information and any subsequent changes in the analysis.

Source: Licensee data as compiled by the NRC

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX I

Operating Nuclear Research and Test Reactors Regulated by the NRC

Licensee Location	Reactor Type OL Issued	Power Level (kW)	Licensee Number Docket Number
Aerotest* San Ramon, CA	TRIGA (Indus) 07/02/1965	250	R-98 05000228
Armed Forces Radiobiology Research Institute Bethesda, MD	TRIGA 06/26/1962	1,100	R-84 05000170
Dow Chemical Company Midland, MI	TRIGA 07/03/1967	300	R-108 05000264
GE-Hitachi Sunol, CA	Tank 10/31/1957	100	R-33 05000073
Idaho State University Pocatello, ID	AGN-201 #103 10/11/1967	0.005	R-110 05000284
Kansas State University Manhattan, KS	TRIGA 10/16/1962	250	R-88 05000188
Massachusetts Institute of Technology Cambridge, MA	HWR Reflected 06/09/1958	6,000	R-37 05000020
Missouri University of Science and Technology Rolla, MO	Pool 11/21/1961	200	R-79 05000123
National Institute of Standards & Technology Gaithersburg, MD	Nuclear Test 05/21/1970	20,000	TR-5 05000184
North Carolina State University Raleigh, NC	Pulstar 08/25/1972	1,000	R-120 05000297
Ohio State University Columbus, OH	Pool 02/24/1961	500	R-75 05000150
Oregon State University Corvallis, OR	TRIGA Mark II 03/07/1967	1,100	R-106 05000243
Pennsylvania State University State College, PA	TRIGA 07/08/1955	1,100	R-2 05000005
Purdue University West Lafayette, IN	Lockheed 08/16/1962	1	R-87 05000182
Reed College Portland, OR	TRIGA Mark I 07/02/1968	250	R-112 05000288

* Permanent shutdown ordered July 24, 2013.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX I

Operating Nuclear Research and Test Reactors Regulated by the NRC (continued)

Licensee Location	Reactor Type OL Issued	Power Level (kW)	Licensee Number Docket Number
Rensselaer Polytechnic Institute Troy, NY	Critical Assembly 07/03/1964	0.1	CX-22 05000225
Rhode Island Atomic Energy Commission Narragansett, RI	GE Pool 07/23/1964	2,000	R-95 05000193
Texas A&M University College Station, TX	AGN-201M #106 08/26/1957	0.005	R-23 05000059
Texas A&M University College Station, TX	TRIGA 12/07/1961	1,000	R-83 05000128
U.S. Geological Survey Denver, CO	TRIGA Mark I 02/24/1969	1,000	R-113 05000274
University of California/Davis Sacramento, CA	TRIGA 08/13/1998	2,300	R-130 05000607
University of California/Irvine Irvine, CA	TRIGA Mark I 11/24/1969	250	R-116 05000326
University of Florida Gainesville, FL	Argonaut 05/21/1959	100	R-56 05000083
University of Maryland College Park, MD	TRIGA 10/14/1960	250	R-70 05000166
University of Massachusetts/Lowell Lowell, MA	GE Pool 12/24/1974	1,000	R-125 05000223
University of Missouri/Columbia Columbia, MO	Tank 10/11/1966	10,000	R-103 05000186
University of New Mexico Albuquerque, NM	AGN-201M #112 09/17/1966	0.005	R-102 05000252
University of Texas Austin, TX	TRIGA Mark II 01/17/1992	1,100	R-129 05000602
University of Utah Salt Lake City, UT	TRIGA Mark I 09/30/1975	100	R-126 05000407
University of Wisconsin Madison, WI	TRIGA 11/23/1960	1,000	R-74 05000156
Washington State University Pullman, WA	TRIGA 03/06/1961	1,000	R-76 05000027

Note: Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX J

Nuclear Research and Test Reactors under Decommissioning Regulated by the NRC

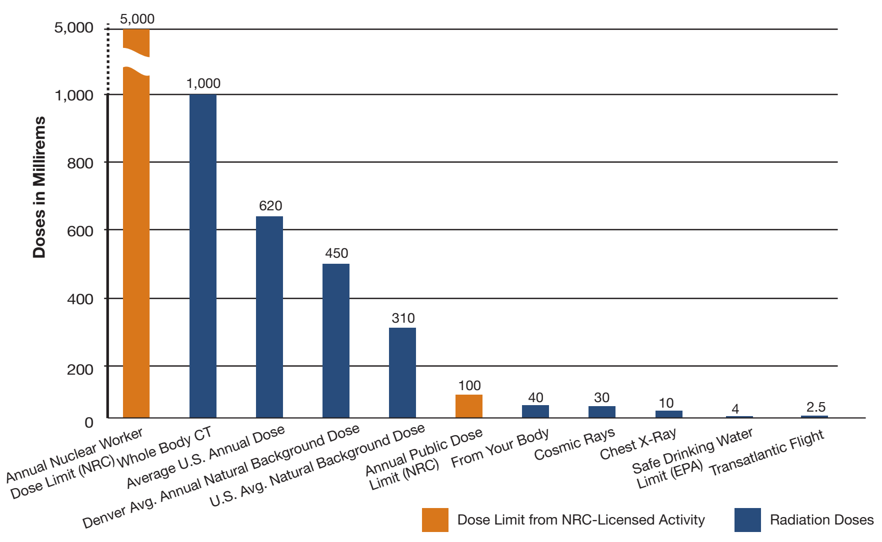
Licensee Location	Reactor Type Power Level (kW)	OL Issued Shutdown
General Atomics San Diego, CA	TRIGA Mark F 1,500	07/01/60 09/07/94
General Atomics San Diego, CA	TRIGA Mark I 250	05/03/58 12/17/96
General Electric Company Sunol, CA	GETR (Tank) 50,000	01/07/59 06/26/85
University of Buffalo Buffalo, NY	Pulstar 2,000	03/24/61 07/23/96
Veterans Administration* Omaha, NE	TRIGA 20	06/26/59 11/05/01

* License terminated as of August 1, 2016.

Note: Data as of July 2015, and the next printed update will be August 2017.

APPENDIX K

Radiation Doses and Regulatory Limits



For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX L
Materials Licenses by State

State	NRC (Number of Licenses)	Agreement States (Number of Licenses)
Alabama	16	425
Alaska	69	0
Arizona	10	358
Arkansas	9	192
California	72	1,789
Colorado	17	335
Connecticut	157	0
Delaware	49	0
District of Columbia	37	0
Florida	25	1,648
Georgia	24	465
Hawaii	55	0
Idaho	71	0
Illinois	31	647
Indiana	252	0
Iowa	2	162
Kansas	15	280
Kentucky	12	388
Louisiana	11	509
Maine	3	111
Maryland	85	539
Massachusetts	35	444
Michigan	466	0
Minnesota	15	166
Mississippi	9	307
Missouri	256	0
Montana	86	0
Nebraska	10	145
Nevada	2	244
New Hampshire	8	80
New Jersey	37	637
New Mexico	11	202
New York	28	1,341
North Carolina	24	615
North Dakota	6	102
Ohio	44	610
Oklahoma	19	224
Oregon	6	396
Pennsylvania	50	665
Rhode Island	1	43
South Carolina	15	396
South Dakota	39	0
Tennessee	25	553
Texas	49	1,571
Utah	10	185
Vermont	33	0
Virginia	61	401
Washington	17	357
West Virginia	172	0
Wisconsin	11	305
Wyoming	88	0
Puerto Rico	131	0
Virgin Islands	9	0
Guam	5	0

Total number of materials licenses in Agreement State jurisdiction	17,837
Total number of materials licenses in NRC jurisdiction	2,800
Total number of materials licenses in the United States	20,637

Agreement State | Letter of intent

Note: The NRC and Agreement State data is as of November 2014. These totals represent an estimate because the number of specific radioactive materials licenses per State may change on a daily basis. Data as of July 2015. Next publish release date August 2017.

The NRC licenses Federal agencies in Agreement States.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX M
Major U.S. Fuel Cycle Facility Sites

Licensee	Location	Status	Docket #
Uranium Hexafluoride Conversion Facility			
Honeywell International, Inc.	Metropolis, IL	active	04003392
Uranium Fuel Fabrication Facilities			
Global Nuclear Fuel-Americas, LLC	Wilmington, NC	active	07001139
Westinghouse Electric Company, LLC Columbia Fuel Fabrication Facility	Columbia, SC	active	07109239
Nuclear Fuel Services, Inc.	Erwin, TN	active	07000143
Babcock & Wilcox Nuclear Operations Group	Lynchburg, VA	active	07000027
AREVA, Inc.	Richland, WA	active	07001257
Mixed Oxide Fuel Fabrication Facility			
Shaw AREVA MOX Services, LLC	Aiken, SC	under construction (operating license under review)	07003098
Gaseous Diffusion Uranium Enrichment Facilities			
USEC, United States Enrichment Corp. Paducah Gaseous Diffusion Plant	Paducah, KY	shut down, certificate termination pending	07007001
Gas Centrifuge Uranium Enrichment Facilities			
USEC, American Centrifuge Operating, LLC Lead Cascade: Test and Demonstration Facility	Piketon, OH	active	07007003
USEC, American Centrifuge Operating, LLC American Centrifuge Plant	Piketon, OH	license issued, construction halted	07007004
Louisiana Energy Services (URENCO-USA)	Eunice, NM	active*	07003103
AREVA Enrichment Services, LLC Eagle Rock Enrichment Facilities	Idaho Falls, ID	license issued, construction not started	07007015
Laser Separation Enrichment Facility			
GE-Hitachi	Wilmington, NC	license issued, construction not started	07007016
Uranium Hexafluoride Deconversion Facility			
International Isotopes	Hobbs, NM (Lea County)	license issued, construction not started	04009086

* Operating and producing enriched uranium while undergoing further phases of construction.

Note: Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX N

Dry Spent Fuel Storage Designs: NRC-Approved for Use by General Licensees

Vendor	Docket #	Storage Design Model
General Nuclear Systems, Inc.	07201000	CASTOR V/21 CASTOR X/33
NAC International, Inc.	07201002	NAC S/T
	07201003	NAC-C28 S/T
	07201015	NAC-UMS
	07201025	NAC-MPC
	07201031	Magnastor
	07201013	NAC-STC
Holtec International	07201008	HI-STAR 100
	07201014	HI-STORM 100
	07201032	HI-STORM FW
	07201040	HI-STORM UMAX
EnergySolutions, Inc.	07201007	VSC-24
	07201026	Fuel Solutions™ (WSNF-220, -221, -223) W-150 Storage Cask W-100 Transfer Cask W-21, W-74 Canisters
Transnuclear, Inc.	07201005	TN-24
	07201027	TN-68
	07201021	TN-32, 32A, 32B
	07201004	Standardized NUHOMS®-24P, -24PHB, -24PTH, -32PT, -32PTH1, -37PTH, -52B, -61BT, -61BTH, -69BTH
	07201029	Standardized Advanced NUHOMS®-24PT1, -24PT4
	07201030	NUHOMS® HD-32PTH
	07201022	NUHOMS®-7P

Note: Data as of July 2015, and the next printed update will be August 2017.
(See latest list on the NRC Web site at www.nrc.gov/waste/spent-fuel-storage/designs.html.)

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX O

Dry Cask Spent Fuel Storage Licensees

Name Licensee	License Type	Vendor	Storage Model	Docket Number
Arkansas Nuclear Entergy Nuclear Operations, Inc.	GL	Energy Solutions, Inc. Holtec International	VSC-24 HI-STORM 100	07200013
Beaver Valley	GL	Transnuclear, Inc	NUHOMS®-37PTH	07201043
Big Rock Point Entergy Nuclear Operations, Inc.	GL	Energy Solutions, Inc.	Fuel Solutions™	07200043 W74
Braidwood Exelon Generation Co., LLC	GL	Holtec International	HI-STORM 100	07200073
Browns Ferry Tennessee Valley Authority	GL	Holtec International	HI-STORM 100S	07200052
Brunswick Carolina Power Co.	GL	Transnuclear, Inc.	NUHOMS®-HD-61BTH	07200006
Byron Exelon Generation Co., LLC	GL	Holtec International	HI-STORM 100	07200068
Callaway	GL	Holtec International	HI-STORM UMAX	07201045
Calvert Cliffs Calvert Cliffs Nuclear Power Plant, Inc.	SL	Transnuclear, Inc.	NUHOMS®-24P NUHOMS®-32P	07200008
Catawba Duke Energy Carolinas, LLC	GL	NAC International, Inc.	NAC-UMS	07200045
Columbia Generating Station Energy Northwest	GL	Holtec International	HI-STORM 100	07200035
Comanche Peak Luminant Generation Company, LLC	GL	Holtec International	HI-STORM 100	07200074
Cook Indiana/Michigan Power	GL	Holtec International	HI-STORM	07200072
Cooper Nuclear Station Nebraska Public Power District	GL	Transnuclear, Inc.	NUHOMS®-61BT	07200066
Davis-Besse FirstEnergy Nuclear Operating Company	GL	Transnuclear, Inc.	NUHOMS®-24P	07200014
Diablo Canyon Pacific Gas & Electric Co.	SL	Holtec International	HI-STORM 100	07200026
Dresden Exelon Generation Company, LLC	GL	Holtec International	HI-STAR 100 HI-STORM 100	07200037
Duane Arnold Next Era Energy Duane Arnold, LLC.	GL	Transnuclear, Inc.	NUHOMS®-61BT	07200032
Fermi	GL	Holtec International	HI-STORM 100	07200071

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX O
Dry Cask Spent Fuel Storage Licensees (continued)

Name Licensee	License Type	Vendor	Storage Model	Docket Number
Fort Calhoun Omaha Public Power District	GL	Transnuclear, Inc.	NUHOMS®-32PT	07200054
Fort St. Vrain* U.S. Department of Energy	SL	FW Energy Applications, Inc.	Modular Vault Dry Store	07200009
Ginna Constellation Energy	GL	Transnuclear, Inc.	NUHOMS®-32PT	07200067
Grand Gulf Entergy Nuclear Operations, Inc.	GL	Holtec International	HI-STORM 100S	07200050
H.B. Robinson Carolina Power & Light Company	SL GL	Transnuclear, Inc. Transnuclear, Inc.	NUHOMS®-7P NUHOMS®-24P	07200003 07200060
Haddam Neck CT Yankee Atomic Power	GL	NAC International, Inc.	NAC-MPC	07200039
Hatch Southern Nuclear Operating, Inc.	GL	Holtec International	HI-STAR 100 HI-STAR 100	07200036
Hope Creek/Salem PSEG Nuclear, LLC	GL	Holtec International	HI-STORM 100	07200048
Humboldt Bay Pacific Gas & Electric Co.	SL	Holtec International	HI-STORM 100HB	07200027
Idaho National Lab TMI-2 Fuel Debris, U.S. Department of Energy	SL	Transnuclear, Inc.	NUHOMS®-12T	07200020
Idaho Spent Fuel Facility Environmental Corp.	SL	Foster Wheeler	Concrete Vault	07200025
Indian Point Entergy Nuclear Operations, Inc.	GL	Holtec International	HI-STORM 100	07200051
James A. FitzPatrick Entergy Nuclear Operations, Inc.	GL	Holtec International	HI-STORM 100	07200012
Joseph M. Farley Southern Nuclear Operating Co.	GL	Transnuclear, Inc.	NUHOMS®-32PT	07200042
Kewaunee Northern States Power Co., Minnesota	GL	Transnuclear, Inc.	NUHOMS®-39PT	07200064
La Salle Exelon Generation Co., LLC	GL	Holtec International	HI-STORM100	07200070
Lacrosse Dairyland Power	GL	NAC International, Inc.	NAC-MPC	07200046
Limerick Exelon Generation Co., LLC	GL	Transnuclear, Inc.	NUHOMS®-61BT	07200065

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX O

Dry Cask Spent Fuel Storage Licensees (continued)

Name Licensee	License Type	Vendor	Storage Model	Docket Number
Maine Yankee Maine Yankee Atomic Power Company	GL	NAC International, Inc.	NAC-UMS	07200030
McGuire Duke Energy, LLC	GL	Transnuclear, Inc.	TN-32	07200038
Millstone Dominion Generation	GL	Transnuclear, Inc.	NUHOMS®-32PT	07200047
Monticello Northern States Power Co., Minnesota	GL	Transnuclear, Inc.	NUHOMS®-61BT NUHOMS®-61BTH	07200058
Nine Mile Point Constellation Energy	GL	Transnuclear, Inc	NUHOMS®-61BT	07201036
North Anna Virginia Electric & Power Company (Dominion Gen.)	SL GL	Transnuclear, Inc. Transnuclear, Inc.	TN-32 NUHOMS®HD32PTH	07200016 07200056
Oconee Duke Energy Company	SL GL	Transnuclear, Inc. Transnuclear, Inc.	NUHOMS®-24P NUHOMS®-24P	07200004 07200040
Oyster Creek AmerGen Energy Company, LLC.	GL	Transnuclear, Inc.	NUHOMS®-61BT	07200015
Palisades Entergy Nuclear Operations, Inc.	GL	EnergySolutions, Inc.	VSC-24 NUHOMS®-32PT	07200007
Palo Verde Arizona Public Service Co.	GL	NAC International, Inc.	NAC-UMS	07200044
Peach Bottom Exelon Generation Company, LLC	GL	Transnuclear, Inc.	TN-68	07200029
Perry FirstEnergy	GL	Holtec International	HI-STORM	07200069
Pilgrim	GL	Holtec International	HI-STORM 100	07201044
Point Beach FLP Energy Point Beach, LLC	GL	EnergySolutions, Inc.	VSC-24 NUHOMS®-32PT	07200005
Prairie Island Northern States Power Co., Minnesota	SL	Transnuclear, Inc.	TN-40 HT TN-40	07200010
Private Fuel Storage Facility	SL	Holtec International	HI-STORM 100	07200022
Quad Cities Exelon Generation Company, LLC	GL	Holtec International	HI-STORM 100S	07200053
Rancho Seco Sacramento Municipal Utility District	SL	Transnuclear, Inc.	NUHOMS®-24P	07200011

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX O

Dry Cask Spent Fuel Storage Licensees (continued)

Name Licensee	License Type	Vendor	Storage Model	Docket Number
River Bend Entergy Nuclear Operations, Inc.	GL	Holtec International	HI-STORM 100S	07200049
Salem PSEG Nuclear	GL	Holtec International	HI-STORM	07200048
San Onofre Southern California Edison Company	GL	Transnuclear, Inc.	NUHOMS®-24PT	07200041
Seabrook FPL Energy	GL	Transnuclear, Inc.	NUHOMS®-HD-32PTH	07200061
Sequoyah Tennessee Valley Authority	GL	Holtec International	HI-STORM 100	07200034
St. Lucie Florida Power and Light Company	GL	Transnuclear, Inc.	NUHOMS®-HD-32PTH	07200061
Surry Virginia Electric & Power Company (Dominion Gen.)	SL	General Nuclear Systems, Inc. Transnuclear, Inc. General Nuclear Westinghouse, Inc.	CASTOR V/21 TN-32 NAC-128 CASTOR X/33 MC-10	07200002
	GL	Transnuclear, Inc.	NUHOMS®HD32PTH	07200055
Susquehanna Susquehanna Nuclear, LLC	GL	Transnuclear, Inc.	NUHOMS®-52B NUHOMS®-61BT NUHOMS®-61BTH	07200028
Trojan Portland General Electric Corp.	SL	Holtec International	HI-STORM 100	07200017
Turkey Point ISFSI Florida Power and Light Company	GL	Transnuclear, Inc.	NUHOMS®-HD-32PTH	07200062
Vermont Yankee Entergy Nuclear Operations, Inc.	GL	Holtec International	HI-STORM100	07200059
Vogtle Southern Company	GL	Holtec International	HI-STORM 100S	07201039
Waterford Steam Electric Station Entergy Nuclear Operations, Inc.	GL	Holtec International	HI-STORM 100	07200075
Yankee Rowe Yankee Atomic Electric	GL	NAC International, Inc.	NAC-MPC	07200031
Zion Zion Solutions, LLC	GL	NAC International, Inc.	Magnastor	07201037

* Fort St. Vrain is undergoing decommissioning and was transferred to DOE on June 4, 1999.
Note: NRC-abbreviated unit names. Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX P

U.S. Low-Level Radioactive Waste Disposal Compact Membership

Appalachian Compact
Delaware
Maryland
Pennsylvania
West Virginia

Atlantic Compact
Connecticut
New Jersey
South Carolina*

Central Compact
Arkansas
Kansas
Louisiana
Oklahoma

Central Midwest Compact
Illinois
Kentucky

Midwest Compact
Indiana
Iowa
Minnesota
Missouri
Ohio
Wisconsin

Northwest Compact
Alaska
Hawaii
Idaho
Montana
Oregon
Utah*
Washington*
Wyoming

Rocky Mountain Compact
Colorado
Nevada
New Mexico
(Northwest accepts Rocky Mountain waste as agreed between compacts.)

Southeast Compact
Alabama
Florida
Georgia
Mississippi
Tennessee
Virginia

Southwestern Compact
Arizona
California
North Dakota
South Dakota

Texas Compact
Texas*
Vermont

Unaffiliated
District of Columbia
Maine
Massachusetts
Michigan
Nebraska
New Hampshire
New York
North Carolina
Puerto Rico
Rhode Island

Closed Low-Level Radioactive Waste Disposal Facility Sites Licensed by the NRC or Agreement States

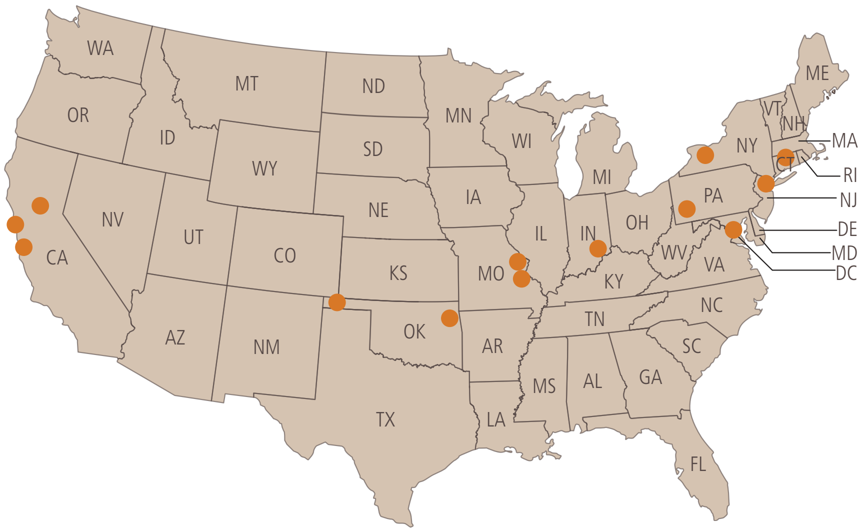
Beatty, NV, closed 1993
Sheffield, IL, closed 1978
Maxey Flats, KY, closed 1977
West Valley, NY, closed 1975

* Site of an active low-level waste disposal facility.
Note: Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX Q

NRC-Regulated Complex Material Sites Undergoing Decommissioning, 2015



● NRC-regulated complex material sites (13)

Company	Location
Alameda Naval Air Station	Alameda, CA
Babcock & Wilcox SLDA	Vandergrift, PA
Beltsville Agricultural Research Center	Beltsville, MD
Cimarron Environmental Trust	Cimarron, OK
Department of Army, Jefferson Proving Ground	Madison, IN
Department of Army, Picatinny Arsenal (ARDEC)	Picatinny, NJ
FMRI, Inc. (Fansteel)	Muskogee, OK
Hunter’s Point Naval Shipyard	San Francisco, CA
McClellan Air Force Base	Sacramento, CA
Sigma Aldrich	Maryland Heights, MO
UNC Naval Products	New Haven, CT
West Valley Demonstration Project	West Valley, NY
Westinghouse Electric Corporation—Hematite	Festus, MO

Note: Data as of July 2016. Next publish release date August 2017

Picatinny Arsenal in New Jersey is managed by Region I.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX R

Nuclear Power Units by Nation

Country	In Operation			Under Construction or on Order		
	Nuclear Power Production GWh*	Number of Units	Capacity Net MWe	Number of Units	Capacity Net MWe	Shutdown
Argentina	5,257	3	1,625	1	25	0
Armenia	2,266	1	376	0	0	1[P]
Belarus	0	0	0	2	2,218	0
Belgium	33,093	7	5,927	0	0	1[P]
Brazil	15,385	2	1,884	1	1,245	0
Bulgaria	15,014	2	1,926	0	0	4[P]
Canada	100,921	19	13,500	0	0	6[P]
China	130,580	27	23,025	24	23,738	0
Czech Republic	28,636	6	3,904	0	0	0
Finland	22,654	4	2,752	1	1,600	0
France	415,900	58	63,130	1	1,600	12[P]
Germany	91,783	9	12,074	0	0	27[P]
Hungary	14,778	4	1,889	0	0	0
India	33,231	21	5,308	6	3,990	0
Iran	4,140	1	915	0	0	0
Italy	0	0	0	0	0	4[P]
Japan	0	43	40,290	2	2,650	11[P] &1[L]
Kazakhstan	0	0	0	0	0	1[P]
Rep. Korea	149,165	24	21,667	4	5,420	0
Lithuania	0	0	0	0	0	2[P]
Mexico	9,312	2	1,330	0	0	0
Netherlands	3,874	1	482	0	0	1[P]
Pakistan	4,610	3	690	2	630	0
Romania	10,754	2	1,300	0	0	0
Russia	169,049	34	24,654	9	7,371	5[P]
Slovakia	14,420	4	1,814	2	880	3[P]
Slovenia	6,061	1	688	0	0	0
South Africa	14,749	2	1,860	0	0	0
Spain	54,832	7	7,121	0	0	1[L]
Sweden	62,270	10	9,470	0	0	3[P]

APPENDIX R

Nuclear Power Units by Nation (continued)

Country	In Operation: Nuclear Power Production GWh*	In Operation: Number of Units	In Operation: Capacity Net MWe	Under Construction or on Order: Number of Units	Under Construction or on Order: Capacity Net MWe	Shutdown
Switzerland	26,370	5	3,333	0	0	1P
Ukraine	83,123	15	13,107	2	1,900	4P
United Arab Emirates	0	0	0	3	4,035	0P
United Kingdom	57,918	16	9,373	0	0	29P
United States	797,067	99	98,639	5	5,633	33P
Total	**2,410,373***	**438**	**379,261**	**67**	**65,482**	**150P & 2L**

* Annual electrical power production for 2014. Total includes information on Taiwan.

P = Permanent Shutdown
L = Long-Term Shutdown

Note: Totals include reactors that are operable, under construction, or on order; country's short-form name used; rounded to the nearest whole number.

Sources: IAEA Power Reactor Information System Database; analysis compiled by the NRC. Data as of July 2015, and the next printed update will be August 2017.

APPENDIX S

Nuclear Power Units by Reactor Type, Worldwide

Reactor Type	In Operation: Number of Units	In Operation: Net MWe
Pressurized light-water reactors (PWR)	279	261,052
Boiling light-water reactors (BWR)	78	74,686
Heavy-water reactors, all types (HWR, PHWR)	49	24,549
Light-water-cooled graphite-moderated reactor (LWGR)	15	10,219
Gas-cooled reactors, all types (GCR)	15	8,175
Liquid-metal-cooled fast breeder reactors (FBR)	2	580
Total	**438**	**379,261**

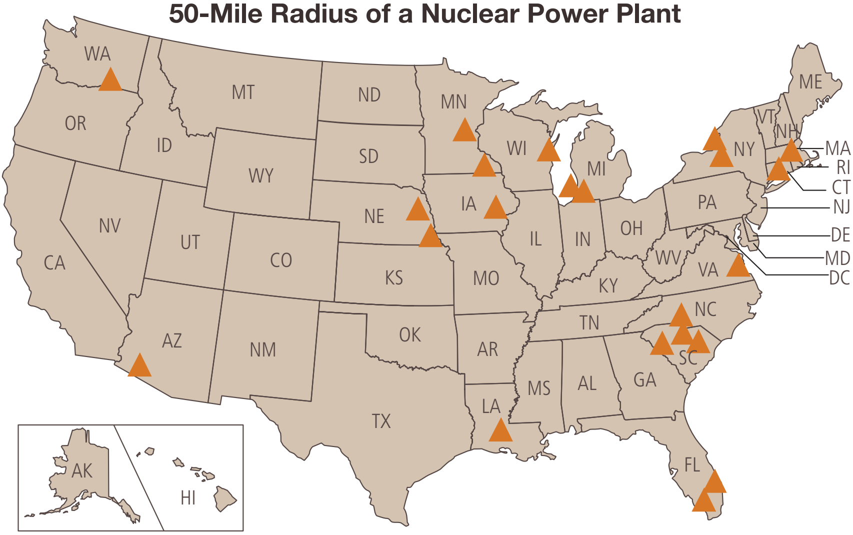
Note: MWe values rounded to the nearest whole number.

Source: IAEA Power Reactor Information System Database, www.iaea.org

Compiled by the NRC from data as of April 2015. Next publish release date August 2017.

APPENDIX T

Native American Reservations and Trust Lands within a 50-Mile Radius of a Nuclear Power Plant



ARIZONA
Palo Verde
Ak-Chin Indian Community
Tohono O'odham
Trust Land
Gila River Reservation

CONNECTICUT
Millstone
Mohegan Reservation
Mashantucket Pequot
Reservation
Narragansett
Reservation
Shinnecock Indian Nation

FLORIDA
St. Lucie
Brighton Reservation
(Seminole Tribes
of Florida)
Fort Pierce Reservation

Turkey Point
Hollywood Reservation
(Seminole Tribes
of Florida)
Miccosukee Reservation
Miccosukee Trust Land

IOWA
Duane Arnold
Sac & Fox Trust Land
Sac & Fox Reservation

KANSAS
Iowa Reservation
Iowa Trust Land

LOUISIANA
River Bend
Tunica-Biloxi Reservation

MASSACHUSETTS
Pilgrim
Wampanoag
Tribe of Gay Head
(Aquinnah)
Trust Land

MICHIGAN
Palisades
Pottawatomi Reservation
Matchebenashshewish
Band
Pokagon Reservation
Pokagon Trust Land*

DC Cook
Pokagon Reservation
Pokagon Trust Land

MINNESOTA
Monticello
Shakopee Community
Shakopee Trust Land
Mille Lacs Reservation

Prairie Island
Prairie Island Community*
Prairie Island Trust Land*
Shakopee Community
Shakopee Trust Land

NEBRASKA
Cooper
Sac & Fox Trust Land
Sac & Fox Reservation
Iowa Reservation
Iowa Trust Land
Kickapoo

Fort Calhoun
Omaha Reservation
Winnebago Reservation
Winnebago Trust Land

NEW YORK
FitzPatrick
Onondaga Reservation
Oneida Reservation

Nine Mile Point
Onondaga Reservation
Oneida Reservation

NORTH CAROLINA
McGuire
Catawba Reservation

SOUTH CAROLINA
Catawba
Catawba Reservation

Oconee
Eastern Cherokee
Reservation

Summer
Catawba Reservation

Virginia
Surry
Pamunkey Reservation

WASHINGTON
Columbia
Yakama Reservation
Yakama Trust Land

WISCONSIN
Point Beach
Oneida Trust Land
Oneida Reservation

* Tribe is located within the 10-mile emergency preparedness zone of operating reactors.
Note: This table uses NRC-abbreviated reactor names and Native American Reservation and Trust land names. There are no reservations or Trust lands within 50 miles of a reactor in Alaska or Hawaii. For more information on other Tribal concerns, go to the NRC Web site at www.nrc.gov.
NRC-abbreviated reactor names listed. Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX U

Regulatory Research Cooperative Agreements and Grants

American Nuclear Society	Support for the development and maintenance of probabilistic risk assessment (PRA)-related standards
American Society of Mechanical Engineers	Support in the following areas: Committee on Nuclear Risk Management on PRA standards, nuclear risk management, code comparison for the Multinational Design Evaluation Program, and harmonization of codes
Electric Power Research Institute	Research on irradiation-assisted stress-corrosion cracking and irradiation-assisted degradation of vessel internals materials
International Commission on Radiological Protection	Research on radiological protection standards
Kansas State University	Development of a High-Fidelity Model with Depleted Fuel for the Kansas State TRIGA Mark II Reactor
National Academy of Sciences	Support in the following areas: The Committee on Geological and Geotechnical Engineering, research to develop a consensus on the assessment of soil liquefaction potential and the related infrastructure consequences, research on porous rocks
National Council on Radiation Protection and Measurements Inc.	Radiation Protection Guidance for the United States: SC 1-23, Guidance on Radiation Dose Limits for the Lens of the Eye, and radiation protection guidance for the United States
Northwestern University	Service Lifetime Extension of Nuclear Power Plants: Prediction of Concrete Aging and Deterioration Through Accelerated Tests, Nondestructive Evaluation, and Stochastic Multiscale Computations
Ohio State University	Severe Accident Management Guidelines (SAMG) Validation within the Context of Severe Accident Uncertainties
Pennsylvania State University	Research on the minimum film boiling temperature for nuclear fuel rods with different types of fouling layers and experiments on scalability of horizontal two-phase flow in small and large diameter pipes
Purdue University	Steel Plate Composite Walls: Behavior, Analysis, and Design for Missile Impact
Texas A&M University	Research on bypass flow in prismatic reactor blocks and prolonged station blackout conditions
The Regents of the University of Colorado	Experimental and Numerical Investigation of Alkali Silica Reaction in Nuclear Reactors
University of California, Los Angeles	Methodological and Software Enhancements of Dynamic PRA Platforms for Event Assessment Applications
University of California-Berkeley	Work on ground motion prediction models for central and eastern North America and postliquefaction residual strength
University of Florida	Synergistic Effect of Thermal Aging and Low-Dose Irradiation on the Cast Stainless Steels and Stainless Steel Welds
University of Illinois	Validation of the PARCS/PATHS/SCALE for PWR Depletion Using the BEAVRS Benchmark
University of Maryland	Study of the Implications of Multi-Unit Accidents in the Context of NRC's Quantitative Health Objectives
University of Michigan	Multiscale thermal hydraulic tool for nuclear power plant safety analyses and assessment of Trace interfacial area transport equations against high-resolution experiments of two-phase vertical flows
University of Tennessee	Research on seismic hazards and associated ground motion for the East Tennessee Seismic Zone
University of Toronto, Ontario	Research to develop a tool to confirm safety margins for modular steel-concrete composite constructions under seismic loads

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX V

Significant Enforcement Actions Issued

Significant (escalated) enforcement actions include notices of violation (NOVs) for severity level (SL) I, II, or III violations; NOVs associated with inspection findings that the significance determination process (SDP) categorizes as white, yellow, or red; civil penalties (CPs); and enforcement-related orders. The NRC Enforcement Policy also allows related violations to be categorized collectively as a single problem. Escalated enforcement actions are issued to reactor, materials, and individual licensees; nonlicensees; and fuel cycle facility licensees.

Action #	Name	Type	Issue Date	Enforcement Action
EA-12-140	South Carolina Electric & Gas Co. (Summer)	Reactor	03/10/2014	Confirmatory order result of an ADR mediation
EA-13-026	University Nuclear and Diagnostics	Materials	05/13/2014	NOV SL III
EA-13-059	Centro De Medicina Nuclear CE	Materials	04/08/2014	Order imposing CP of $7,000
EA-13-076	Entergy Nuclear IP2 LLC (Indian Point)	Reactor	04/29/2014	NOV SL III
EA-13-078	Entergy Nuclear IP2 LLC (Indian Point)	Reactor	04/29/2014	NOV SL III
EA-13-105	Geisser Engineering Corporation	Materials	03/20/2014 07/31/2014	NOV/CP SL II - $11,200 (CP subsequently reduced) Order imposing CP of $8,400
EA-13-136	Geisser Engineering Corporation	Materials	03/20/2014	NOV SL II
EA-13-196	Chicago Bridge and Iron Company (Lake Charles, LA)	Reactor	09/25/2014	Confirmatory order result of an ADR mediation
EA-13-215	Valley Quarries, Inc.	Materials	02/06/2014	Problem/CP SL III - $3,500
EA-13-222	Omaha Public Power District (Fort Calhoun)	Reactor	04/25/2014	NOV White SDP finding resulting in plant inspections
EA-13-223	FPL Energy Duane Arnold, LLC (Duane Arnold)	Reactor	02/11/2014	NOV White SDP finding resulting in plant inspections
EA-13-227	Tetra Tech, Inc.	Materials	02/24/2014	NOV SL III
EA-13-233	Entergy Operations, Inc. (Waterford 3)	Reactor	03/28/2014	NOV White SDP finding resulting in plant inspections
EA-13-240	Wittnauer Worldwide, LP	Materials	10/24/2014	NOV SL III
EA-13-244	Kuehne Company	Materials	03/20/2014	NOV SL III
EA-13-247	R.E. Ginna Nuclear Power Plant, LLC	Reactor	04/17/2014	NOV White SDP finding resulting in plant inspections
EA-13-251	ATC Group Services, Inc., d/b/a Car	Materials	11/19/2014	NOV/CP SL III - $3,500
EA-14-001	City of Kirksville, MO	Materials	03/17/2014	NOV SL III
EA-14-005	Tennessee Valley Authority (Browns Ferry)	Reactor	04/30/2014 05/01/2014	NOV White SDP finding resulting in plant inspections Confirmatory order result of an ADR mediation

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX V

Significant Enforcement Actions Issued (continued)

Action #	Name	Type	Issue Date	Enforcement Action
EA-14-008	Entergy Operations, Inc. (Arkansas Nuclear One, Units 1 and 2)	Reactor	06/23/2014	2 NOV Yellow SDP findings resulting in plant inspections
EA-14-009	Entergy Operations, Inc. (River Bend)	Reactor	12/03/2014	Confirmatory order, with a CP of $70,000, result of ADR mediation
EA-14-013	Entergy Nuclear Operations, Inc. (Palisades)	Reactor	07/21/2014	Confirmatory order result of an ADR mediation
EA-14-017	Southern Nuclear Operating Co., Inc. (Farley)	Reactor	02/14/2014	NOV White SDP finding resulting in plant inspections
EA-14-024	Wolf Creek Nuclear Operating Corp. (Wolf Creek)	Reactor	07/01/2014	NOV White SDP finding resulting in plant inspections
EA-14-026	Dominion NDT Services, Inc.	Materials	04/02/2014	NOV SL III
EA-14-028	IUPUI/Indiana University Medical Center	Materials	04/03/2014	NOV SL III
EA-14-029	ECS Carolinas, LLP	Materials	04/23/2014	Problem SL III
EA-14-030	Dominion Engineering Associates, Inc.	Materials	12/18/2014	NOV/CP SL III - $3,500
EA-14-072	Metro Cardiovascular Diagnostics	Materials	09/30/2014	NOV/CP SL III - $3,500
Problem SL III	Agreement State-Illinois GeoLog Well Services, Inc.	Materials	6/11/13	NOV SL III
EA-14-075	ConAgra Foods	Materials	08/01/2014	Problem SL III
EA-14-089	Idahoan Foods	Materials	10/16/2014	Problem SL III
EA-14-091	Duke Energy Corp. (Oconee 1)	Reactor	08/12/2014	NOV White SDP finding resulting in plant inspections
EA-14-092	Dominion Nuclear Connecticut, Inc. (Millstone 3)	Reactor	10/20/2014	NOV White SDP finding resulting in plant inspections
EA-14-094	FirstEnergy Nuclear Operating Co. (Davis-Besse)	Reactor	06/30/2014	Confirmatory order
EA-14-100	Calvert Cliffs Nuclear Power Plant, Inc. (Calvert Cliffs)	Reactor	10/27/2014	NOV White SDP finding resulting in plant inspections
EA-14-106	City of St. Peters, MO	Materials	08/19/2014	NOV SL III
EA-14-108	Diagnostic Imaging Centers, PA	Materials	08/26/2014	NOV SL III
EA-14-112	Southern Nuclear Operating Co., Inc. (Vogtle)	Reactor	08/06/2014	NOV White SDP finding resulting in plant inspections
EA-14-113	Kruger Technologies Inc.	Materials	10/28/2014	Confirmatory order result of an ADR mediation

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX V

Significant Enforcement Actions Issued (continued)

Action #	Name	Type	Issue Date	Enforcement Action
EA-14-115	Truman Medical Center	Materials	10/08/2014	NOV SL III
EA-14-116	Bradley D. Bastow, D.O.	Materials	11/06/2014	Problem/CP SL III - $7,000
EA-14-167	Kim Engineering	Materials	12/23/2014	NOV SL III
EA-14-187	Omaha Public Power District (Fort Calhoun)	Reactor	11/25/2014	NOV White SDP finding resulting in plant inspections
IA-12-045	Mr. Michael P. Cooley	Reactor	03/10/2014	Prohibition order
IA-13-012	Mr. Armando N. Clavero	Materials	05/13/2014	Prohibition order
IA-13-033	Mr. George Geisser, III	Materials	07/17/2014	Prohibition order
IA-13-055	Mr. John Amburgey	Reactor	01/13/2014	NOV SL III
IA-13-059	Mr. Richard B. Smith	Reactor	05/14/2014	Prohibition order
IA-13-064	Mr. Daniel L. Wilson	Reactor	04/29/2014	Prohibition order
IA-14-002	Mr. Lane McHugh	Reactor	02/24/2014	NOV SL III
IA-14-004	Mr. Douglas D. Stouffer	Reactor	04/14/2014	NOV SL III
IA-14-007	Mr. Trey Brattin	Materials	07/24/2014	NOV SL III
IA-14-014	Mr. Donald K. Brown	Reactor	07/09/2014	NOV SL III
IA-14-021	Mr. Gary Meekins	Reactor	07/09/2014	NOV SL III
IA-14-025	Mr. James Chaisson	Materials	07/11/2014	Prohibition order

Note: Reactor facilities in a decommissioning status are listed as materials licensees. The NRC report on issued significant enforcement actions can be found on the NRC Web site at www.nrc.gov/about-nrc/regulatory/enforcement/current.html.

Note: Data as of July 2015, and the next printed update will be August 2017.

APPENDIX W

Laws Governing the U.S. Nuclear Regulatory Commission

1. Atomic Energy Act of 1954, as amended (Pub. L. 83–703)
2. Energy Reorganization Act of 1974, as amended (Pub. L. 93–438)
3. Reorganization Plan No. 1 of 1980, 5 U.S.C., App 1.
4. Uranium Mill Tailings Radiation Control Act of 1978, as amended (Pub. L. 95–604)
5. Nuclear Non-Proliferation Act of 1978 (Pub. L. 95–242)
6. West Valley Demonstration Project Act of 1980 (Pub. L. 96–368)
7. Nuclear Waste Policy Act of 1982, as amended (Pub. L. 97–425)
8. Low-Level Radioactive Waste Policy Amendments Act of 1985 (Pub. L. 99–240)
9. Energy Policy Act of 1992 (Pub. L. 102–486)
10. Energy Policy Act of 2005 (Pub. L. 109–58)

Fundamental Laws Governing Civilian Uses of Radioactive Materials

Nuclear Materials and Facilities

1. Atomic Energy Act of 1954, as amended
2. Energy Reorganization Act of 1974, as amended
3. Reorganization Plan No. 1 of 1980

Radioactive Waste

1. Nuclear Waste Policy Act of 1982, as amended
2. Low-Level Radioactive Waste Policy Amendments Act of 1985
3. Uranium Mill Tailings Radiation Control Act of 1978

Nonproliferation

1. Nuclear Non-Proliferation Act of 1978

Fundamental Laws Governing the Processes of Regulatory Agencies

1. Administrative Procedure Act (5 U.S.C. Chapters 5 through 8)
2. National Environmental Policy Act

APPENDIX X

International Activities

CONVENTIONS AND TREATIES PERTAINING TO NUCLEAR SAFETY, SECURITY, AND INTERNATIONAL SAFEGAURDS*

1. Treaty on the Non-Proliferation of Nuclear Weapons, entry into force on March 5, 1970, United States (U.S.) is a party to the Treaty
2. Treaty for the Prohibition of Nuclear Weapons in Latin America (Tlatelolco Treaty), entry into force for each government individually, United States is a party to the specific protocols appended to the Treaty
3. Three to four other treaties specifying nuclear weapons-free zones in Africa, the South Pacific (Rarotonga), and Southeast Asia, including one being negotiated on the Middle East, the United States is only bound by specific protocols
4. Convention on Early Notification of a Nuclear Accident, entry into force October 27, 1986, United States is a party
5. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, entry into force February 26, 1987, U.S. is a party
6. Convention on Nuclear Safety, entry into force October 24, 1996, U.S. is a party
7. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, entry into force June 18, 2001, U.S. is a party
8. Convention on the Physical Protection of Nuclear Material (CPPNM), entry into force February 8, 1987, U.S. is a party
9. Amendment to the CPPNM, entry into force May 8, 2016, U.S. is a party
10. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, entry into force August 30, 1975, U.S. is a party (also to amendments in 1978 (incineration), 1978 (disputes), 1980 (list of substances), 1989 (procedures), 1993 (banning dumping into sea of low-level radioactive wastes), 1996 (protocol to replace the 1972 Convention with a more restrictive text regulating the use of the sea as a depository for waste materials)
11. Convention on Supplementary Compensation for Nuclear Damage
12. Agreement between the United States of America and the Agency for the Application of Safeguards in the United States of America (INFCIRC/288), entry into force December 9, 1980
13. Model Protocol Additional to the Agreement Between State(s) and the IAEA for the Application of Safeguards in Connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America (INFCIRC/366), entry into force April 6, 1989, U.S. is a party
14. Protocol Additional to the Agreement between the United States of America and the Agency for the Application of Safeguards in the United States of America (INFCIRC/288/Add. 1), entry into force January 6, 2009

* This excludes arms control agreements.

Note: Data as of July 2015, and the next printed update will be August 2017.

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX Y
International Activities

LIST OF THE NRC'S PARTICIPATION WITH MULTILATERAL ORGANIZATIONS

International Commission on Radiological Protection

International Atomic Energy Agency

- Commission on Safety Standards
  - Nuclear Safety Standards Committee
  - Radiation Safety Standards Committee
  - Transport Safety Standards Committee
  - Waste Safety Standards Committee
- Nuclear Security Guidance Committee

International Nuclear Regulators Association

Multinational Design Evaluation Program

Nuclear Energy Agency (NEA)

- NEA Steering Committee for Nuclear Energy
- Committee on Nuclear Regulatory Activities
  - Working Group on Inspection Practices
  - Working Group on Operating Experience
  - Working Group on Public Communication of Nuclear Regulatory Organisations
  - Working Group on the Regulation of New Reactors
  - Safety of Research Reactors Task Group
  - Senior-Level Task Group on Impacts of the Fukushima Accident
  - Task Group on Nonconforming, Counterfeit, Fraudulent, and Suspect Items
  - Task Group on Accident Management
- Committee on Radiation Protection and Public Health
  - Expert Group on the Implications of ICRP Recommendations
  - Expert Group on Occupational Exposure
  - Expert Group on the Public Health Perspective in Radiological Protection
  - Expert Group on the Radiological Protection Aspects of the Fukushima Accident
  - Expert Group on Radiological Protection Science
  - Working Party on Nuclear Emergency Matters

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

APPENDIX Y
International Activities

LIST OF THE NRC'S PARTICIPATION WITH MULTILATERAL ORGANIZATIONS (CONTINUED)

- Committee on the Safety of Nuclear Installations (CSNI)
  - CSNI Program Review Group
  - Working Group on Integrity and Ageing of Components and Structures
  - Working Group on Analysis and Management of Accidents
  - Working Group on Risk Assessment
  - Working Group on Human and Organisational Factors
  - Working Group on Fuel Safety
  - Working Group on Fuel Cycle Safety
- Radioactive Waste Management Committee
  - Forum on Stakeholder Confidence
  - Integration Group for the Safety Case of Radioactive Waste Repositories
  - Regulators' Forum
  - Working Party on Decommissioning and Dismantling

United Nations Scientific Committee on the Effects of Atomic Radiation

BILATERAL INFORMATION EXCHANGE AND COOPERATION AGREEMENTS WITH THE NRC

Agreement Country			
Argentina	Finland	Korea, Rep. of	Spain
Armenia	France	Lithuania	Sweden
Australia	Germany	Mexico	Switzerland
Belgium	Greece	Netherlands	Tecro (Taiwan)
Brazil	Hungary	Peru	Thailand
Bulgaria	India	Philippines	Turkey
Canada	Indonesia	Poland	Ukraine
China	Israel	Romania	United Arab Emirates
Croatia	Italy	Russia	United Kingdom
Czech Republic	Japan	Slovakia	Vietnam
Egypt	Jordan	Slovenia	
EURATOM	Kazakhstan	South Africa	

Note: The country's short-form name is used. NRC's technical arrangements are initiated and renewed for 5-year terms.
Data as of July 2015, and the next printed update will be August 2017.
EURATOM—The European Atomic Energy Community
Tecro (Taiwan) is the Taipei Economic and Cultural Representative Office in the United States.

APPENDIX Z

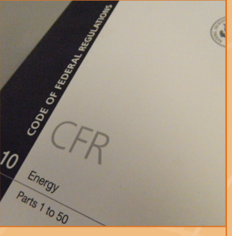
International Activities

LIST OF IMPORT AND EXPORT LICENSES

List of NRC Import and Export Licenses by Applicant and Docket Number issued can now be found at the Dataset Index Web page online at: http://www.nrc.gov/reading-rm/doc-collections/datasets

For the most recent information, go to the Dataset Index Web page at http://www.nrc.gov/reading-rm/doc-collections/datasets/.

A-Z



Glossary

Glossary (Abbreviations, Definitions, and Illustrations)

Agreement State

A U.S. State that has signed an agreement with the U.S. Nuclear Regulatory Commission authorizing the State to regulate certain uses of radioactive materials within the State.

Atomic energy

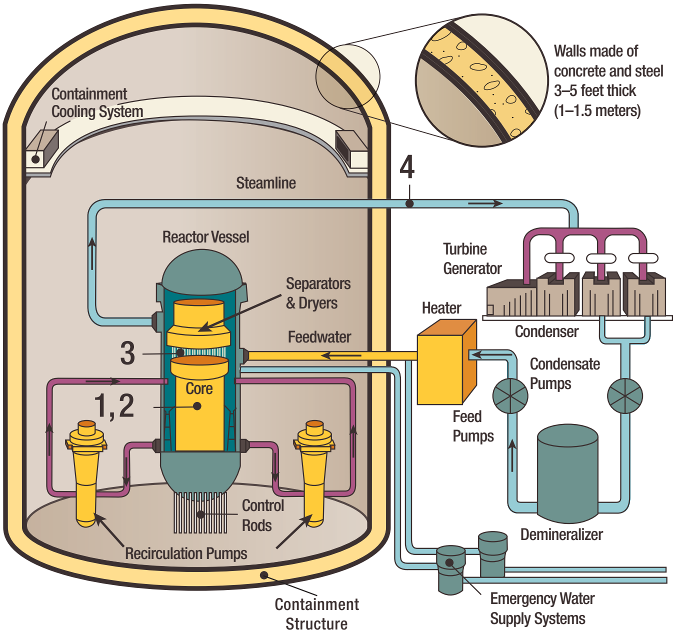
The energy that is released through a nuclear reaction or radioactive decay process. One kind of nuclear reaction is fission, which occurs in a nuclear reactor and releases energy, usually in the form of heat and radiation. In a nuclear power plant, this heat is used to boil water to produce steam that can be used to drive large turbines. The turbines drive generators to produce electrical power.

Background radiation

The natural radiation that is always present in the environment. It includes cosmic radiation that comes from the sun and stars, terrestrial radiation that comes from the Earth, and internal radiation that exists in all living things and enters organisms by ingestion or inhalation. The typical average individual exposure in the United States from natural background sources is about 310 millirems per year.

Boiling-water reactor (BWR)

A nuclear reactor in which water is boiled using heat released from fission. The steam released by boiling then drives turbines and generators to produce electrical power. BWRs operate similarly to electrical plants using fossil fuel, except that the BWRs are heated by nuclear fission in the reactor core.



How Nuclear Reactors Work

In a typical design concept of a commercial BWR, the following process occurs:

1. The nuclear fuel core inside the reactor vessel creates heat from nuclear fission.
2. A steam-water mixture is produced when very pure water (reactor coolant) moves upward through the core, absorbing heat.
3. The steam-water mixture leaves the top of the core and enters the two stages of moisture separation where water droplets are removed before the steam is allowed to enter the steamline.
4. The steam is piped to the main turbine, causing it to turn the turbine generator, which produces electricity.
5. The steam is exhausted to the condenser, where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps and pumped back to the reactor vessel.

The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps. These pumps and other operating systems in the plant receive their power from the electrical grid. If offsite power is lost, emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need electric power. BWRs contain between 370–800 fuel assemblies.

Brachytherapy

A medical procedure during which a sealed radioactive source (or sources) is implanted directly into a person being treated for cancer (usually of the mouth, breast, lung, prostate, ovaries, or uterus). The radioactive implant may be temporary or permanent, and the radiation kills cells in the tumor as long as the device remains in place and emits radiation. Brachytherapy uses radioisotopes, such as iridium-192 or iodine-125, which are regulated by the NRC and Agreement States.

Byproduct material

As defined by NRC regulations, byproduct material includes any radioactive material (except enriched uranium or plutonium) produced by a nuclear reactor, through the use of a particle accelerator, or any discrete source of radium-226 used for a commercial, medical, or research activity. It also includes the tailings or wastes produced by the extraction or concentration of uranium or thorium or the fabrication of fuel for nuclear reactors. In addition, the NRC, in consultation with the U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Department of Homeland Security, and others, can designate as byproduct material any source of naturally occurring radioactive material, other than source material, that it determines would pose a threat to public health and safety or the common defense and security of the United States.

Canister

See Dry cask storage.

Capability

The maximum load that a generating unit, generating station, or other electrical apparatus can carry under specified conditions for a given period of time without exceeding approved limits of temperature and stress.

Capacity

The amount of electric power that a generator, turbine transformer, transmission, circuit, or system is able to produce, as rated by the manufacturer.

Capacity factor

The ratio of the available capacity (the amount of electrical power actually produced by a generating unit) to the theoretical capacity (the amount of electrical power that could theoretically have been produced if the generating unit had operated continuously at full power) during a given time period.

Capacity utilization

A percentage that a generating unit fulfilled its capacity in generating electric power over a given time period. This percentage is defined as the margin between the unit's available capacity (the amount of electrical power the unit actually produced) and its theoretical capacity (the amount of electrical power that could have been produced if the unit had operated continuously at full power) during a certain time period. Capacity utilization is computed by dividing the amount of power actually produced by the theoretical capacity and multiplying by 100.

Cask

A heavily shielded container used for the dry storage or shipment (or both) of radioactive materials such as spent nuclear fuel or other high-level radioactive waste (HLW). Casks are often made from lead, concrete, and/or steel. Casks must meet regulatory requirements.

Categories of radiation sources

The categories for radiation sources are defined by NRC requirements and the IAEA's Code of Conduct on the Safety and Security of Radioactive Sources. This helps ensure that sufficient controls are being used to achieve safety and security.

- Category 1 sources, if not safely or securely managed, would be likely to cause permanent injury to a person who handled them or was otherwise in contact with them for more than a few minutes. It would probably be fatal to be close to this amount of unshielded material for a period of a few minutes to an hour. These sources are typically used in radiothermal generators, irradiators, and radiation teletherapy.

- Category 2 sources, if not safely or securely managed, could cause permanent injury to a person who handled them or was otherwise in contact with them for a short time (minutes to hours). It could possibly be fatal to be close to this amount of unshielded radioactive material for a period of hours to days. These sources are typically used in industrial gamma radiography, high- and medium-dose rate brachytherapy, and radiography.

- Category 3 sources, if not safely or securely managed, could cause permanent injury to a person who handled them or was otherwise in contact with them for hours. It could possibly—although it is unlikely—be fatal to be close to this amount of unshielded radioactive material for a period of days to weeks. These sources are typically used in fixed industrial gauges such as level gauges, dredger gauges, conveyor gauges, spinning pipe gauges, and well logging.

Categories of special nuclear material

The NRC categorizes special nuclear materials and the facilities that possess them into three categories based upon the materials' potential for use in nuclear weapons, or their "strategic significance." The three categories are:

- Category I, high strategic significance
- Category II, moderate strategic significance
- Category III, low strategic significance

The NRC's physical security and safeguards requirements differ by category, with Category I facilities subject to more stringent requirements because they pose greater security and safeguards risks.

Classified information

Information that has been determined pursuant to Executive Order to require protection against unauthorized disclosure and is marked to indicate its classified status when in documentary form. The NRC has two types of classified information. The first type, known as national security information, is information that is classified by an Executive Order. Its release would damage national security. The second type, known as restricted data, would assist individuals or organizations in designing, manufacturing, or using nuclear weapons. Access to both types of information is restricted to authorized persons who have been properly cleared and have a "need to know" the information to accomplish their official duties.

Combined license (COL)

An NRC-issued license that authorizes a licensee to construct and (with certain specified conditions) operate a nuclear power facility, such as a nuclear plant at a specific site.

Commercial Irradiator

A facility that uses high doses of radiation to sterilize or treat products, such as food and spices, medical supplies, and wood flooring. Irradiation can be used to eliminate harmful bacteria, germs, and insects or for hardening or other purposes. The radiation does not leave radioactive residue or make the treated products radioactive. Radiation sources include radioactive materials (e.g., cobalt-60), an x-ray machine, or an electron beam.

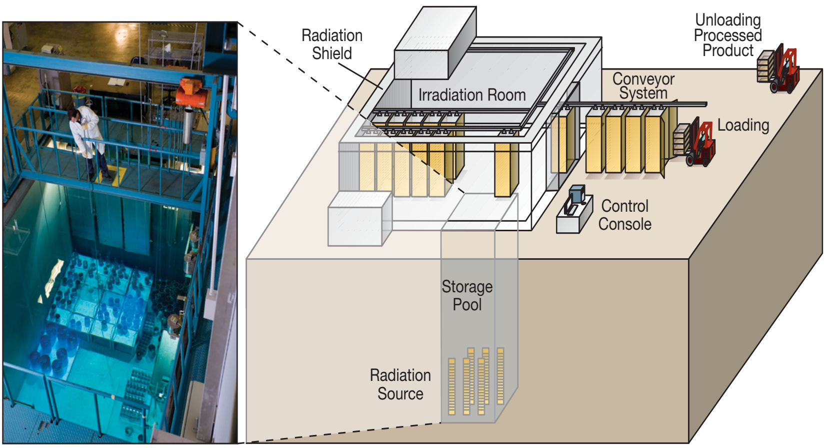


Photo courtesy: Nordion

Compact

A group of two or more U.S. States that have formed alliances to dispose of low-level radioactive waste (LLW).

Construction recapture

The maximum number of years that could be added to a nuclear power plant's license expiration date to recapture the period between the date the NRC issued the plant's construction permit and the date it granted an operating license. A licensee must submit an application to request this extension.

Containment structure

A resilient gas-tight shell or other enclosure around a nuclear reactor to confine fission products that otherwise might be released to the atmosphere in the event of a severe reactor accident. Such enclosures are usually dome-shaped and made of steel-reinforced concrete.

Contamination

Undesirable radiological, chemical, or biological material (with a potentially harmful effect) that is either airborne or deposited in (or on the surface of) structures, objects, soil, water, or living organisms.

Criticality

The condition involving fission of nuclear materials when the number of neutrons produced equals or exceeds the nuclear containment. During normal reactor operations, nuclear fuel sustains a fission chain reaction or criticality. A reactor achieves criticality (and is said to be critical) when each fission event releases a sufficient number of neutrons to sustain an ongoing series of reactions.

Decommissioning

The process of safely closing a nuclear power plant (or other facility where nuclear materials are handled) to retire it from service after its useful life has ended. This process primarily involves decontaminating the facility to reduce residual radioactivity and then releasing the property for unrestricted or (under certain conditions) restricted use. This often includes dismantling the facility or dedicating it to other purposes. *See ENTOMB and SAFSTOR.*

DECON

A phase of reactor decommissioning in which structures, systems, and components that contain radioactive contamination are removed from a site and safely disposed of at a commercially operated low-level waste (LLW) disposal facility or decontaminated to a level that permits the site to be released for unrestricted use.

Decontamination

A process used to reduce, remove, or neutralize radiological, chemical, or biological contamination to reduce the risk of exposure. Decontamination may be accomplished by cleaning or treating surfaces to reduce or remove the contamination, filtering contaminated air or water, or subjecting contamination to evaporation and precipitation. The process can also simply allow adequate time for radioactive decay to decrease the radioactivity.

Defense-in-depth

An approach to designing and operating nuclear facilities that prevents and mitigates accidents that release radiation or hazardous materials. The key is creating multiple independent and redundant layers of controls or design features to compensate for potential human and mechanical failures so that no single control, no matter how robust, is exclusively relied upon to achieve safety or security. Defense-in-depth includes the use of access controls, physical barriers, redundant and diverse key safety functions, and emergency response measures.

Depleted uranium

Uranium with a percentage of uranium-235 lower than the 0.7 percent (by mass) contained in natural uranium. Depleted uranium is the byproduct of the uranium enrichment process. Depleted uranium can be blended with highly enriched uranium, such as that from weapons, to make reactor fuel.

Design-basis threat (DBT)

A description of the type, composition, and capabilities of an adversary that a security system is designed to protect against. The NRC uses the DBT as a basis for designing safeguards systems to protect against acts of radiological sabotage and to prevent the theft of special nuclear material. Certain nuclear facility licensees are required to defend against the DBT.

Design certification

Certification and approval by the NRC of a standard nuclear power plant design independent of a specific site or an application to construct or operate a plant. A design certification is valid for 15 years from the date of issuance but can be renewed for an additional 10 to 15 years.

Dose (radiation)

The National Council on Radiation Protection and Measurements estimates that an average person in the United States receives a total annual dose of about 0.62 rem (620 millirem) from all radiation sources, a level that has not been shown to cause humans any harm. Of this total, natural background sources of radiation—including radon and thoron gas, natural radiation from soil and rocks, radiation from space, and radiation sources that are found naturally within the human body—account for about 50 percent. Medical procedures such as computed tomography (CT) scans and nuclear medicine account for about another 48 percent. Other small contributors of exposure to the U.S. population include consumer products and activities, industrial and research uses, and occupational tasks. The maximum permissible yearly dose for a person working with or around nuclear material is 5 rem.

Dry cask storage

A method for storing spent nuclear fuel in special containers known as dry casks. After fuel has been cooled in a spent fuel pool, dry cask storage allows spent fuel assemblies to be sealed in casks and surrounded by inert gas. They are welded or bolted closed, and each cask includes steel, concrete, lead, or other material to provide leak-tight containment and radiation shielding. The casks may store fuel horizontally or vertically.

Early site permit (ESP)

A permit granted by the NRC to approve one or more proposed sites for a nuclear power facility, independent of a specific nuclear plant design or an application for a construction permit or COL. An ESP is valid for 10 to 20 years but can be renewed for an additional 10 to 20 years.

Economic Simplified Boiling-Water Reactor (ESBWR)

A 4,500-megawatt thermal nuclear reactor design, which has passive safety features and uses natural circulation (with no recirculation pumps or associated piping) for normal operation. The NRC certified the ESWBR standard design submitted by GE-Hitachi Nuclear Energy (GEH) on October 15, 2014.

Efficiency, plant

The percentage of the total energy content of a power plant's thermal energy that is converted into electricity. The remaining energy is lost to the environment as heat.

Electric power grid

A system of synchronized power providers and consumers, connected by transmission and distribution lines and operated by one or more control centers. In the continental United States, the electric power grid consists of three systems—the Eastern Interconnect, the Western Interconnect, and the Texas Interconnect. In Alaska and Hawaii, several systems encompass areas smaller than the State.

Electric utility

A corporation, agency, authority, person, or other legal entity that owns or operates facilities within the United States, its territories, or Puerto Rico for the generation, transmission, distribution, or sale of electric power (primarily for use by the public). Facilities that qualify as cogenerators or small power producers under the Public Utility Regulatory Policies Act are not considered electric utilities.

Emergency classifications

Sets of plant conditions that indicate various levels of risk to the public and that might require response by an offsite emergency response organization to protect citizens near the site.

Emergency preparedness (EP)

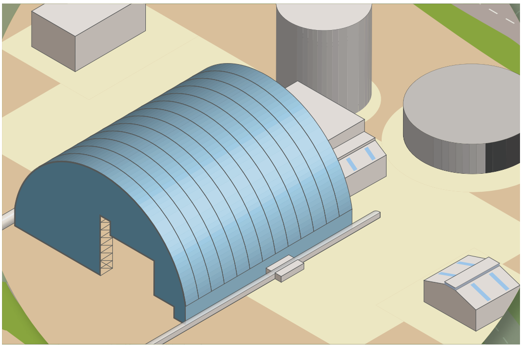
The programs, plans, training, exercises, and resources used to prepare for and rapidly identify, evaluate, and respond to emergencies, including those arising from terrorism or natural events such as hurricanes. EP strives to ensure that operators of nuclear power plants and certain fuel cycle facilities can implement measures to protect public health and safety in the event of a radiological emergency. Licensees who operate certain nuclear facilities, such as nuclear power plants, must develop and maintain EP plans that meet NRC requirements.

Energy Information Administration (EIA)

The agency, within the U.S. Department of Energy, that provides policy-neutral statistical data, forecasts, and analyses to promote sound policymaking, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment.

Enrichment
See Uranium enrichment.

ENTOMB
A method of decommissioning a nuclear power plant, in which radioactive contaminants are encased in a structurally long-lived material, such as concrete. The entombed structure is maintained and surveillance is continued until the radioactive waste decays to a level permitting termination of the license and unrestricted release of the property.



Event Notification System
An automated system used by the NRC to document incoming notifications of significant nuclear events with an actual or potential effect on the health and safety of the public and the environment. Significant events are reported to the NRC by licensees, Agreement States, other Federal agencies, the public, and other countries.

Exposure (radiation)
Absorption of ionizing radiation or the amount of a hazardous substance that has been ingested, inhaled, or contacted the skin. Acute exposure occurs over a short period of time. Chronic exposure is exposure received over a long period of time, such as during a lifetime. *See Occupational dose.*

Federal Emergency Management Agency (FEMA)
A component of the U.S. Department of Homeland Security responsible for protecting the Nation and reducing the loss of life and property from all hazards such as natural disasters and acts of terrorism. FEMA leads and supports a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.

Federal Energy Regulatory Commission (FERC)
An independent agency that regulates the interstate transmission of electricity, natural gas, and oil. FERC also regulates and oversees hydropower projects and the construction of liquefied natural gas terminals and interstate natural gas pipelines. FERC protects the economic, environmental, and safety interests of the American public, while working to ensure abundant, reliable energy in a fair, competitive market.

Fiscal year (FY)

The 12-month period from October 1 through September 30 used by the Federal Government for budget formulation and execution. The FY is designated by the calendar year in which it ends; for example, FY 2016 runs from October 1, 2015, through September 30, 2016.

Fissile material

A nuclide that is capable of undergoing fission after capturing neutrons. Although sometimes used as a synonym for fissionable material, this term has acquired its more restrictive interpretation with the limitation that the nuclide must be fissionable by thermal neutrons. With that interpretation, the three primary fissile materials are uranium-233, uranium-235, and plutonium-239. This definition excludes natural uranium and depleted uranium that have not been irradiated or have only been irradiated in thermal reactors.

Fission

The splitting of an atom, which releases a considerable amount of energy (usually in the form of heat). Fission may be spontaneous but is usually caused by the nucleus of an atom becoming unstable (or "heavy") after capturing or absorbing a neutron. During fission, the nucleus splits into roughly equal parts, producing the nuclei of at least two lighter elements. In addition to energy, this reaction usually releases gamma radiation and two or more daughter neutrons.

Force-on-force

A type of security exercise designed to evaluate and improve the effectiveness of a security system. For the NRC, force-on-force exercises are used to assess the ability of the licensee to defend a nuclear power plant and other nuclear facilities against a design-basis threat (DBT).

Foreign Assignee Program

An on-the-job training program sponsored by the NRC for assignees from other countries, usually under bilateral information exchange arrangements with their respective regulatory organizations. The assignees' regulatory authorities generally identify the individuals participating and pay their salaries.

Freedom of Information Act (FOIA)

A Federal law that requires Federal agencies to provide, upon written request, access to records or information. Some material is exempt from FOIA, and FOIA does not apply to records that are maintained by State and local governments, Federal contractors, grantees, or private organizations or businesses.

Fuel assembly (fuel bundle, fuel element)

A structured group of fuel rods (long, slender, metal tubes containing pellets of fissionable material, which provide fuel for nuclear reactors). Depending on the design, each reactor core may have dozens of fuel assemblies (also known as fuel bundles), each of which contains dozens of fuel rods.

Fuel cycle

The series of steps involved in supplying fuel for nuclear power reactors. The uranium fuel cycle includes the following:

- uranium recovery to extract and concentrate the uranium to produce yellowcake
- conversion of yellowcake into uranium hexafluoride (UF_6)
- enrichment to increase the concentration of uranium in UF_6
- fuel fabrication to convert enriched UF_6 into fuel for nuclear reactors
- use of the fuel in reactors (nuclear power research or naval propulsion)
- interim storage of spent nuclear fuel
- reprocessing of spent fuel to recover the fissionable material remaining in the spent fuel (currently not done in the United States)
- final disposition disposal of high-level radioactive waste
- transportation of the uranium in all forms including spent fuel

The NRC regulates these processes, as well as the fabrication of mixed-oxide (MOX) nuclear fuel, which is a combination of uranium and plutonium oxides.

Fuel reprocessing (recycling)

The processing of reactor fuel to separate the unused fissionable material from waste material. Reprocessing extracts uranium and plutonium from spent nuclear fuel so they can be used again as reactor fuel. Commercial reprocessing is not practiced in the United States, although it has been in the past. However, the U.S. Department of Energy operates reprocessing facilities such as in Hanford, WA, and Savannah River, SC, for national defense purposes.

Fuel rod

A long, slender, zirconium metal tube containing pellets of fissionable material, which provide fuel for nuclear reactors. Fuel rods are assembled into bundles called fuel assemblies, which are loaded individually into the reactor core.

Full-time equivalent (FTE)

A human resources measurement equal to one person working full time for 1 year.

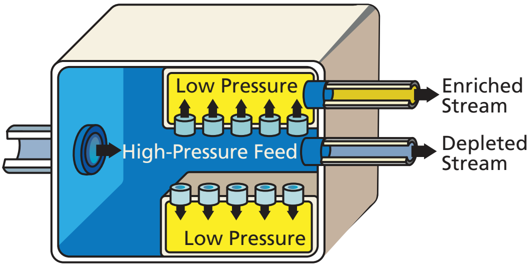
Gas centrifuge

Uranium enrichment technology that uses many rotating cylinders that are connected in long lines to increase the concentration of uranium-235. Gas is placed in the cylinder, which spins at a high speed, creating a strong centrifugal force. Heavier gas molecules move to the cylinder wall, while lighter molecules collect near the center. The stream, slightly enriched, is fed into the next cylinder. The depleted stream is recycled back into the previous cylinder.

Gas chromatography

An analytical technique for separating chemical substances from a mixed sample by passing the sample, carried by a moving stream of gas, through a tube packed with a finely divided solid that may be coated with a liquid film. Gas chromatography devices are used to analyze air pollutants, blood alcohol content, essential oils, and food products.

Gaseous diffusion



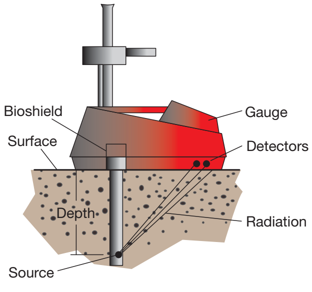
A uranium enrichment process used to increase the concentration of uranium-235 in uranium for use in fuel for nuclear reactors by separating its isotopes (as gases) based on their slight difference in mass. (Lighter isotopes diffuse faster through a porous membrane or vessel than do heavier isotopes.) This process involves filtering UF_6 gas to separate uranium-234 and uranium-235 from uranium-238, increasing the percentage of uranium-235.

In May 2013, the last remaining gaseous diffusion plant in operation in the United States in Paducah, KY, shut down. A similar plant near Piketon, OH, was closed in March 2001. Another plant in Oak Ridge, TN. closed years ago and was not regulated by the NRC.

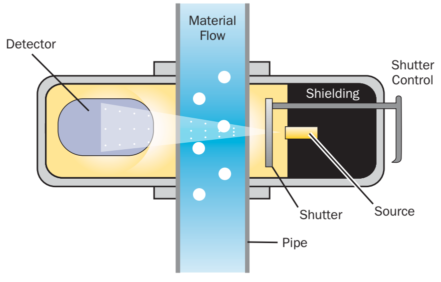
Gauging devices

Devices used to measure, monitor, and control the thickness of sheet metal, textiles, paper napkins, newspaper, plastics, photographic film, and other products as they are manufactured. Gauges mounted in fixed locations are designed for measuring or controlling material density, flow, level, thickness, or weight. The gauges contain sealed sources that radiate through the substance being measured to a readout or controlling device. Portable gauging devices, such as moisture density gauges, are used at field locations. These gauges contain a gamma-emitting sealed source, usually cesium-137, or a sealed neutron source, usually americium-241 and beryllium.

Moisture Density Gauge



Fixed Fluid Gauge



Generation (gross)

The total amount of electric energy produced by a power generating station, as measured at the generator terminals.

Generation (net)

The gross amount of electric energy produced by a generating station, minus the amount used to operate the station. Net generation is usually measured in watthours.

Generator capacity

The maximum amount of electric energy that a generator can produce (from the mechanical energy of the turbine), adjusted for ambient conditions. Generator capacity is commonly expressed in megawatts (MW).

Geological repository

An excavated, underground facility that is designed, constructed, and operated for safe and secure permanent disposal of high-level radioactive waste (HLW). A geological repository uses an engineered barrier system and a portion of the site's natural geology, hydrology, and geochemical systems to isolate the radioactivity of the waste.

Gigawatt (GW)

A unit of power equivalent to one billion (1,000,000,000) watts.

Gigawatthour (GWh)

One billion (1,000,000,000) watthours.

Grid

See Electric power grid.

Half-life (radiological)

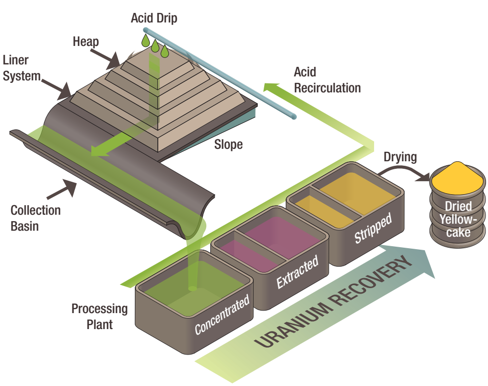
The time required for half the atoms of a particular radioactive material to decay. A specific half-life is a characteristic property of each radioisotope. Measured half-lives range from millionths of a second to billions of years, depending on the stability of the nucleus. Radiological half-life is related to, but different from, biological half-life and effective half-life.

Health physics

The science concerned with recognizing and evaluating the effects of ionizing radiation on the health and safety of people and the environment, monitoring radiation exposure, and controlling the associated health risks and environmental hazards to permit the safe use of technologies that produce ionizing radiation.

Heap leach recovery process

A method for extracting uranium from ore. The ore is placed in piles or heaps on top of liners. The liners prevent uranium and other chemicals from moving into the ground. Sulfuric acid is dripped onto the heap and dissolves uranium as it moves through the ore. Uranium solution drains into collection basins, where it is piped to a processing plant. At the plant, uranium is extracted, concentrated, and dried to form yellowcake.



High-level radioactive waste (HLW)

The highly radioactive materials produced as byproducts of fuel reprocessing or of the reactions that occur inside nuclear reactors. HLW includes the following:

- irradiated spent nuclear fuel discharged from commercial nuclear power reactors
- highly radioactive liquid and solid materials resulting from the reprocessing of spent nuclear fuel, which contains fission products in concentration including some reprocessed HLW from defense activities and a small quantity of reprocessed commercial HLW
- other highly radioactive materials that the Commission may determine require permanent isolation

Highly (or high-) enriched uranium

Uranium enriched to at least 20 percent uranium-235 (a higher concentration than exists in natural uranium ore).

In situ recovery (ISR)

A common method currently used to extract uranium from ore bodies without physical excavation of the ore. ISR is also known as “solution mining” or in situ leaching.

Incident response

Activities that address the short-term, direct effects of a natural or human-caused event and require an emergency response to protect life or property.

Independent spent fuel storage installation (ISFSI)

A complex designed and constructed for the interim storage of spent nuclear fuel; solid, reactor-related, greater-than-Class-C waste; and other associated radioactive materials. A spent fuel storage facility may be considered independent, even if it is located on the site of another NRC-licensed facility.

International Atomic Energy Agency (IAEA)

A United Nations agency established in 1957 to serve as a world center of cooperation in the nuclear field. The agency works with nearly 170 member States and multiple partners worldwide to promote safe, secure, and peaceful nuclear technology.

International Nuclear Regulators Association

An association established in January 1997 to give national nuclear regulators with mature civilian nuclear reactor and materials programs a forum to discuss nuclear safety and security issues of mutual interest. Canada, France, Japan, the Republic of South Korea, Spain, Sweden, the United Kingdom, and the United States are members.

Irradiation

Exposure to ionizing radiation. Irradiation may be intentional, such as in cancer treatments or in sterilizing medical instruments. Irradiation may also be accidental, such as from exposure to an unshielded source. Irradiation does not usually result in radioactive contamination, but damage can occur, depending on the dose received.

Isotope

Two or more forms (or atomic configurations) of a given element that have identical atomic numbers (the same number of protons in their nuclei) and the same or very similar chemical properties but different atomic masses (different numbers of neutrons in their nuclei) and distinct physical properties. Thus, carbon-12, carbon-13, and carbon-14 are isotopes of the element carbon, and the numbers denote the approximate atomic masses. Among their distinct physical properties, some isotopes (known as radioisotopes) are radioactive, because their nuclei are unstable and emit radiation as they decay spontaneously toward a more stable nuclear configuration. For example, carbon-12 and carbon-13 are stable, but carbon-14 is unstable and radioactive.

Kilowatt (kW)

A unit of power equivalent to 1,000 watts.

Licensed material

Source material, byproduct material, or special nuclear material that is received, possessed, used, transferred, or disposed of under a general or specific license issued by the NRC or Agreement States and is not otherwise exempt from regulation.

Licensee

A company, organization, institution, or other entity to which the NRC or an Agreement State has granted a general or specific license to construct or operate a nuclear facility, or to receive, possess, use, transfer, or dispose of source, byproduct, or special nuclear material.

Licensing basis

The collection of documents or technical criteria that provides the basis upon which the NRC issues a license to construct or operate a nuclear facility; to conduct operations involving the emission of radiation; or to receive, possess, use, transfer, or dispose of source, byproduct, or special nuclear material.

Light-water reactor

A term used to describe reactors using ordinary water as a moderated coolant, including boiling-water reactors (BWRs) and pressurized-water reactors (PWRs), the most common types used in the United States.

Low-level radioactive waste (LLW)

A general term for a wide range of waste that is contaminated with radioactive material or has become radioactive through exposure to neutron radiation. A variety of industries, hospitals and medical institutions, educational and research institutions, private or government laboratories, and nuclear fuel cycle facilities generate LLW. Some examples include radioactively contaminated protective shoe covers and clothing; cleaning rags, mops, filters, and reactor water treatment residues; equipment and tools; medical tubes, swabs, and hypodermic syringes; and carcasses and tissues from laboratory animals.

Loss-of-coolant accident (LOCA)

A potential accident in which a breach in a reactor's pressure boundary causes the coolant water to rush out of the reactor faster than makeup water can be added back in. Without sufficient coolant, the reactor core could heat up and potentially melt the zirconium fuel cladding, causing a major release of radioactivity.

Megawatt (MW)

A unit of power equivalent to 1,000,000 watts.

Megawatt-hour (MWh)

A unit equals 1,000 kilowatts of electricity used continuously for 1 hour.

Metric ton

About 2,200 pounds.

Mill tailings

Primarily, the solid residue from a conventional uranium recovery facility in which uranium or thorium ore is crushed and processed mechanically or chemically to recover the uranium, thorium, or other valuable materials. This naturally radioactive ore residue contains the radioactive decay products from the uranium chains (mainly the uranium-238 chain). Although the milling process recovers about 93 percent of the uranium, the "tailings" contain several naturally occurring radioactive elements, including uranium, thorium, radium, polonium, and radon as well as heavy metals and other constituents.

Mixed-oxide (MOX) fuel

A type of nuclear reactor fuel that contains plutonium oxide mixed with either natural or depleted uranium oxide, in ceramic pellet form. This differs from conventional nuclear fuel, which is made of uranium oxide before it is irradiated in a reactor. Using plutonium reduces the amount of enriched uranium needed to produce a controlled reaction in commercial light-water reactors. However, plutonium exists only in trace amounts in nature and, therefore, must be produced by neutron irradiation of uranium-238 or obtained from other manufactured sources. As directed by Congress, the NRC regulates the fabrication of MOX fuel by DOE, a program that is intended to dispose of plutonium from excess nuclear weapons.

Monitoring of radiation

Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination in a region. Radiation monitoring is a safety measure to protect the health and safety of the public and the environment through the use of bioassay, alpha scans, and other radiological survey methods to monitor air, surface water and ground water, soil and sediment, equipment surfaces, and personnel.

National Response Framework

The guiding principles, roles, and structures that enable all domestic incident response partners to prepare for and provide a unified national response to disasters and emergencies. It describes how the Federal Government, States, Tribes, communities, and the private sector work together to coordinate a national response. The framework, which became effective March 22, 2008, builds upon the National Incident Management System, which provides a template for managing incidents.

National Source Tracking System (NSTS)

A secure, Web-based data system that helps the NRC and its Agreement States track and regulate the medical, industrial, and academic uses of certain nuclear materials, from the time they are manufactured or imported to the time of their disposal or exportation. This information enhances the ability of the NRC and Agreement States to conduct inspections and investigations, communicate information to other government agencies, and verify the ownership and use of nationally tracked sources.

Natural uranium

Uranium containing the relative concentrations of isotopes found in nature: 0.7 percent uranium-235, 99.3 percent uranium-238, and a trace amount of uranium-234 by mass. In terms of radioactivity, however, natural uranium contains about 2.2 percent uranium-235, 48.6 percent uranium-238, and 49.2 percent uranium-234. Natural uranium can be used as fuel in nuclear reactors or as feedstock for uranium enrichment facilities.

Net electric generation

The gross amount of electric energy produced by a generating station, minus the amount used to operate the station. Note: Electricity required for pumping at pumped-storage plants is regarded as electricity for station operation and is deducted from gross generation. Net electric generation is measured in watthours, except as otherwise noted.

Nonpower reactor (research and test reactor)

A nuclear reactor that is used for research, training, or development purposes (which may include producing radioisotopes for medical and industrial uses) but has no role in producing electrical power. These reactors, which are also known as research and test reactors, contribute to almost every field of science, including physics, chemistry, biology, medicine, geology, archeology, and ecology.

NRC Headquarters Operations Center

The primary center of communication and coordination among the NRC, its licensees, State and Tribal agencies, and other Federal agencies regarding operating events involving nuclear reactors or materials. Located in Rockville, MD, the Headquarters Operations Center is staffed 24 hours a day by employees trained to receive and evaluate event reports and coordinate incident response activities.

Nuclear energy

See Atomic energy.

Nuclear Energy Agency (NEA)

A specialized agency within the Organisation for Economic Co-operation and Development (OECD), which was created to assist its member countries in maintaining and further developing the scientific, technological, and legal bases for safe, environmentally friendly, and economical use of nuclear energy for peaceful purposes. The NEA's current membership consists of 31 countries in Europe, North America, and the Asia-Pacific region, which account for about 86 percent of the world's installed nuclear capacity.

Nuclear fuel

Fissionable material that has been enriched to a composition that will support a self-sustaining fission chain reaction when used to fuel a nuclear reactor, thereby releasing energy (usually in the form of heat or useful radiation) for use in other processes.

Nuclear materials

See Special nuclear material, Source material, and Byproduct material.

Nuclear Material Management and Safeguards System (NMMSS)

A centralized U.S. Government database used to track and account for source and special nuclear material. The system contains current and historical data on the possession, use, and shipment of source and special nuclear material within the United States, as well as all exports and imports of such material. The database is jointly funded by the NRC and DOE and is operated under a DOE contract.

Nuclear poison (or neutron poison)

In reactor physics, a substance (other than fissionable material) that has a large capacity for absorbing neutrons in the vicinity of the reactor core. This effect may be undesirable in some reactor applications, because it may prevent or disrupt the fission chain reaction, thereby affecting normal operation. However, neutron-absorbing materials (commonly known as “poisons”) are intentionally inserted into some types of reactors to decrease the reactivity of their initial fresh fuel load for fuel intended to achieve higher burnup levels during the fuel cycle. Adding poisons, such as control rods or boron, is described as adding “negative reactivity” to the reactor.

Nuclear power plant

A thermal power plant, in which the energy (heat) released by the fissioning of nuclear fuel is used to boil water to produce steam. The steam spins the propeller-like blades of a turbine that turns the shaft of a generator to produce electricity. Of the various nuclear power plant designs, pressurized-water reactors (PWRs) and boiling-water reactors (BWRs) are in commercial operation in the United States. These facilities generate about 20 percent of U.S. electrical power.

Nuclear and Radiological Incident Annex

An annex to the National Response Framework, which provides for a timely, coordinated response by Federal agencies to nuclear or radiological accidents or incidents within the United States. This annex covers radiological dispersal devices and improvised nuclear devices, as well as accidents involving commercial reactors or weapons production facilities, lost radioactive sources, transportation accidents involving radioactive material, and foreign accidents involving nuclear or radioactive material.

Nuclear reactor

The heart of a nuclear power plant or nonpower reactor, in which nuclear fission may be initiated and controlled in a self-sustaining chain reaction to generate energy or produce useful radiation. Although there are many types of nuclear reactors, they all incorporate certain essential features, including the use of fissionable material as fuel, a moderator (such as water) to increase the likelihood of fission (unless reactor operation relies on fast neutrons), a reflector to conserve escaping neutrons, coolant provisions for heat removal, instruments for monitoring and controlling reactor operation, and protective devices (such as control rods and shielding).

Nuclear waste

A subset of radioactive waste that includes unusable byproducts produced during the various stages of the nuclear fuel cycle, including extraction, conversion, and enrichment of uranium; fuel fabrication; and use of the fuel in nuclear reactors. Specifically, these stages produce a variety of nuclear waste materials, including uranium mill tailings, depleted uranium, and spent (depleted) fuel, all of which are regulated by the NRC. (By contrast, "radioactive waste" is a broader term, which includes all wastes that contain radioactivity, regardless of how they are produced. It is not considered "nuclear waste," because it is not produced through the nuclear fuel cycle and is generally not regulated by the NRC.)

Occupational dose

The internal and external dose of ionizing radiation received by workers in the course of employment in such areas as fuel cycle facilities, industrial radiography, nuclear medicine, and nuclear power plants. These workers are exposed to varying amounts of radiation, depending on their jobs and the sources with which they work. The NRC requires its licensees to limit occupational exposure to 5,000 mrem (50 millisieverts) per year. Occupational dose does not include the dose received from natural background sources, doses received as a medical patient or participant in medical research programs, or "second-hand doses" to members of the public received through exposure to patients treated with radioactive materials.

Organisation for Economic Co-operation and Development (OECD)

An intergovernmental organization (based in Paris, France) that provides a forum for discussion and cooperation among the governments of industrialized countries committed to democracy and the market economy. The primary goal of OECD and its member countries is to support sustainable economic growth, boost employment, raise living standards, maintain financial stability, assist other countries' economic development, and contribute to growth in world trade. In addition, OECD is a reliable source of comparable statistics and economic and social data. OECD also monitors trends, analyzes and forecasts economic developments, and researches social changes and evolving patterns in trade, environment, agriculture, technology, taxation, and other areas.

Orphan sources (unwanted radioactive material)

Sealed sources of radioactive material contained in a small volume (but not radioactively contaminated soils and bulk metals) in any one or more of the following conditions:

- an uncontrolled condition that requires removal to protect public health and safety from a radiological threat
- a controlled or uncontrolled condition, for which a responsible party cannot be readily identified
- a controlled condition, compromised by an inability to ensure the continued safety of the material (e.g., the licensee may have few or no options to provide for safe disposition of the material)
- an uncontrolled condition, in which the material is in the possession of a person who did not seek, and is not licensed, to possess it
- an uncontrolled condition, in which the material is in the possession of a State radiological protection program solely to mitigate a radiological threat resulting from one of the above conditions, and for which the State does not have the necessary means to provide for the appropriate disposition of the material

Outage

The period during which a generating unit, transmission line, or other facility is out of service. Outages may be forced or scheduled and full or partial.

Outage (forced)

The shutdown of a generating unit, transmission line, or other facility for emergency reasons, or a condition in which the equipment is unavailable as a result of an unanticipated breakdown. An outage (whether full, partial, or attributable to a failed start) is considered "forced" if it could not reasonably be delayed beyond 48 hours from identification of the problem, if there had been a strong commercial desire to do so. In particular, the following problems may result in forced outages:

- any failure of mechanical, fuel handling, or electrical equipment or controls within the generator's ownership or direct responsibility (i.e., from the point the generator is responsible for the fuel through to the electrical connection point)
- a failure of a mine or fuel transport system dedicated to that power station with a resulting fuel shortage that cannot be economically managed
- inadvertent or operator error
- limitations caused by fuel quality

Forced outages do not include scheduled outages for inspection, maintenance, or refueling.

Outage (full forced)

A forced outage that causes a generating unit to be removed from the committed state (when the unit is electrically connected and generating or pumping) or the available state (when the unit is available for dispatch as a generator or pump but is not electrically connected and not generating or pumping). Full-forced outages do not include failed starts.

Outage (scheduled)

The shutdown of a generating unit, transmission line, or other facility for inspection, maintenance, or refueling, which is scheduled well in advance (even if the schedule changes). Scheduled outages do not include forced outages and could be deferred if there were a strong commercial reason to do so.

Pellet, fuel

A thimble-sized ceramic cylinder (about 3/8-inch in diameter and 5/8-inch in length), consisting of uranium (typically uranium oxide), which has been enriched to increase the concentration of uranium-235 (U-235) to fuel a nuclear reactor. Modern reactor cores in PWRs and BWRs may contain up to 10 million pellets, stacked in the fuel rods that form fuel assemblies.

Performance-based regulation

A regulatory approach that focuses on desired, measurable outcomes, rather than prescriptive processes, techniques, or procedures. Performance-based regulation leads to defined results without specific direction regarding how those results are to be obtained. At the NRC, performance-based regulatory actions focus on identifying performance measures that ensure an adequate safety margin and offer incentives for licensees to improve safety without formal regulatory intervention by the agency.

Performance indicator

A quantitative measure of a particular attribute of licensee performance that shows how well a plant is performing when measured against established thresholds. Licensees submit their data quarterly; the NRC regularly conducts inspections to verify the submittals and then uses its own inspection data plus the licensees' submittals to assess each plant's performance.

Possession-only license

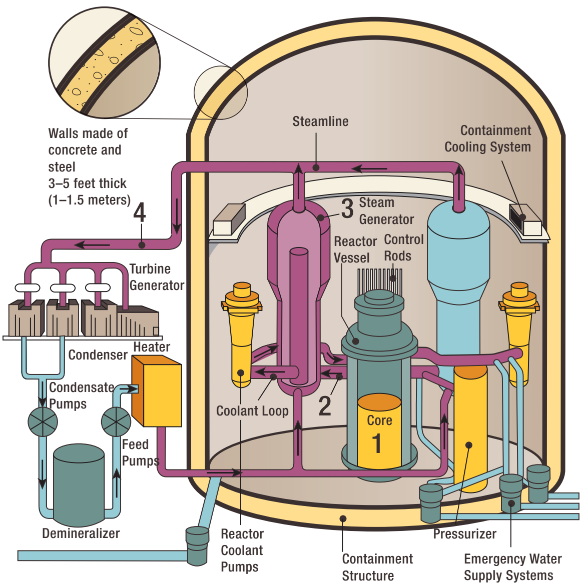
A license, issued by the NRC, that authorizes the licensee to possess specific nuclear material but does not authorize its use or the operation of a nuclear facility.

Power uprate

The process of increasing the maximum power level at which a commercial nuclear power plant may operate. This power level, regulated by the NRC, is included in the plant's operating license and technical specifications. A licensee may only change its maximum power output after the NRC approves an uprate application. The NRC analyses must demonstrate that the plant could continue to operate safely with its proposed new configuration. When all requisite conditions are fulfilled, the NRC may grant the power uprate by amending the plant's operating license and technical specifications.

Pressurized-water reactor (PWR)

A common nuclear power reactor design in which very pure water is heated to a very high temperature by fission, kept under high pressure (to prevent it from boiling), and converted to steam by a steam generator (rather than by boiling, as in a BWR). The resulting steam is used to drive turbines, which activate generators to produce electrical power. A PWR essentially operates like a pressure cooker, where a lid is tightly placed over a pot of heated water, causing the pressure inside to increase as the temperature increases (because the steam cannot escape) but keeping the water from boiling at the usual 212 degrees Fahrenheit (100 degrees Celsius). About two-thirds of the operating nuclear reactor power plants in the United States are PWRs.



How Nuclear Reactors Work

In a typical design concept of a commercial PWR, the following process occurs:

1. The core inside the reactor vessel creates heat.
2. Pressurized water in the primary coolant loop carries the heat to the steam generator.
3. Inside the steam generator, heat from the primary coolant loop vaporizes the water in a secondary loop, producing steam.
4. The steamline directs the steam to the main turbine, causing it to turn the turbine generator, which produces electricity.

The unused steam is exhausted to the condenser, where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the steam generator. The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps. These pumps and other operating systems in the plant receive their power from the electrical grid. If offsite power is lost, emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need electric power. PWRs contain between 150–200 fuel assemblies.

Probabilistic risk assessment (PRA)

A systematic method for assessing three questions that the NRC uses to define "risk." These questions consider (1) what can go wrong, (2) how likely it is to happen, and (3) what the consequences might be. These questions allow the NRC to understand likely outcomes, sensitivities, areas of importance, system interactions, and areas of uncertainty, which the staff can use to identify risk-significant scenarios. The NRC uses PRA to determine a numeric estimate of risk to provide insights into the strengths and weaknesses of the design and operation of a nuclear power plant.

Production expense

Production expense is one component of the cost of generating electric power, which includes costs associated with fuel, as well as plant operation and maintenance.

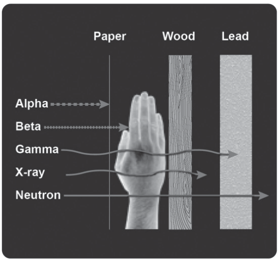
Rad (radiation-absorbed dose)

One of the two units used to measure the amount of radiation absorbed by an object or person, known as the "absorbed dose," which reflects the amount of energy that radioactive sources deposit in materials through which they pass. The radiation-absorbed dose (rad) is the amount of energy (from any type of ionizing radiation) deposited in any medium (e.g., water, tissue, air). An absorbed dose of 1 rad means that 1 gram of material absorbed 100 ergs of energy (a small but measurable amount) as a result of exposure to radiation. The related international system unit is the gray (Gy), where 1 Gy is equivalent to 100 rad.

Radiation, ionizing

A form of radiation, which includes alpha particles, beta particles, gamma rays, and x-rays, neutrons, high-speed electrons, and high-speed protons. Compared to nonionizing radiation, such as found in ultraviolet light or microwaves, ionizing radiation is considerably more energetic. When ionizing radiation passes through material such as air, water, or living tissue, it deposits enough energy to break molecular bonds and displace (or remove) electrons. This electron displacement may lead to changes in living cells. Given this ability, ionizing radiation has a number of beneficial uses, including treating cancer or sterilizing medical equipment. However, ionizing radiation is potentially harmful if not used correctly, and high doses may result in severe skin or tissue damage. It is for this reason that the NRC strictly regulates commercial and institutional uses of the various types of ionizing radiation.

Radiation, nuclear



Energy given off by matter in the form of tiny, fast-moving particles (alpha particles, beta particles, and neutrons) or pulsating electromagnetic rays or waves (gamma rays) emitted from the nuclei of unstable radioactive atoms. All matter is composed of atoms, which are made up of various parts; the nucleus contains minute particles called protons and neutrons, and the atom's outer shell contains other particles called electrons. The nucleus carries a positive electrical charge, while the electrons carry a negative electrical charge. These forces work toward a strong, stable balance by getting rid of excess atomic energy (radioactivity). In that process, unstable radioactive nuclei may emit energy, and this spontaneous emission is called nuclear radiation. All types of nuclear radiation are also ionizing radiation, but the reverse is not necessarily true; for example, x-rays are a type of ionizing radiation, but they are not nuclear radiation, because they do not originate from atomic nuclei. In addition, some elements are naturally radioactive, as their nuclei emit nuclear radiation as a result of radioactive decay, but others become radioactive by being irradiated in a reactor. Naturally occurring nuclear radiation is indistinguishable from induced radiation.

Radiation source

A radioactive material or byproduct that is specifically manufactured or obtained for the purpose of using the emitted radiation. Such sources are commonly used in teletherapy or industrial radiography; in various types of industrial gauges, irradiators, and gamma knives; and as power sources for batteries (such as those used in spacecraft). These sources usually consist of a known quantity of radioactive material, which is encased in a manmade capsule, sealed between layers of nonradioactive material, or firmly bonded to a nonradioactive substrate to prevent radiation leakage. Other radiation sources include devices such as accelerators and x-ray generators.

Radiation standards

Exposure limits; permissible concentrations; rules for safe handling; and regulations regarding receipt, possession, use, transportation, storage, disposal, and industrial control of radioactive material.

Radiation therapy (radiotherapy)

The therapeutic use of ionizing radiation to treat disease in patients. Although most radiotherapy procedures are intended to kill cancerous tissue or reduce the size of a tumor, therapeutic doses may also be used to reduce pain or treat benign conditions. For example, intervascular brachytherapy uses radiation to treat clogged blood vessels. Other common radiotherapy procedures include gamma stereotactic radiosurgery (gamma knife), teletherapy, and iodine treatment to correct an overactive thyroid gland. These procedures use radiation sources, regulated by the NRC and its Agreement States, that may be applied either inside or outside the body. In either case, the goal of radiotherapy is to deliver the required therapeutic or pain-relieving dose of radiation with high precision and for the required length of time, while preserving the surrounding healthy tissue.

Radiation warning symbol

An officially prescribed magenta or black trefoil on a yellow background, which must be displayed where certain quantities of radioactive materials are present or where certain doses of radiation could be received.

Radioactive contamination

Undesirable radioactive material (with a potentially harmful effect) that is either airborne or deposited in (or on the surface of) structures, objects, soil, water, or living organisms (people, animals, or plants) in a concentration that may harm people, equipment, or the environment.

Radioactive decay

The spontaneous transformation of one radioisotope into one or more different isotopes (known as "decay products" or "daughter products"), accompanied by a decrease in radioactivity (compared to the parent material). This transformation takes place over a defined period of time (known as a "half-life"), as a result of electron capture; fission; or the emission of alpha particles, beta particles, or photons (gamma radiation or x-rays) from the nucleus of an unstable atom. Each isotope in the sequence (known as a "decay chain") decays to the next until it forms a stable, less energetic end product. In addition, radioactive decay may refer to gamma-ray and conversion electron emission, which only reduces the excitation energy of the nucleus.

Radioactivity

The property possessed by some elements (such as uranium) of spontaneously emitting energy in the form of radiation as a result of the decay (or disintegration) of an unstable atom. Radioactivity is also the term used to describe the rate at which radioactive material emits radiation. Radioactivity is measured in units of becquerels or disintegrations per second.

Radiography

The use of sealed sources of ionizing radiation for nondestructive examination of the structure of materials. When the radiation penetrates the material, it produces a shadow image by blackening a sheet of photographic film that has been placed behind the material, and the differences in blackening suggest flaws and unevenness in the material.

Radioisotope (radionuclide)

An unstable isotope of an element that decays or disintegrates spontaneously, thereby emitting radiation. About 5,000 natural and artificial radioisotopes have been identified.

Radiopharmaceutical

A pharmaceutical drug that emits radiation and is used in diagnostic or therapeutic medical procedures. Radioisotopes that have short half-lives are generally preferred to minimize the radiation dose to the patient and the risk of prolonged exposure. In most cases, these short-lived radioisotopes decay to stable elements within minutes, hours, or days, allowing patients to be released from the hospital in a relatively short time.

Reactor core

The central portion of a nuclear reactor, which contains the fuel assemblies, water, and control mechanisms, as well as the supporting structure. The reactor core is where fission takes place.

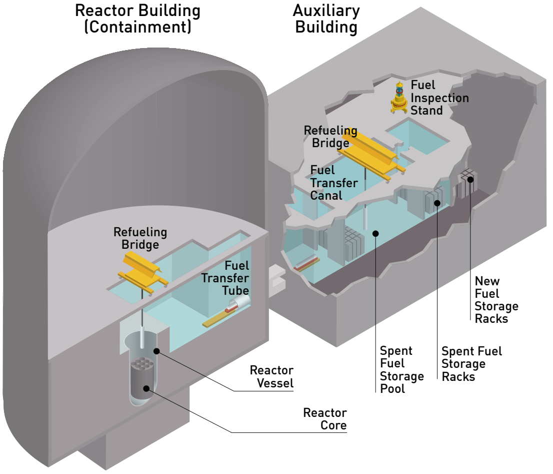
Reactor Oversight Process (ROP)

The process by which the NRC monitors and evaluates the performance of commercial nuclear power plants. Designed to focus on those plant activities that are most important to safety, the ROP uses inspection findings and performance indicators to assess each plant's safety performance.

Refueling

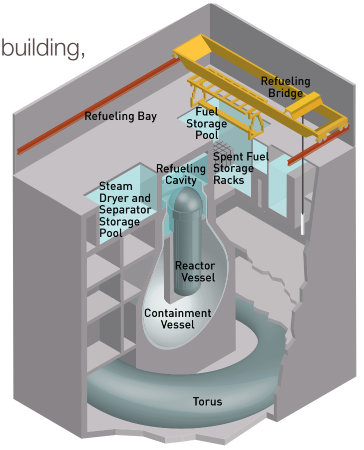
The process of removing older fuel and loading new fuel.

PWR Refueling



As new fuel shipping canisters arrive in the reactor building, the reactor building crane (not shown) lifts them to the refueling floor, where the fuel is removed from the canister and inspected for defects. The fuel can then be stored in either the new fuel storage racks (which are dry), or in the refueling pool, depending upon the needs of the site. Fuel in the new fuel storage area is moved into the fuel pool using the reactor building crane prior to refueling activities. To refuel the reactor, the vessel head is removed, the fuel transfer canals and transfer tube areas are flooded, and removable gates are opened in order to connect the refueling canal to the fuel pool. The reactor building refueling bridge is used to remove a fuel assembly from the reactor vessel and transfer it to the "up-ender" basket, which is then tilted until it is horizontal, sent through the transfer tube into the auxiliary building, and returned upright. The refueling bridge then moves the fuel assembly into the spent fuel storage racks. This process is reversed when fuel is loaded into the reactor.

BWR Refueling



As new fuel shipping canisters arrive in the reactor building, the reactor building crane lifts them to the refueling floor, where the fuel is removed from the canister and inspected for defects. The fuel can then be stored in either the new fuel storage area (which is dry), or in the refueling pool, depending upon the needs of the site. To refuel the reactor, the containment vessel lid and the reactor vessel head are removed, the refueling cavity above the reactor vessel is flooded, and the gates between the reactor cavity and fuel pool are removed. The refueling bridge (not shown) removes one fuel bundle at a time from the reactor and transfers it to the spent fuel storage racks until about a third of the fuel is removed. These actions are all performed underwater in order to provide continuous cooling for the fuel, and provide shielding from the radioactive spent fuel. The process is reversed when fuel is removed from the fuel pool and placed in the reactor. In BWRs the fuel remains in a vertical position throughout the process.

Regulation

The governmental function of controlling or directing economic entities through the process of rulemaking and adjudication.

Regulatory Information Conference

An annual NRC conference that brings together NRC staff, regulated utilities, materials users, and other interested stakeholders to discuss nuclear safety topics and significant and timely regulatory activities through informal dialogue to ensure an open regulatory process.

Rem (roentgen equivalent man)

One of the two standard units used to measure the dose equivalent (or effective dose), which combines the amount of energy (from any type of ionizing radiation) that is deposited in human tissue with the biological effects of the given type of radiation. For beta and gamma radiation, the dose equivalent is the same as the absorbed dose. By contrast, the dose equivalent is larger than the absorbed dose for alpha and neutron radiation, because these types of radiation are more damaging to the human body. Thus, the dose equivalent (in rems) is equal to the absorbed dose (in rads) multiplied by the quality factor of the type of radiation (Title 10 of the *Code of Federal Regulations* (10 CFR) 20.1004, “Units of Radiation Dose”). The related international system unit is the sievert (Sv), where 100 rem is equivalent to 1 Sv.

Renewable resources

Natural, but limited, energy resources that can be replenished, including biomass, hydro, geothermal, solar, and wind. These resources are virtually inexhaustible but limited in the amount of energy that is available per unit of time. In the future, renewable resources could also include the use of ocean thermal, wave, and tidal action technologies. Utility renewable resource applications include bulk electricity generation, onsite electricity generation, distributed electricity generation, nongrid- connected generation, and demand-reduction (energy efficiency) technologies.

Risk

The combined answer to three questions that consider (1) what can go wrong, (2) how likely it is to occur, and (3) what the consequences might be. These three questions allow the NRC to understand likely outcomes, sensitivities, areas of importance, system interactions, and areas of uncertainty, which can be used to identify risk-significant scenarios.

Risk-based decisionmaking

An approach to regulatory decisionmaking that considers only the results of a probabilistic risk assessment.

Risk-informed decisionmaking

An approach to regulatory decisionmaking in which insights from probabilistic risk assessment are considered with other engineering insights.

Risk-informed regulation

An approach to regulation taken by the NRC that incorporates an assessment of safety significance or relative risk. This approach ensures that the regulatory burden imposed by an individual regulation or process is appropriate to its importance in protecting the health and safety of the public and the environment.

Risk significant

Risk significant can refer to a facility's system, structure, component, or accident sequence that exceeds a predetermined limit for contributing to the risk associated with the facility. The term also describes a level of risk exceeding a predetermined significance level.

Safeguards

The use of material control and accounting programs to verify that all special nuclear material is properly controlled and accounted for, as well as the physical protection (or physical security) equipment and security forces. As used by the IAEA, this term also means verifying that the peaceful use commitments made in binding nonproliferation agreements, both bilateral and multilateral, are honored.

Safeguards Information

A special category of sensitive unclassified information that must be protected. Safeguards Information concerns the physical protection of operating power reactors, spent fuel shipments, strategic special nuclear material, or other radioactive material.

Safety related

In the regulatory arena, this term applies to systems, structures, components, procedures, and controls (of a facility or process) that are relied upon to remain functional during and following design-basis events. Their functionality ensures that key regulatory criteria, such as levels of radioactivity released, are met. Examples of safety-related functions include shutting down a nuclear reactor and maintaining it in a safe-shutdown condition.

Safety significant

When used to qualify an object, such as a system, structure, component, or accident sequence, this term identifies that object as having an impact on safety, whether determined through risk analysis or other means, that exceeds a predetermined significance criterion.

SAFSTOR

A long-term storage condition for a permanently shutdown nuclear power plant. During SAFSTOR, radioactive contamination decreases substantially, making subsequent decontamination and demolition easier and reducing the amount of low-level waste (LLW) requiring disposal.

Scram

The sudden shutting down of a nuclear reactor, usually by rapid insertion of control rods, either automatically or manually by the reactor operator (also known as a "reactor trip").

Sensitive unclassified nonsafeguards information

Information that is generally not publicly available and that encompasses a wide variety of categories, such as proprietary information, personal and private information, or information subject to attorney-client privilege.

Shutdown

A decrease in the rate of fission (and heat or energy production) in a reactor (usually by the insertion of control rods into the core).

Source material

Uranium or thorium, or any combination thereof, in any physical or chemical form, or ores that contain, by weight, 1/20 of 1 percent (0.05 percent) or more of (1) uranium, (2) thorium, or (3) any combination thereof. Source material does not include special nuclear material.

Special nuclear material

Plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235.

Spent fuel pool

An underwater storage and cooling facility for spent (depleted) fuel assemblies that have been removed from a reactor.

Spent (depleted or used) nuclear fuel

Nuclear reactor fuel that has been used to the extent that it can no longer effectively sustain a chain reaction.

Subcriticality

The condition of a nuclear reactor system in which nuclear fuel no longer sustains a fission chain reaction (i.e., the reaction fails to initiate its own repetition, as it would in a reactor's normal operating condition). A reactor becomes subcritical when its fission events fail to release a sufficient number of neutrons to sustain an ongoing series of reactions, possibly as a result of increased neutron leakage or poisons.

Teletherapy

Treatment in which the source of the therapeutic radiation is at a distance from the body. Because teletherapy is often used to treat malignant tumors deep within the body by bombarding them with a high-energy beam of gamma rays (from a radioisotope such as cobalt-60) projected from outside the body, it is often called "external beam radiotherapy."

Title 10 of the *Code of Federal Regulations* (10 CFR)

The *Code of Federal Regulations* (CFR) addresses energy-related topics. Chapter I, Parts 1 to 199 contain the regulations (or rules) established by the NRC. These regulations govern the transportation and storage of nuclear materials; use of radioactive materials at nuclear power plants, research and test reactors, uranium recovery facilities, fuel cycle facilities, waste repositories, and other nuclear facilities; and use of nuclear materials for medical, industrial, and academic purposes.

Transient

A change in the reactor coolant system temperature, pressure, or both, attributed to a change in the reactor's power output. Transients can be caused by (1) adding or removing neutron poisons, (2) increasing or decreasing electrical load on the turbine generator, or (3) accident conditions.

Transuranic waste

Material contaminated with transuranic elements—artificially made radioactive elements, such as neptunium, plutonium, americium, and others—that have atomic numbers higher than uranium in the periodic table of elements. Transuranic waste is primarily produced from recycling spent fuel or using plutonium to fabricate nuclear weapons.

Tritium

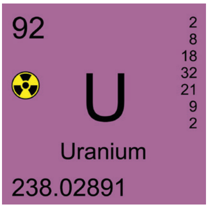
A radioactive isotope of hydrogen. Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion path. It decays by emitting beta particles and has a half-life of about 12.5 years.

Uprate

See Power uprate.

Uranium

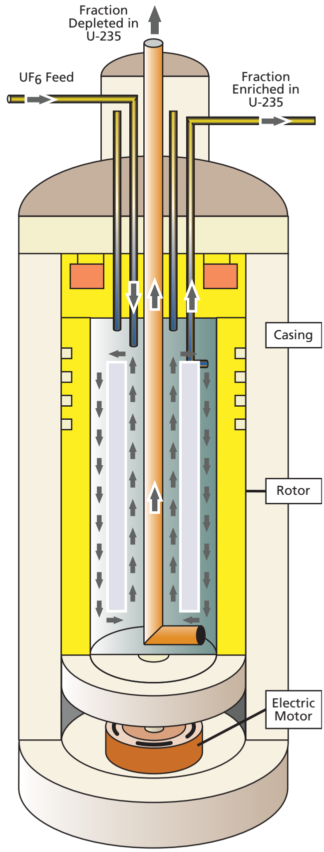
A radioactive element with the atomic number 92 and, as found in natural ores, an atomic weight of about 238. The two principal natural isotopes are uranium-235 and uranium-238. Uranium-235 is composed of 0.7 percent natural uranium and is fissile. Uranium-238 is composed of 99.3 percent natural uranium and is fissionable by fast neutrons and is fertile. This means that it becomes fissile after absorbing one neutron. Natural uranium also includes a minute amount of uranium-234.



A piece of natural uranium ore

Uranium enrichment process

The process of increasing the percentage of uranium-235 (U-235) from 0.7 percent in natural uranium to about 3 to 5 percent for use in fuel for nuclear reactors. Enrichment can be done through gaseous diffusion, gas centrifuges, or laser isotope separation.



Gas Centrifuge Process

The gas centrifuge process uses many rotating cylinders that are connected in long lines. Gas is placed in the cylinder, which spins at a high speed, creating a strong centrifugal force. Heavier gas molecules move to the cylinder wall, while lighter molecules collect near the center. The stream, now slightly enriched, is fed into the next cylinder. The depleted stream is recycled back into the previous cylinder.

Uranium fuel fabrication facility

A facility that converts enriched UF_6 into fuel for commercial light-water power reactors, research and test reactors, and other nuclear reactors. The UF_6, in solid form in containers, is heated to a gaseous form and then chemically processed to form uranium dioxide (UO_2) powder. This powder is then processed into ceramic pellets and loaded into metal tubes, which are subsequently bundled into fuel assemblies. Fabrication can also involve MOX fuel that contains plutonium oxide mixed with either natural or depleted uranium oxide in ceramic pellet form.

Uranium hexafluoride production facility (or uranium conversion facility)

A facility that receives natural uranium in the form of ore concentrate (known as yellowcake) and converts it into UF_6, in preparation for fabricating fuel for nuclear reactors.

U.S. Department of Energy (DOE)

The Federal agency established by Congress to advance the national, economic, and energy security of the United States, among other missions.

U.S. Department of Homeland Security (DHS)

The Federal agency responsible for leading the unified national effort to secure the United States against those who seek to disrupt the American way of life. DHS is also responsible for preparing for and responding to all hazards and disasters and includes the formerly separate FEMA, the Coast Guard, and the Secret Service.

U.S. Environmental Protection Agency (EPA)

The Federal agency responsible for protecting human health and safeguarding the environment. The EPA leads the Nation's environmental science, research, education, and assessment efforts to ensure that attempts to reduce environmental risk are based on the best available scientific information. The EPA also ensures that environmental protection is an integral consideration in U.S. policies.

Viability assessment

A decisionmaking process used by DOE to assess the prospects for safe and secure permanent disposal of high-level waste (HLW) in an excavated, underground facility known as a geologic repository. This decisionmaking process is based on (1) specific design work on the critical elements of the repository and waste package, (2) a total system performance assessment that will describe the probable behavior of the repository, (3) a plan and cost estimate for the work required to complete the license application, and (4) an estimate of the costs to construct and operate the repository.

Waste, radioactive

Radioactive materials at the end of their useful life or in a product that is no longer useful and requires proper disposal *(see high-level waste, low-level waste, and spent nuclear fuel).*

Waste classification (classes of waste)

Classification of low-level waste (LLW) according to its radiological hazard. The classes include Class A, B, and C, with Class A being the least hazardous and accounting for 96 percent of LLW. As the waste class and hazard increase, the regulations established by the NRC require progressively greater controls to protect the health and safety of the public and the environment.

Watt

A unit of power (in the International System of Units) defined as the consumption or conversion of 1 joule of energy per second. In electricity, a watt is equal to current (in amperes) multiplied by voltage (in volts).

WWW

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Web Link Index

NRC: An Independent Regulatory Agency

Mission, Goals, and Statutory Authority

Strategic Plan (NUREG-1614)
www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1614/

Statutory Authority
www.nrc.gov/about-nrc/governing-laws.html

Major Activities

Public Involvement
www.nrc.gov/public-involve.html

Freedom of Information Act (FOIA) and Privacy Act
www.nrc.gov/reading-rm/foia/foia-privacy.html

Regulatory Guides
www.nrc.gov/reading-rm/doc-collections/reg-guides/

Title 10, *Code of Federal Regulations*
www.nrc.gov/reading-rm/doc-collections/cfr/

Rulemaking Actions
www.regulations.gov

Significant Enforcement Actions
www.nrc.gov/reading-rm/doc-collections/enforcement/actions/

Organizations and Functions

Organization Chart
www.nrc.gov/about-nrc/organization/nrcorg.pdf

The Commission
www.nrc.gov/about-nrc/organization/commfuncdesc.html

Commission Direction-Setting and Policymaking Activities
www.nrc.gov/about-nrc/policymaking.html

NRC Regions
www.nrc.gov/about-nrc/locations.html

NRC Budget

Performance Budget: Fiscal Year 2016 (NUREG-1100)
www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1100

U.S. and Worldwide Nuclear Energy

U.S. Electricity

Energy Information Administration
Official Energy Statistics from the U.S. Government
www.eia.doe.gov

Worldwide Electricity Generated by Commercial Nuclear Power

International Atomic Energy Agency (IAEA)
www.iaea.org

IAEA Power Reactor Information System (PRIS)
www.iaea.org/programmes/a2

Nuclear Energy Agency (NEA)
www.oecd-nea.org

World Nuclear Association (WNA)
www.world-nuclear.org/

World Nuclear Power Reactors and Uranium Requirements
www.world-nuclear.org/info/reactors.html

WNA Reactor Database
www.world-nuclear.org/nucleardatabase/default.aspx

NRC Office of International Programs
www.nrc.gov/about-nrc/organization/oipfuncdesc.html

NRC Regulatory Information Conference (RIC)
www.nrc.gov/public-involve/conference-symposia/ric/index.html

International Activities

Treaties and Conventions
www.nrc.gov/about-nrc/ip/treaties-conventions.html

Code of Conduct on the Safety and Security of Radioactive Sources
www-ns.iaea.org/tech-areas/radiation-safety/code-of-conduct.asp

Radiation Sources Regulatory Partnership
http://rsrp-online.org

International Regulatory Development Partnership
http://irdp-online.org

Operating Nuclear Reactors

U.S. Commercial Nuclear Power Reactors

Commercial Reactors
www.nrc.gov/info-finder/reactor/

Oversight of U.S. Commercial Nuclear Power Reactors

Reactor Oversight Process (ROP)
www.nrc.gov/NRR/OVERSIGHT/ASSESS/index.html

NUREG/BR-0508, "Reactor Oversight Process"
www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0508/

NUREG-1649, "Reactor Oversight Process"
www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1649

ROP Performance Indicators Summary
www.nrc.gov/NRR/OVERSIGHT/ASSESS/pi_summary.html

ROP Contact Us Form
www.nrc.gov/NRR/OVERSIGHT/ASSESS/contactus.html

Future U.S. Commercial Nuclear Power Reactor Licensing

New Reactor Licensing Process
www.nrc.gov/reactors/new-reactor-op-lic/licensing-process.html#licensing

New Reactors

New Reactor Licensing
www.nrc.gov/reactors/new-reactors.html

Reactor License Renewal

Reactor License Renewal Process
www.nrc.gov/reactors/operating/licensing/renewal/process.html

10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions”
www.nrc.gov/reading-rm/doc-collections/cfr/part051/

10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants”
www.nrc.gov/reading-rm/doc-collections/cfr/part054/

Status of License Renewal Applications and Industry Activities
www.nrc.gov/reactors/operating/licensing/renewal/applications.html

U.S. Nuclear Research and Test Reactors

Research and Test Reactors
www.nrc.gov/reactors/non-power.html

Nuclear Regulatory Research

Nuclear Reactor Safety Research
www.nrc.gov/about-nrc/regulatory/research/reactor-rsch.html

State-of-the-Art Reactor Consequence Analyses (SOARCA)
www.nrc.gov/about-nrc/regulatory/research/soar.html

Risk Assessment in Regulation
www.nrc.gov/about-nrc/regulatory/risk-informed.html

Digital Instrumentation and Controls
www.nrc.gov/about-nrc/regulatory/research/digital.html

Computer Codes
www.nrc.gov/about-nrc/regulatory/research/safetycodes.html

Generic Issues Program
www.nrc.gov/about-nrc/regulatory/gen-issues.html

The Committee To Review Generic Requirements (CRGR)
www.nrc.gov/about-nrc/regulatory/crgr.html

Probabilistic Flood Hazard Assessment
www.nrc.gov/public-involve/public-meetings/meeting-archives/research-wkshps.html

Cancer Study
www.nrc.gov/reading-rm/doc-collections/fact-sheets/bg-analys-cancer-risk-study.html

NUREG-1925, Revision 3, “Research Activities”
www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1925/r3/

Nuclear Materials

U.S. Fuel Cycle Facilities

U.S. Fuel Cycle Facilities
www.nrc.gov/info-finder/materials/fuel-cycle/

Uranium Recovery

Uranium Milling/Recovery

www.nrc.gov/info-finder/materials/uranium/

U.S. Materials Licenses

Materials Licensees Toolkits

www.nrc.gov/materials/miau/mat-toolkits.html

Domestic Licensing of Special Nuclear Material-Part 70

www.nrc.gov/reading-rm/doc-collections/cfr/part70/

Medical Applications and Others

Medical Applications and Others

www.nrc.gov/materials/medical.html

Medical Uses

Medical Uses

www.nrc.gov/materials/miau/med-use.html

Nuclear Gauges and Commercial Product Irradiators

General License Uses

www.nrc.gov/materials/miau/general-use.html

Industrial Uses of Nuclear Materials

Industrial Applications

www.nrc.gov/materials/miau/industrial.html

Exempt Consumer Product Uses

www.nrc.gov/materials/miau/consumer-pdts.html

Radioactive Waste

U.S. Low-Level Radioactive Waste Disposal

Low-Level Radioactive Waste

www.nrc.gov/waste/low-level-waste.html

U.S. High-Level Radioactive Waste Management: Disposal and Storage

High-Level Radioactive Waste

www.nrc.gov/waste/high-level-waste.html

Spent Nuclear Fuel Storage

Spent Nuclear Fuel Storage

www.nrc.gov/waste/spent-fuel-storage.html

U.S. Nuclear Materials Transportation

Nuclear Materials Transportation

www.nrc.gov/materials/transportation.html

Decommissioning

Decommissioning

www.nrc.gov/about-nrc/regulatory/decommissioning.html

Status of the Decommissioning Program 2015 Annual Report

www.nrc.gov/docs/ML1530/ML15302A432.pdf

Nuclear Security and Emergency Preparedness Nuclear Security

Nuclear Security

Nuclear Security
www.nrc.gov/security.html

Domestic Safeguards

Domestic Safeguards
www.nrc.gov/security/domestic.html

Information Security

Information Security
www.nrc.gov/security/info-security.html

Ensuring the Security of Radioactive Material
www.nrc.gov/security/byproduct.html

Emergency Preparedness and Response

Emergency Preparedness and Response
www.nrc.gov/about-nrc/emerg-preparedness.html

Research and Test Reactors Security
www.nrc.gov/reactors/non-power.html

Emergency Preparedness Stakeholder Meetings and Workshops
www.nrc.gov/public-involve/public-meetings/stakeholder-mtngs-wksps.html

Emergency Action Level Development
www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/emerg-action-level-dev.html

Hostile-Action-Based Emergency Preparedness Drills
www.nrc.gov/about-nrc/emerg-preparedness/respond-to-emerg/hostile-action.html

NRC Participation Exercise Schedule
www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/exercise-schedules.html

Other Web Links

Datasets

Spreadsheets of NRC-regulated information
http://www.nrc.gov/reading-rm/doc-collections/datasets/

Employment Opportunities

NRC—A Great Place to Work
www.nrc.gov/about-nrc/employment.html

Glossary

NRC Basic References
www.nrc.gov/reading-rm/basic-ref/glossary/full-text.html

Glossary of Electricity Terms

www.eia.gov/tools/glossary

Glossary of Security Terms

www.dhs.gov/definition-terms

Public Involvement

NRC Library
www.nrc.gov/reading-rm.html

Freedom of Information and Privacy Acts
www.nrc.gov/reading-rm/foia/foia-privacy.html

Agencywide Documents Access and Management System (ADAMS)
www.nrc.gov/reading-rm/adams.html

Public Document Room
www.nrc.gov/reading-rm/pdr.html

Public Meeting Schedule
http://Meetings.nrc.gov/pmns/mtg

Documents for Comment
www.nrc.gov/public-involve/doc-comment.html

Small Business and Civil Rights

Contracting Opportunities for Small Businesses
www.nrc.gov/about-nrc/contracting/small-business.html

Workplace Diversity
www.nrc.gov/about-nrc/employment/workingatnrc.html

Discrimination Complaint Activity
www.nrc.gov/about-nrc/civil-rights.html

Equal Employment Opportunity Policy
www.nrc.gov/about-nrc/civil-rights/crp/eeo.html

Limited English Proficiency
www.nrc.gov/about-nrc/civil-rights/limited-english.html

Minority Serving Institutions Program
www.nrc.gov/about-nrc/grants.html#msip

NRC Comprehensive Diversity Management Plan brochure
www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0316

Social Media Platforms

NRC Blog
https://public-blog.nrc-gateway.gov/

Twitter
https://twitter.com/nrcgov

YouTube
https://www.youtube.com/user/NRCgov

Flickr
https://www.flickr.com/photos/nrcgov

Facebook
https://www.facebook.com/nrcgov

GovDelivery
http://www.nrc.gov/public-involve/listserver.html#gov

RSS
http://www.nrc.gov/public-involve/listserver.html#rss

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