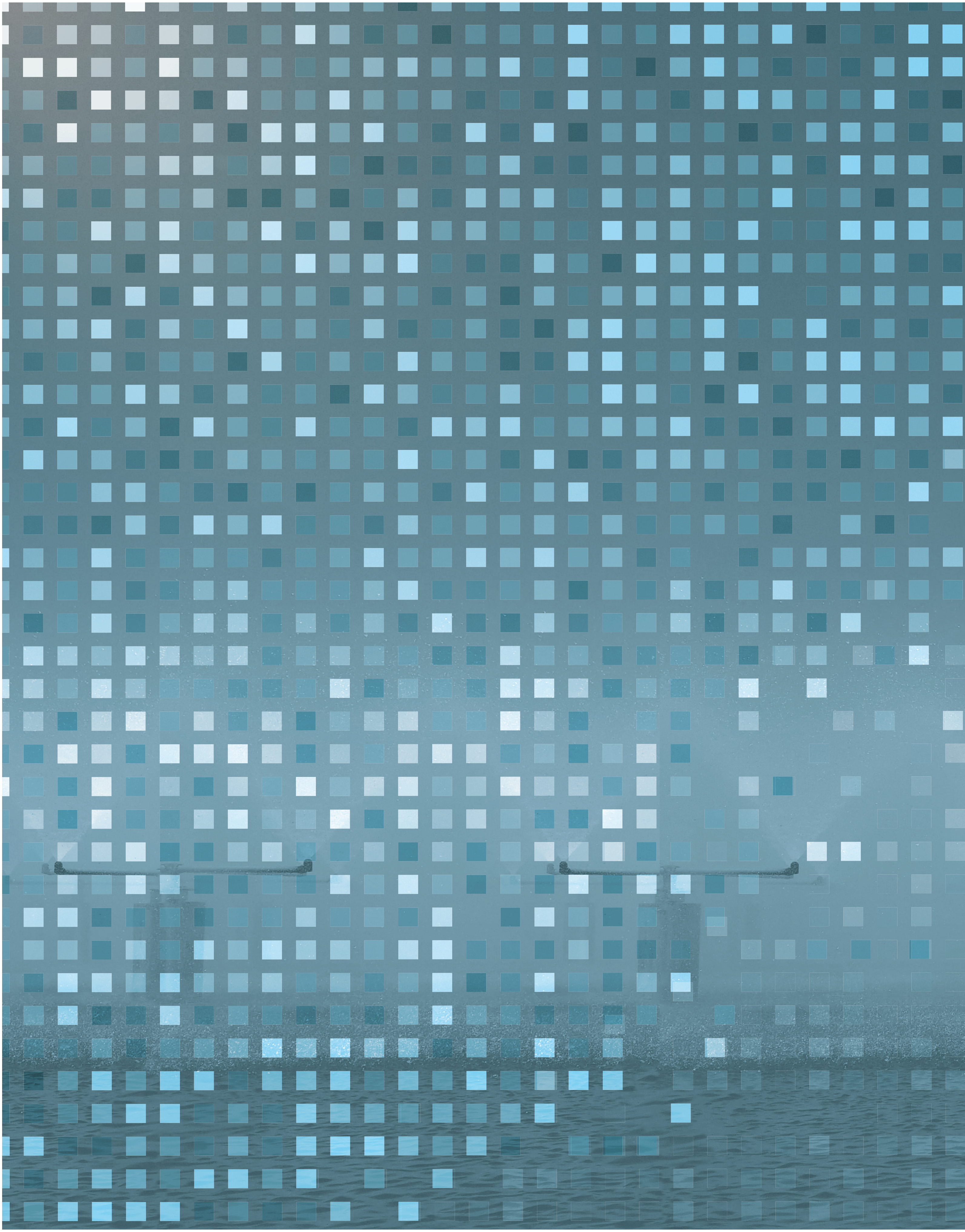
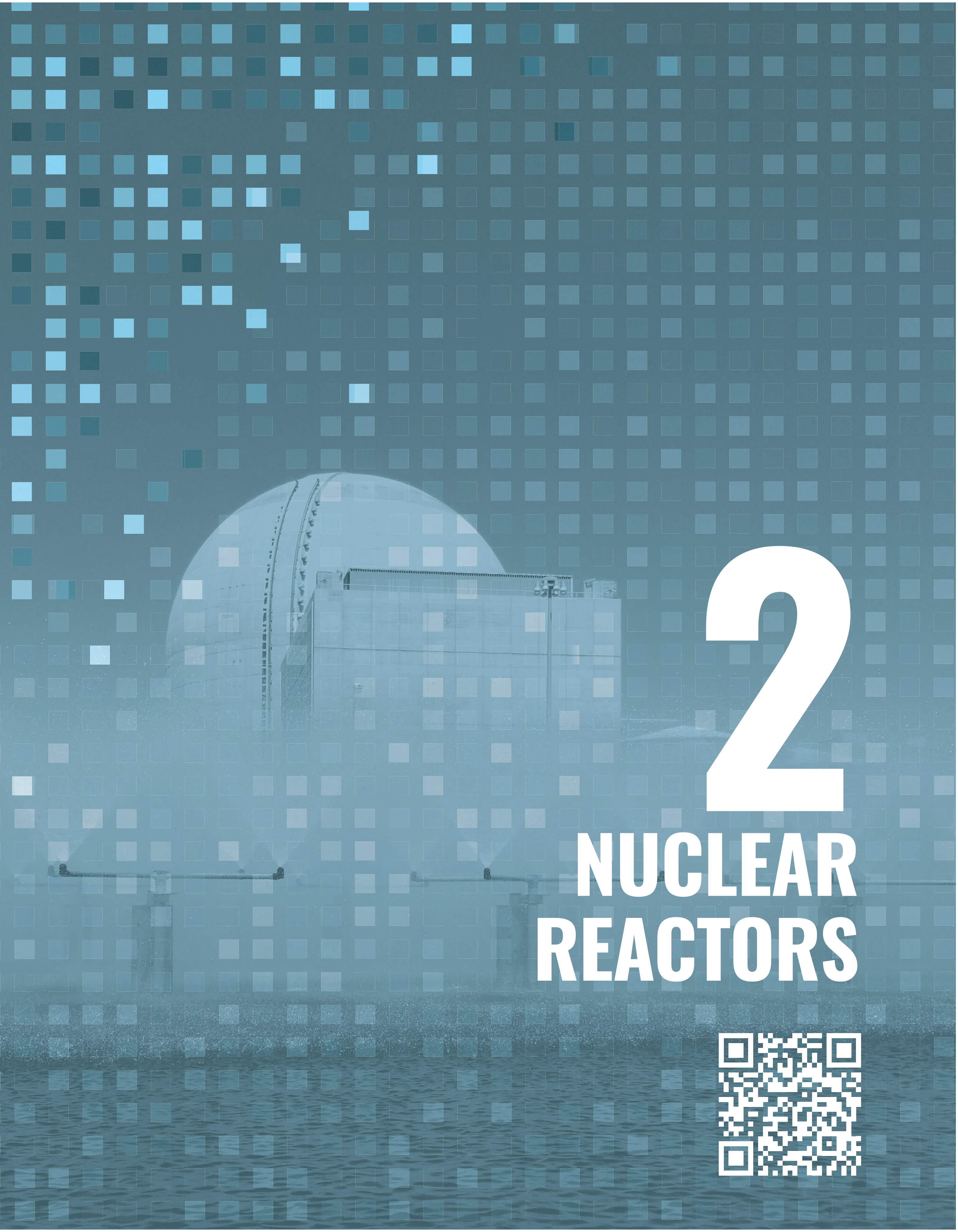




2 NUCLEAR REACTORS

U.S. ELECTRICITY GENERATED BY COMMERCIAL NUCLEAR POWER

According to the U.S. Energy Information Administration (EIA), in 2023, preliminary estimates show that 4.18 trillion kilowatt-hours of electricity were generated in the United States. About 43.1 percent of this electricity generation was from natural gas, 16.2 percent from coal, 21.4 percent from renewable energy sources, 18.6 percent from nuclear energy, 0.4 percent from petroleum, and 0.3 percent from other gases and sources. (See Figure 11. U.S. Gross Electricity Share by Energy Source.)

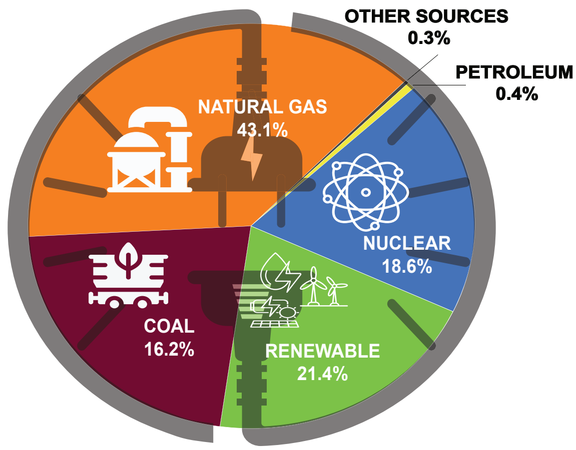


Figure 11. U.S. Gross Electricity Share by Energy Source

Since the 1970s, the Nation's nuclear operating companies have asked permission to generate more electricity from existing nuclear plants. The NRC regulates the amount of heat a commercial nuclear reactor may generate. This heat, or power level, is used with other data in many analyses that demonstrate the safety of the nuclear power plant. Because this power level is included in the plant's license and technical specifications, the NRC must review and approve any licensee's requested change to it, as it would for any license or technical specification change. Increasing a commercial nuclear power plant's maximum operational power level is called a "power uprate." The NRC has approved power uprates that have given the nation's electricity grid an additional six gigawatts electric, approximately the equivalent of six large light-water reactors. (See Figure 12. NRC-Licensed Operating Nuclear Reactor Uprates.) ***>>See the glossary on the NRC's website for information on the electric power grid at https://www.nrc.gov/reading-rm/basic-ref/glossary.html.<<***

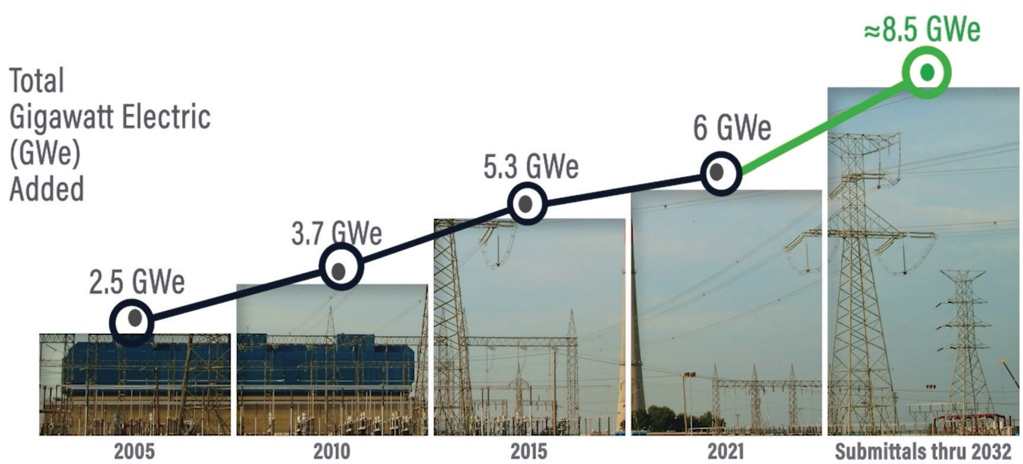


Figure 12. NRC-Licensed Operating Nuclear Reactor Uprates

According to the EIA, by the end of 2023, each of the following States generated more than 40,000 megawatt-hours of electricity from nuclear power: Illinois, Pennsylvania, South Carolina, Alabama, North Carolina, and Texas. Illinois ranked first in the nation in both generating capacity and net electricity generation from nuclear power. Illinois nuclear power plants accounted for 12.5 percent of the Nation’s nuclear power generation.

U.S. COMMERCIAL NUCLEAR POWER REACTORS

Power plants convert heat into electricity using steam. At nuclear power plants, the heat to boil water into 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 reaction’s heat creates steam to turn a turbine. As the turbine spins, the generator turns, and its magnetic field produces electricity.

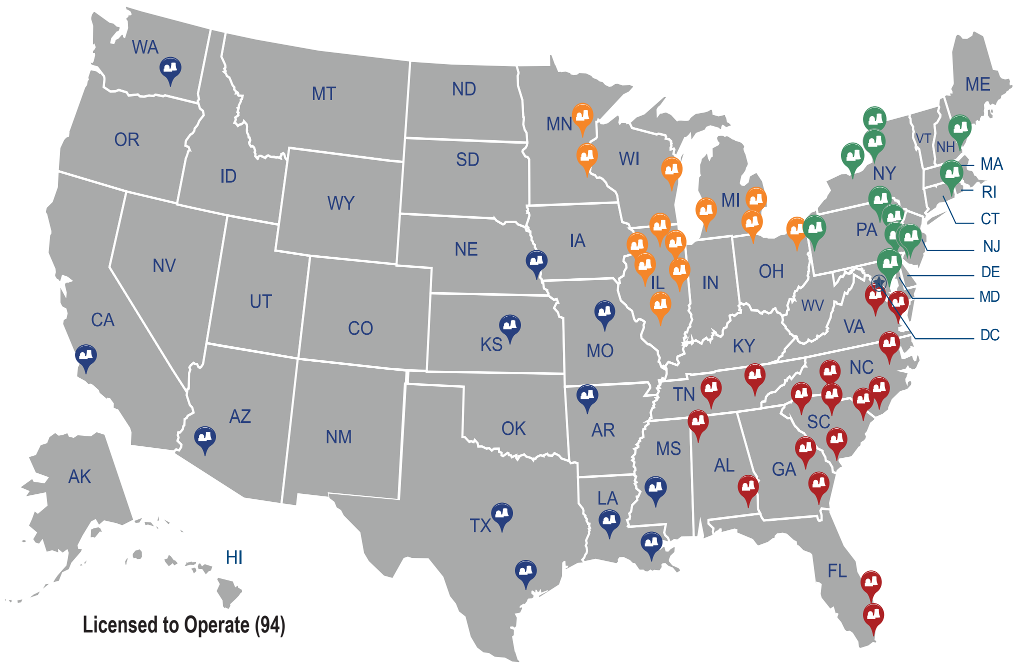
Nuclear power plants are very complex. There are many buildings at the site and many different systems. Some of the systems work directly to make electricity, while others keep the plant working correctly and safely. All nuclear power plants have a containment structure with reinforced concrete about 4 feet (1.2 meters) thick that houses the reactor. To keep reactors performing efficiently, operators remove about one-third of the fuel every year or two and replace it with fresh fuel. Used fuel is stored and cooled in deep pools of water located on site. The process of removing used fuel and adding fresh fuel is known as refueling.

The United States has two types of commercial nuclear reactors. Pressurized-water reactors, or PWRs, keep water in the reactor under pressure, so it heats to over 500 degrees Fahrenheit (260 degrees Celsius) 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, called BWRs, the water heated in the reactor actually boils and turns into steam, which then turns a turbine generator to produce electricity. In both types of plants, the steam is turned back into water and reused.

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 PWRs and BWRs are currently in commercial operation in the United States. Although commercial U.S. reactors have many similarities, each one is considered unique (See Figure 13. U.S. Operating Commercial Nuclear Power Reactors). ***>>See the glossary on the NRC’s website for information on the typical PWR and BWR designs.<<***

An NRC team inspects Diablo Canyon Unit 1 during a maintenance and refueling outage. The team accessed areas inside the containment and reviewed plant structures, and portions of the discharge tunnel not visible from shore.

NRC Region IV Regional Administrator John Monninger (left) tours the River Bend nuclear power plant with Resident Inspector Curtis Wynar. (Photo courtesy of Entergy)



REGION I

CONNECTICUT
- Millstone 2 and 3

MARYLAND
- Calvert Cliffs 1 and 2

NEW HAMPSHIRE
- Seabrook

NEW JERSEY
- Hope Creek
- Salem 1 and 2

NEW YORK
- FitzPatrick
- Ginna
- 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

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
- Hatch 1 and 2
- Vogtle 1, 2, 3, and 4

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

MICHIGAN
- Cook 1 and 2
- Fermi 2

MINNESOTA
- Monticello
- Prairie Island 1 and 2

OHIO
- Davis-Besse
- Perry

WISCONSIN
- Point Beach 1 and 2

REGION IV

ARKANSAS
- Arkansas Nuclear One 1 and 2

ARIZONA
- Palo Verde 1, 2, and 3

CALIFORNIA
- Diablo Canyon 1 and 2

KANSAS
- Wolf Creek

LOUISIANA
- River Bend 1
- Waterford 3

MISSISSIPPI
- Grand Gulf

MISSOURI
- Callaway

NEBRASKA
- Cooper

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

WASHINGTON
- Columbia

Note: NRC-abbreviated reactor names are listed. Data are current as of October 2024. For the most recent information, go to the NRC facility locator page at https://www.nrc.gov/info-finder/reactors/index.html.

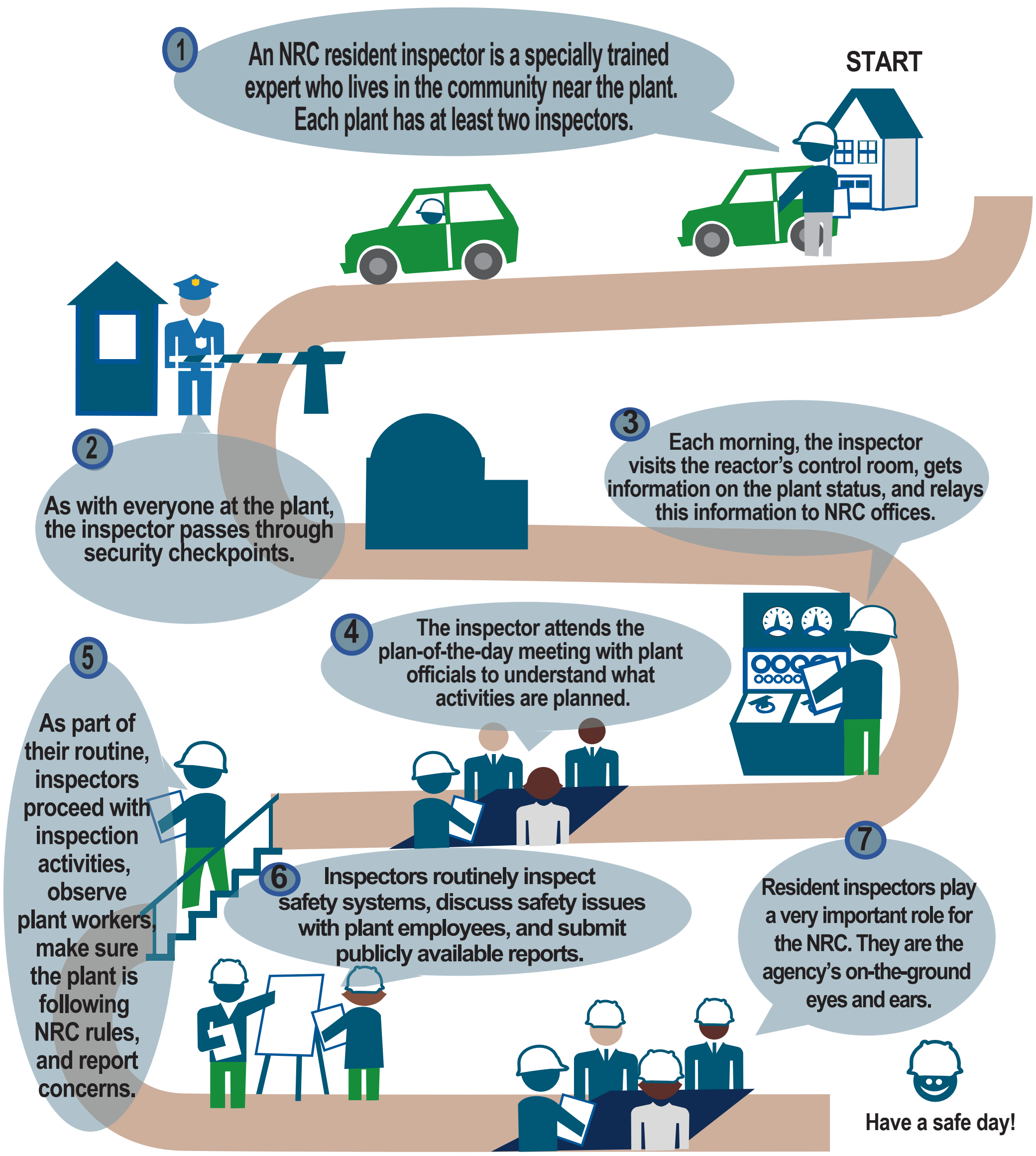
Figure 13. U.S. Operating Commercial Nuclear Power Reactors

>>See Appendix A for a list of commercial nuclear power reactors and their general licensing information and Appendix P for Native American reservations and trust lands near nuclear power plants.<<

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 personnel are referred to as "resident inspectors." Each plant has at least two resident inspectors, and their work is at the core of the agency's reactor inspection program. These highly trained and qualified professionals scrutinize activities at the plants and verify adherence to Federal safety requirements. The inspectors visit the control room and review operator logbook entries, visually assess areas of the plant, observe tests of (or repairs to) important systems or components, interact with plant employees, and check 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 they 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 (ROP) and the resident inspector program is available on the agency's website (See Figure 14. Day in the Life of an NRC Resident Inspector).



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

Figure 14. Day in the Life of an NRC Resident Inspector

Principal Licensing, Inspection, and Enforcement Activities

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

- *Reviewing separate license change requests, called "amendments," from power reactor licensees.*
- *Performing inspections at each operating reactor site.*
- *Conducting initial reactor operator licensing examinations.*
- *Ensuring NRC-licensed reactor operators maintain their knowledge and skills current by passing an exam every 6 years.*
- *Reviewing applications for proposed new reactors.*
- *Inspecting construction activities.*
- *Reviewing operating experience items each year and sharing 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 safety and security regulations.*
- *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 each year to examine potential safety issues for existing or proposed reactors.*
- *Using the Process for the Ongoing Assessment of Natural Hazard Information framework to systematically moniitor and assess new and updated natural hazards information to determine any safety implications. New hazards information with a potentially significant effect on plant safety is referred to the appropriate NRC regulatory program for detailed assessment and further action.*

NRC Senior Resident Inspector Scott Rutenkroger monitors operations at the Peach Bottom nuclear power plant during severe winter weather.

Ray McKinley, a senior manager from NRC Region I (right), examines a system during a visit to the Susquehanna nuclear power plant in Pennsylvania with Erin Brady a resident inspector assigned to the site.

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 plants operate safely and securely within these requirements by licensing the plants to operate, licensing control room operators, 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.

The NRC staff uses the ROP to evaluate NRC inspection findings and performance records for each reactor and applies this information to assess the reactor's safety performance and security measures. 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."

NRC inspections start with detailed baseline-level activities for every reactor. Baseline inspections from resident and specialist inspectors are the minimum needed to ensure that plants meet "safety cornerstone " objectives. As the number of issues at a reactor increases, the scope of the NRC's inspections increases. 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 website.

The ROP is informed by 50 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 website and in NUREG-1649, Revision 6, "Reactor Oversight Process," issued July 2016 (See Figure 15. Reactor Oversight Framework, and Figure 16. Reactor Oversight Action Matrix Performance Indicators).

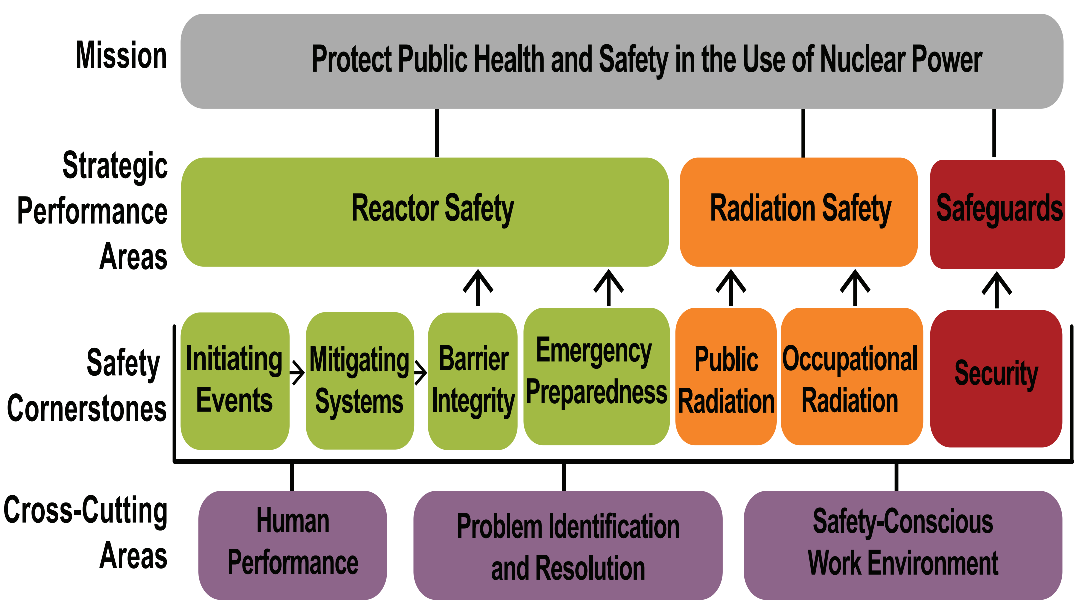


Figure 15. Reactor Oversight Framework

Figure 16. Reactor Oversight Action Matrix Performance Indicators

>>See Appendix C for a list of commercial nuclear power reactors undergoing decommissioning and permanently shut down, and Appendices E and F for power reactor operating licenses issued and expiring by year.<<

REACTOR LICENSE RENEWAL

The Atomic Energy Act of 1954, as amended, authorizes the NRC to issue 40-year initial licenses for commercial power reactors. It 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. 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 (See Figure 17. License Renewal Process). Congress set the original 40-year term after considering economic and antitrust issues, as opposed to nuclear technology issues. There can be systems, structures, and components for which the licensee used "time-limited" aging analyses. To receive a renewed license, NRC regulations provide options on how to address these time-limited analyses, including that the applicant show that the analyses remain valid for the period of extended operation (See Figure 18. License Renewals Granted for Operating Nuclear Power Reactors). For current reactors grouped by how long they have operated, see Figure 19. U.S. Commercial Nuclear Power Reactors—Years of Operation by the End of 2024.

The license renewal process proceeds along two tracks—one for review of safety issues and another for environmental issues. The safety review evaluates the licensee's plans for managing aging plant systems during the renewal period. For the environmental review, the agency uses NUREG-1437, Revision 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants," issued August 2024, to evaluate impacts common to all nuclear power plants, then prepares a supplemental environmental impact statement for each individual plant. The supplement examines impacts unique to the plant's site. The public has two opportunities to contribute to the environmental review—at the beginning and when the draft report is published.

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 (NUREG-2157) 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. The environmental impacts of continued storage of spent nuclear fuel are incorporated into each environmental review for license renewal.

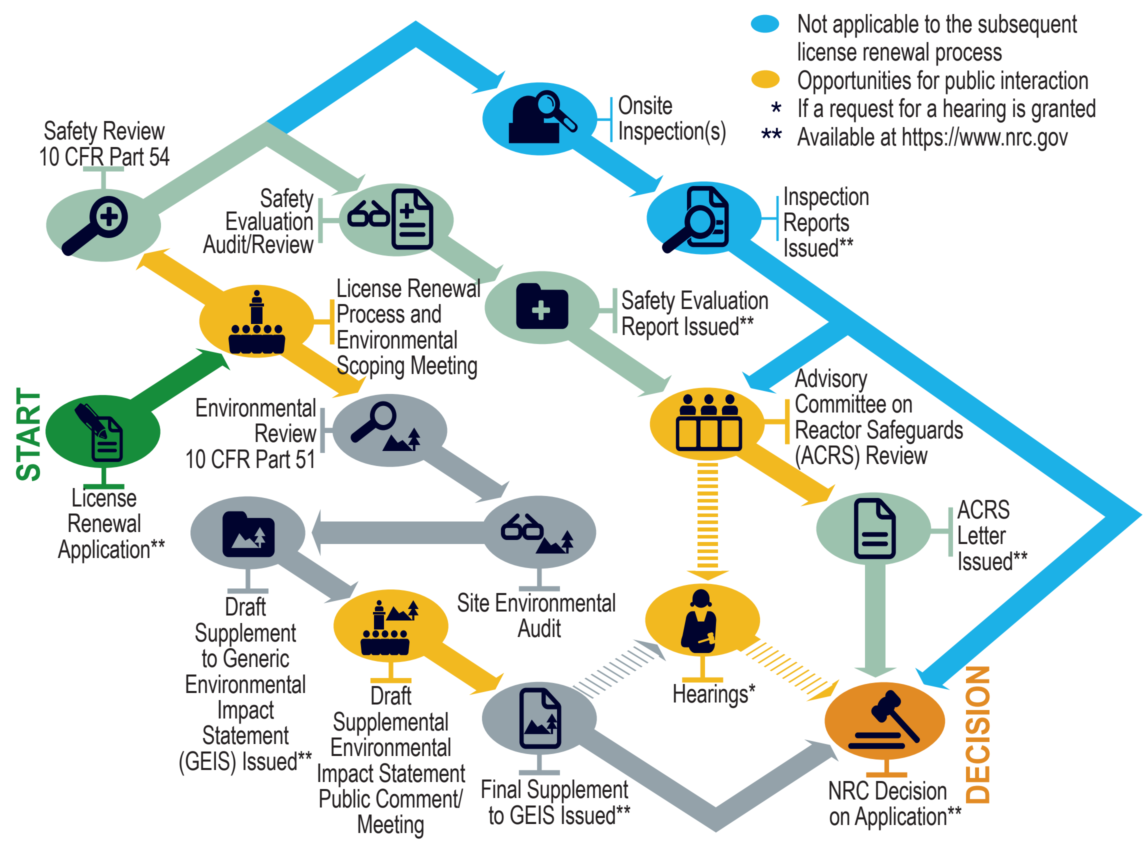
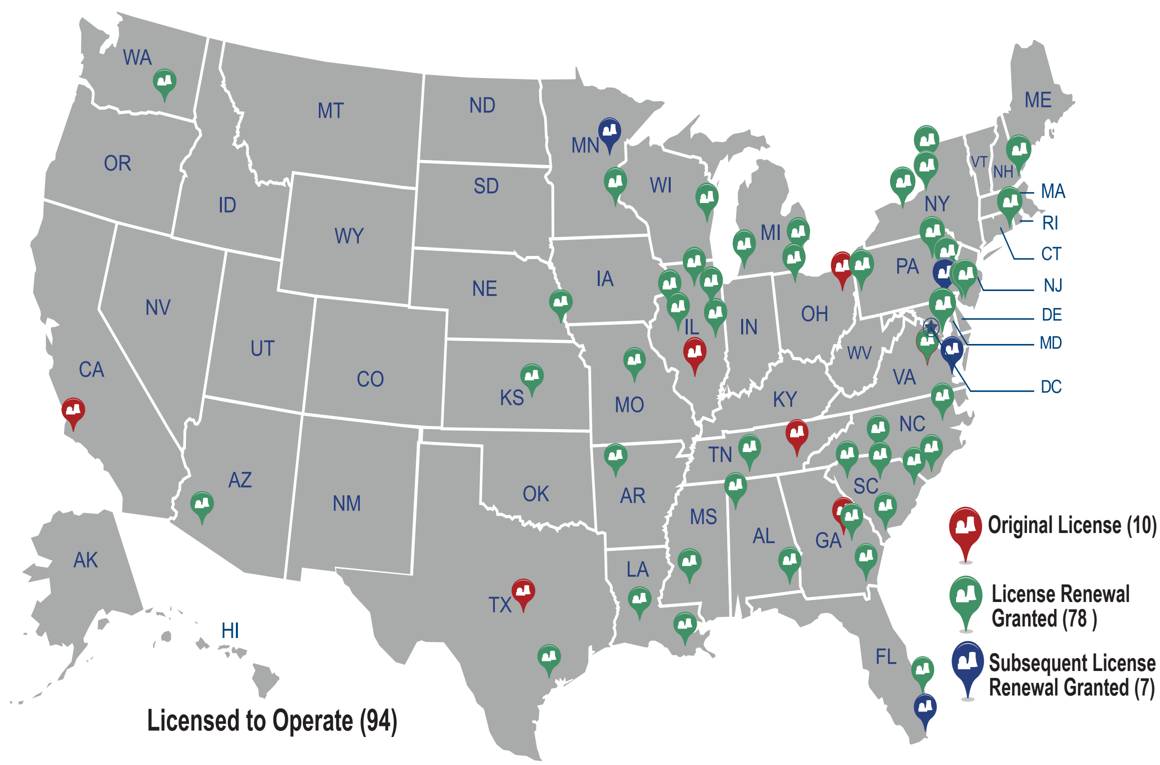


Figure 17. License Renewal Process



Note: This data reflects from current operating reactors as of December 2024. For the most recent information, go to the NRC website at *https://www.nrc.gov/info-finder.html*.

Figure 18. License Renewals Granted for Operating Nuclear Power Reactors

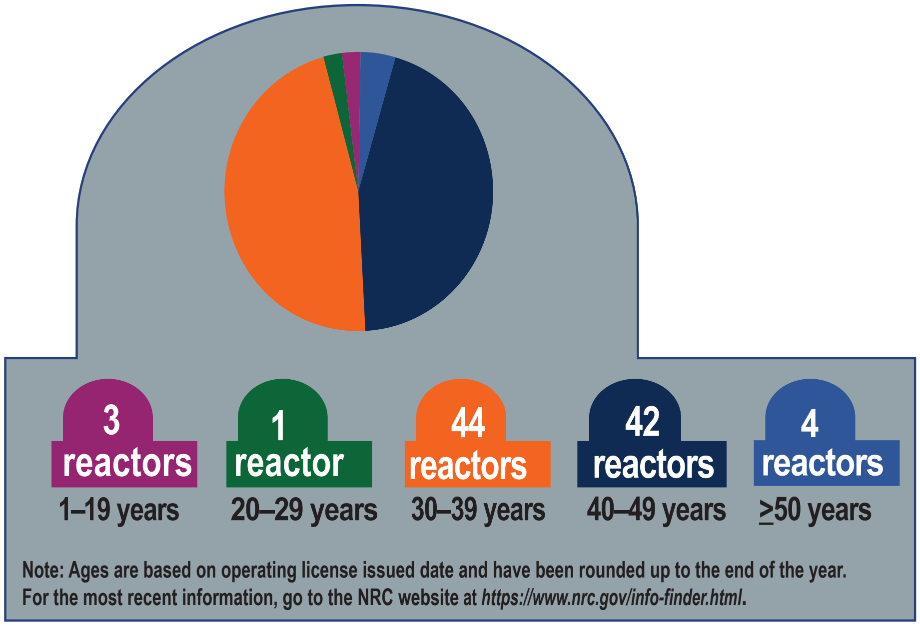


Figure 19. U.S. Commercial Nuclear Power Reactors—Years of Operation by the End of 2024

Subsequent License Renewal

The NRC staff developed guidance and a standard review plan for "subsequent license renewals" that would allow plants to operate for more than 60 years (the 40 years of the original license plus the 20 years in the initial license renewal).

The Commission determined that the agency's existing regulations are adequate for subsequent license renewals. Nevertheless, the Commission asked the staff to develop new guidance to better help licensees develop aging management programs for the 60-year to 80-year period. The staff issued this guidance (NUREG-2191 and NUREG-2192) in July 2017. The NRC's NUREG-1437, Revision 2 "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" issued August 2024, applies to the first period of subsequent license renewal.

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. The NRC shares information provided by the applicant, holds public meetings, and publicly documents the results of its technical and environmental reviews. In addition, the ACRS reviews license renewal applications and discusses them at its meetings.

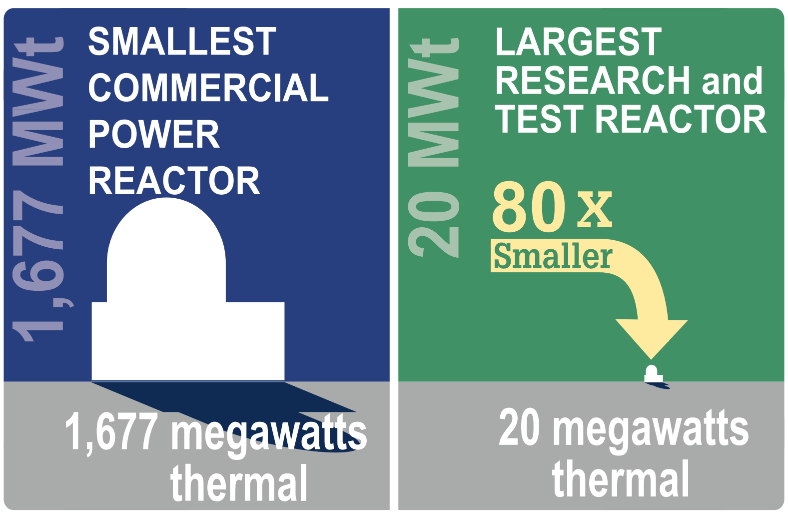
Individuals or groups can challenge a license renewal application in an NRC adjudicatory proceeding if they would be affected by the renewal and meet basic requirements for requesting a hearing.

NONPOWER PRODUCTION AND UTILIZATION FACILITIES

Nonpower production and utilization facilities include nuclear research and test reactors, medical radioisotope utilization and production facilities, and advanced RTRs. None of theses NPUFs produce electricity. RTRs are primarily used for research, training, and development to support science and education in nuclear engineering, physics, chemistry, biology, anthropology, medicine, materials science, and related fields. One advanced RTR is under construction, and it will help demonstrate that new reactor technologies and materials work as intended. Most U.S. RTRs are at universities or colleges.

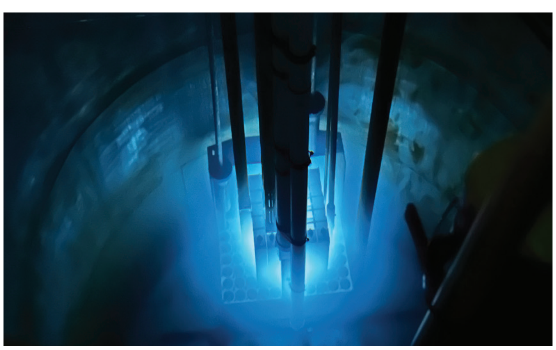
The largest U.S. RTR, with a license to operate at 20 megawatts thermal (MWt), is approximately 80 times smaller than the smallest U.S. commercial power nuclear reactor (which operates at 1,677 MWt). Medical radioisotope facilities create or use radioactive materials for diagnosis and treatment in a variety of ways, including imagining and cancer treatment. The NRC regulates a wide variety of NPUFs located across the country (See Figure 20. Size Comparison of Operating Commercial and Research Reactors, and Figure 21. U.S. Nuclear Nonpower Production and Utilization Facilities). The DOE also uses nonpower nuclear research reactors, but they are not regulated by the NRC.

NRC inspectors visit each operating RTR facility about once a year to provide varying levels of oversight. Operating RTRs licensed to operate at 2 MWt or more receive a full NRC inspection every year. Those licensed to operate at less than 2 MWt receive a full inspection every 2 years.



For the most recent information, go to NRC website at *https://www.nrc.gov/info-finder.html.*

Figure 20. Size Comparison of Operating Commercial and Research Reactors

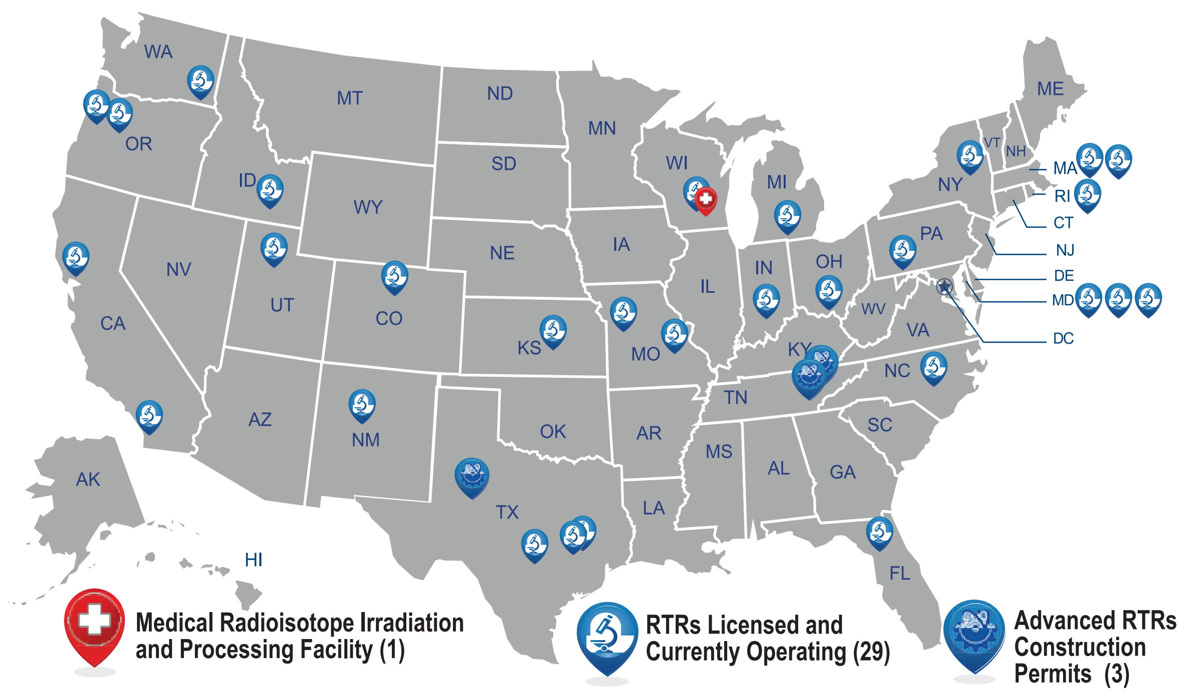


The blue glow in Purdue University's research and test reactor is Cherenkov radiation, emitted when charged particles travel faster than light in water. Licensed and inspected by the NRC, this reactor educates and trains future nuclear engineers and is the only NRC-licensed facility with a fully digital safety and control system.

Principal Licensing and Inspection Activities

The NRC's NPUF licensing and inspection activities include the following:

- *Licensing new and currently operating sites, including construction permits, operating licenses, license renewals, and license amendments.*
- *Licensing operators.*
- *Overseeing operator licensing renewal programs.*
- *Conducting inspections each year, based on inspection frequency and procedures for operating RTRs.*
- *Overseeing facility security and emergency preparedness programs.*
- *Inspecting construction for new facilities.*
- *Inspecting operational readiness for new facilities.*



Note: NPUFs include RTRs, medical radioisotope irradiation and processing facilities, and advanced RTRs.
For the most recent information, go to NRC website at *https://www.nrc.gov/info-finder.html.*

Figure 21. Locations of U.S. Nuclear Nonpower Production and Utilization Facilities

NEW COMMERCIAL NUCLEAR POWER REACTOR LICENSING

New reactors are any reactors proposed in addition to the current fleet of operating reactors (See Figure 22. The Different NRC Classifications for Types of Reactors).

The NRC can license new commercial nuclear power plants in two ways. A two-step licensing process (10 CFR Part 50) involves a construction permit and an operating license. The first step, after the NRC is satisfied that a preliminary plant design is safe and the prospective site is acceptable, provides a construction permit for the applicant (e.g., utility) to begin building the plant. Sometime during construction, the utility applies for an operating license, which the NRC issues only if all safety and environmental requirements are met.

In 1989, the NRC established a one-step licensing process under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants” (See Figure 23. New Reactor Licensing Process), in which applicants ask for a combined license that authorizes both construction and operation (as long as the plant is built according to acceptance criteria). The regulations in 10 CFR Part 52 also include an early site permit (ESP) process for early resolution of environmental issues, as well as processes to license manufacturing of a design, approve a standard plant design, and certify a design for use anywhere in the United States (certification is described in more detail below). The NRC is developing an optional “10 CFR Part 53” licensing process that uses risk insights to set performance standards applicable to any reactor technology.

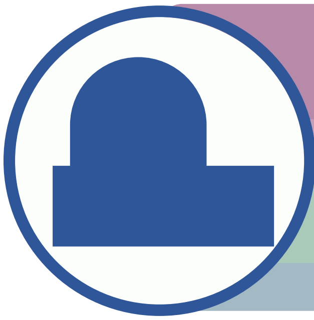
The NRC continues to review applications submitted by prospective licensees and (when appropriate) issues standard design approvals, standard design certifications, ESPs, limited work authorizations, construction permits, operating licenses, and COLs for facilities in a variety of projected locations throughout the United States (See Figure 24. Locations of New Nuclear Power Reactors with Active Applications and Approved Licenses). The NRC has implemented the Commission’s policies of new reactor safety through rules, guidance, staff reviews, and inspections.

>>See Appendices G and H for a list of RTRs regulated by the NRC that are operating or are in the process of decommissioning, and Appendix B for a list of new nuclear power plant licensing applications in the United States.<<

Andrea Veil, former director of the Office of Nuclear Reactor Regulation, with Kairos Power Vice President Peter Hastings, sign construction permits to build two additional test reactors and a power system at its site.

Gerry Stirewalt, a senior geologist and technical reviewer, develops and implements software to ensure licensees properly characterize geologic features at proposed nuclear power plants. He also conducts in-person field audits.

Operating Reactors



Design: The U.S. fleet consists mainly of large reactors that use regular water ("light" water (H_2O), as opposed to "heavy" water (D_2O) that has a different type of hydrogen than commonly found in nature) for both cooling the core and facilitating the nuclear reaction.

Capacity: The generation base load of these plants is 1,677 MWt (approximately 570 MWe) or higher.

Safety: These reactors have "active" safety systems powered by alternating current (ac) and require an operator to reach a safe-shutdown state.

Fuel: These reactors require enriched uranium.

Advanced Reactors

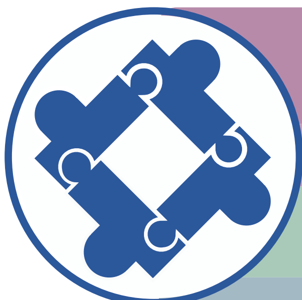
Design: Advanced reactors are a new generation of non-light-water reactors.They use coolants such as molten salts, liquid metals, and even gases like helium.

Capacity: These plants range in power from very small reactors to a power level comparable to existing operating reactors.

Safety: These reactors are expected to provide enhanced margins of safety and use simplified, inherent, and passive means to ensure safety. They may not require an operator to shut down.

Fuel: These reactors could use enriched uranium, thorium, or used nuclear fuel.

Small Modular Reactors



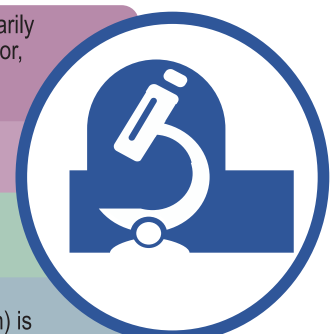
Design: Small modular reactors (SMRs) are similar to large light-water reactors but are smaller, compact designs. These factory-fabricated reactors can be transported by truck or rail to a nuclear power site. Additional SMRs can be installed on site to scale or to meet increased energy needs.

Capacity: These reactors are about one-third the size of typical reactors, with a generation base load of 1,000 MWt (300 MWe) or less.

Safety: These reactors can be installed underground, providing more safety and security. They are built with passive safety systems and can be shut down without an operator.

Fuel: These reactors require enriched uranium.

Research and Test Reactors



Design: Research and test reactors—also called "nonpower" reactors—are primarily used for research, training, and development. They are classified by their moderator, the material used to slow down the neutrons, in the nuclear reaction. Typical moderators include water (H_2O), heavy water (D_2O), polyethylene, and graphite.

Capacity: Currently licensed RTRs range in size from 5 watts (less than a night light) to 20 MWt (equivalent to 20 standard medical x-ray machines).

Safety: All NRC-licensed research and test reactors have a built-in safety feature that reduces reactor power during potential accidents before an unacceptable power level or temperature can be reached.

Fuel: Reactors may also be classified by the type of fuel used, such as MTR (plate-type fuel) or TRIGA fuel. TRIGA fuel is unique in that a moderator (hydrogen) is chemically bonded to the fuel.

Figure 22. The Different NRC Classifications for Types of Reactors

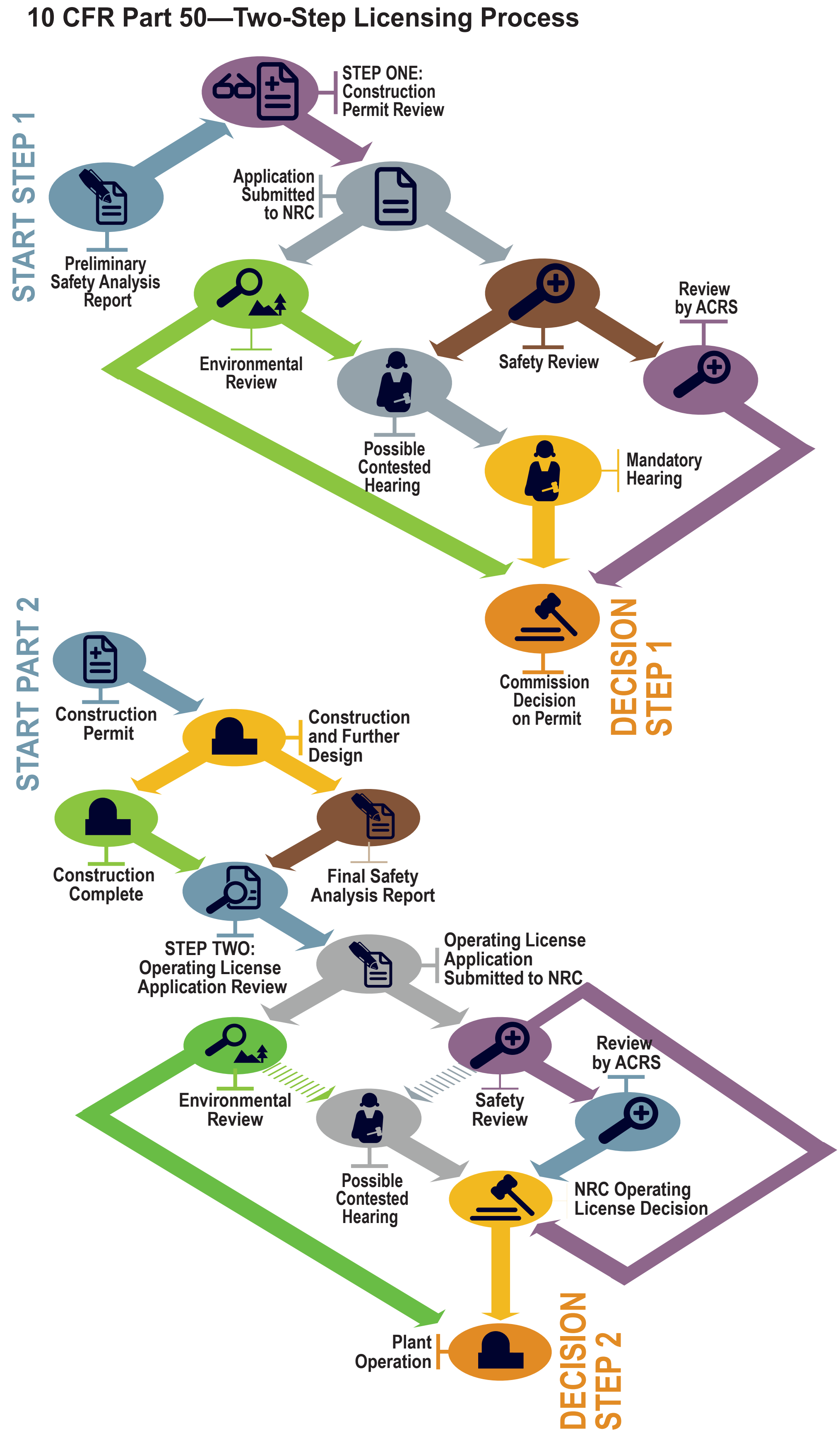


Figure 23. New Reactor Licensing Process

10 CFR Part 52—Combined License Application Review Process

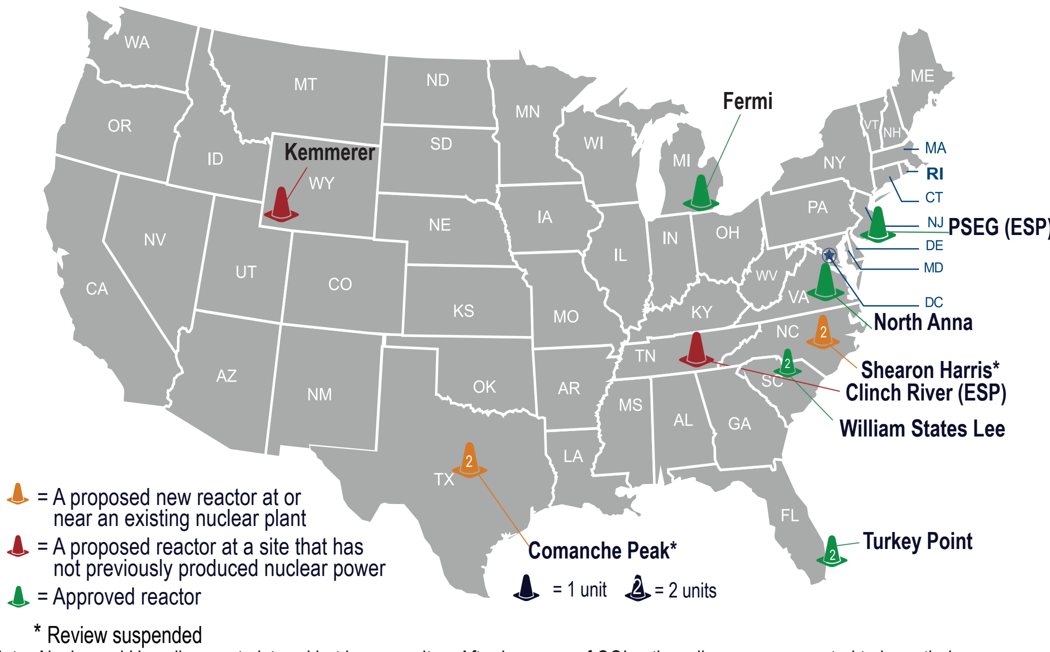
Figure 23. New Reactor Licensing Process (Continued)

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 can participate. After the application is submitted, the NRC asks the public to comment on which factors the agency should consider in its environmental review under the National Environmental Policy Act.

The NRC later posts a draft environmental evaluation on its website 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 Atomic Safety and Licensing Board 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 news releases, in the *Federal Register,* and on its website.

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.



Note: Alaska and Hawaii are not pictured but have no sites. After issuance of COLs, three licensees requested to have their licenses terminated by the NRC. Two COLs issued to South Carolina Electric & Gas and its financial partner on March 30, 2012, for Virgil C. Summer Nuclear Station, Units 2 and 3, were terminated on March 6, 2019. Two COLs issued to South Texas Project Nuclear Operating Company on February 12, 2016, for South Texas Project, Units 3 and 4, were terminated on July 12, 2018. Two COLs issued to Duke Energy Florida, LLC, on October 26, 2016, for Levy Nuclear Plants, Units 1 and 2 were terminated on April 26, 2018. Applications were withdrawn for Calvert Cliffs, Grand Gulf, Nine Mile Point, Victoria County, and Callaway (COL and ESP). NRC-abbreviated reactor names are listed. Data are current as of October 2024.
For the most recent information, go to the NRC website at https://www.nrc.gov.

Figure 24 . Locations of New Nuclear Power Reactors with Active Applications and Approved Licenses

Design Certifications

The NRC issues standard design certifications through rulemaking for reactor designs that meet basic requirements for ensuring safe operation. Utilities can cite a certified design when applying for a nuclear power plant construction permit, COL, ESP, or manufacturing license. The certification is valid for 15 years from the date issued and can be renewed for an additional 15 years. The NRC staff has also issued standard design approvals upon completion of the final safety evaluation report for the design. Standard design approvals may be referenced by a construction permit, COL, or manufacturing license. The new reactor designs under review incorporate new elements such as passive safety systems and simplified system designs. The seven certified designs are—

- *GE-Hitachi Nuclear Energy's Advanced Boiling-Water Reactor (ABWR)*
- *Westinghouse Electric Company's System 80+*
- *Westinghouse Electric Company's AP600*
- *Westinghouse Electric Company's AP1000*
- *GE-Hitachi Economic Simplified Boiling-Water Reactor (ESBWR)*
- *Korean Electric Power Corporation APR 1400 (Advanced Power Reactor)*
- *NuScale US600 Small Modular Reactor*

Design Certification Renewals

The NRC approved renewal of GE-Hitachi's ABWR design certification in 2021.

Advanced Reactor Designs

Several companies are considering advanced reactor designs and technologies and are conducting preapplication activities with the NRC. These reactors are cooled by liquid metals, molten salt mixtures, or inert gases. Advanced reactors can also consider fuel materials and designs that differ radically from today's enriched uranium dioxide (UO_2) pellets with zirconium cladding. The NRC is reviewing TerraPower's advanced power reactor application for the US SFR Owner, LLC-Kemmerer Unit 1. While developing the regulatory framework for advanced reactor licensing, the NRC is examining policy issues in areas such as security and emergency preparedness.

Small Modular Reactors

Small modular reactors (SMRs) use water to cool the reactor core in the same way as today's large light-water reactors. SMR designs also use the same enriched uranium fuel as today's reactors. However, SMR designs are considerably smaller. Each SMR module generates 300 MWe (1,000 MWt) or less, compared to today's large designs that can generate 1,000 MWe (3,300 MWt) or more per reactor.

New Reactor Construction Inspections

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

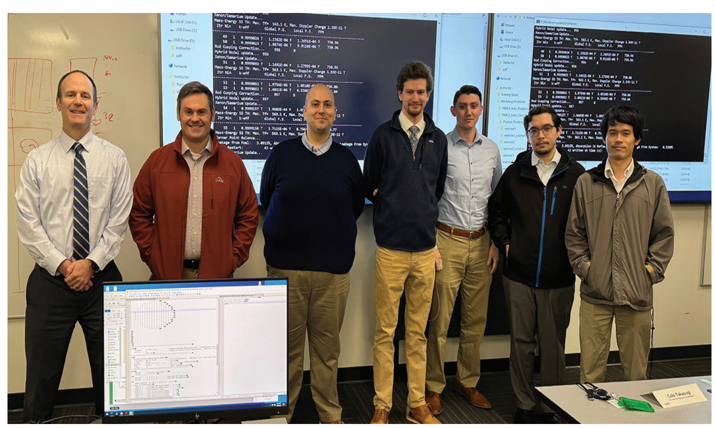
The NRC staff examines the licensee's operational programs in areas such as security, radiation protection, and operator training and qualification. Inspections at a construction site verify that a licensee has completed required inspections, tests, and analyses and has met associated acceptance criteria. The NRC's onsite resident construction inspectors oversee day-to-day licensee and contractor activities.

In addition, specialists in NRC Region II's Division of Construction Oversight 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 that the licensee has met all 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.

Technetium-99 (Tc-99) is produced by the decay of molybdenum-99 and is used in diagnostic nuclear medical imaging procedures.



NRC staff members participate in training at Oak Ridge National Laboratory on light-water reactor core physics codes and neutronics safety analysis methodology. The output generated from these codes supports technical reviews and confirmatory analyses to ensure nuclear reactor safety.

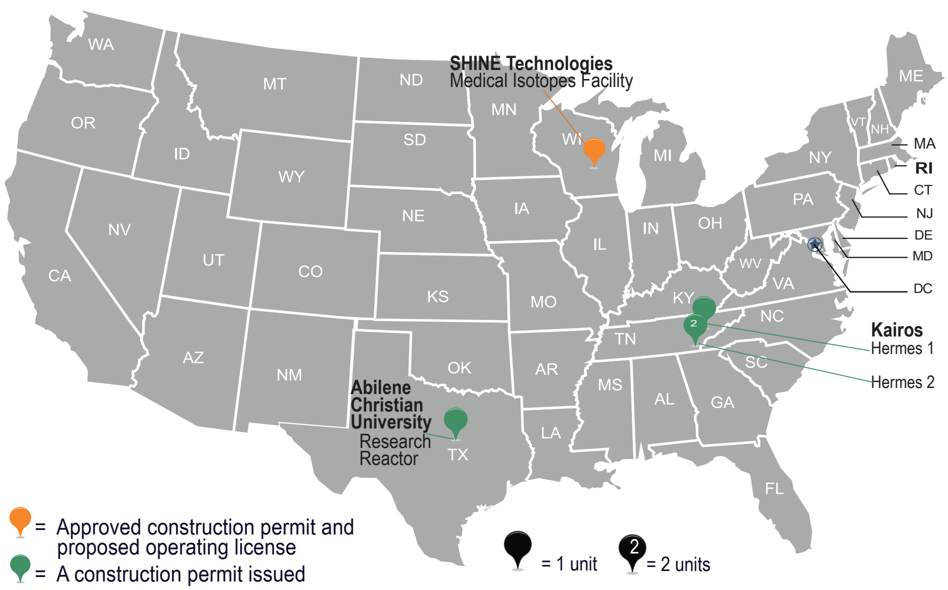
NEW LICENSING OF NONPOWER PRODUCTION AND UTILIZATION FACILITIES

Research reactors, testing facilities, and other nonpower facilities can be used to produce medical radioisotopes and demonstrate advanced reactor technologies. These RTRs are used to demonstrate new reactor technologies to meet future energy needs, promote training and education, and support needed medical care. To support these efforts, the NRC staff conducts safety and environmental reviews of construction permit and operating license applications, which are also subject to regulatory requirements for hearings and an independent review by the ACRS.

Doctors worldwide rely on a steady supply of molybdenum-99 (Mo-99) to produce technetium-99 (Tc-99), which is used in a radiopharmaceutical applied 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 these facilities submitted in accordance with the provisions of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." Since 2013, the NRC staff has received two construction permit applications and one operating license application for these facilities. The proposed facilities would irradiate low-enriched uranium targets in utilization facilities, then separate Mo-99 from other fission products in hot cells contained within a production facility. The NRC approved the construction permits for SHINE Medical Technologies, LLC (SHINE), in February 2016 and for Northwest Medical Isotopes, LLC, in May 2018. The staff is reviewing SHINE's application for a license to operate its facility.

The NRC staff has issued four nonpower reactor construction permits: three for Kairos Power's advanced test reactors and one for Abilene Christian University's advanced research reactor (See Figure 25: Locations of New NPUFs with Active Applications and Approved Licenses). The NRC anticipates receiving additional topical reports, construction permit applications, operating license applications, materials license applications, and license amendment requests in the coming years from other potential Mo-99 producers and advanced nonpower reactor applicants.

The NRC continues to update the 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 interagency interactions.



Note: Alaska and Hawaii are not pictured but have no sites.
Data are current as of December 2024. For the most recent information, go to the NRC website at https://www.nrc.gov.

Figure 25. Locations of New NPUFs with Active Applications and Approved Licenses