United States of America - 2025

PREAMBLE AND SUMMARY

This report provides information on the status and development of the nuclear power program in the United States of America (USA), including factors related to the effective planning, decision making, and implementation of the nuclear power program that together led to safe and economical operations of nuclear power plants.

The CNPP summarizes organizational and industrial aspects of the nuclear power program and provides information about the relevant legislative, regulatory, and international framework in the USA.

In 2024, the USA had 94 operating nuclear power reactors that produced nearly 18% of total electricity production. Nuclear generation also supports 475,000 U.S. jobs. The Alvin W. Vogtle two reactor unit expansion project was completed in 2024, adding 2200 MW(e) of new nuclear generation capacity to the U.S. grid. In addition, several decommissioned nuclear power plants are in the process of restarting. The Palisades Nuclear Plant has requested approval from the Nuclear Regulatory Commission (NRC) to restart in 2025, Three Mile Island Station, Unit 1 (renamed as the Crane Clean Energy Center), has requested approval to restart in 2028, and the Duane Arnold Energy Center has expressed interest in restarting.

1. COUNTRY ENERGY OVERVIEW

1.1. ENERGY SYSTEM

1.1.1. Energy Policy

The overall direction of the energy sector is determined largely by market forces rather than by formal government policy. However, federal policies and regulations do influence specific aspects of energy production and transmission, including, but not limited to, interstate commerce, mine safety, leasing of federal lands, support for research and development (R&D) activities, investment incentives, income taxes, tax incentives, nuclear licensing, and nuclear safety oversight.

The DOE Civil Nuclear Credit Program (CNC Program) is a US $6 billion strategic investment to help preserve the existing U.S. reactor fleet and retain thousands of high-paying jobs across the country. Under the new program, owners or operators of commercial U.S. reactors can apply for certification to bid on credits to support their continued operations. An application must demonstrate the reactor is projected to close for economic reasons and that closure will lead to a rise in air pollutants. Credits are allocated to selected certified reactors over a four-year period beginning on the date of the selection and credits can be awarded through 30 September 2031, if funds remain available. In January 2024, credits were awarded to the Diablo Canyon Power Plant, allowing the plant to stay in operation and continue to provide 9% of California's total power generation. Under the Consolidated Appropriations Act, 2024, Congress repurposed an aggregate amount of up to $3.72 billion in the CNC Program's unobligated balances appropriated under the Infrastructure Investment and Jobs Act of 2021 to carry out nuclear programs supporting small modular reactors (SMRs) and a uranium strategy pursuant to the Nuclear Fuel Security Act of 2023.

In addition to the federal role, state agencies formulate policies and issue regulations affecting the energy sector within each state. State involvement is generally related to mine safety and permitting, severance or other taxes, tax incentives, energy standards and renewable portfolio standards. States may regulate the electric power sector through public utility commissions and associated integrated resource planning processes and rate setting procedures.

1.1.2. Energy Statistics

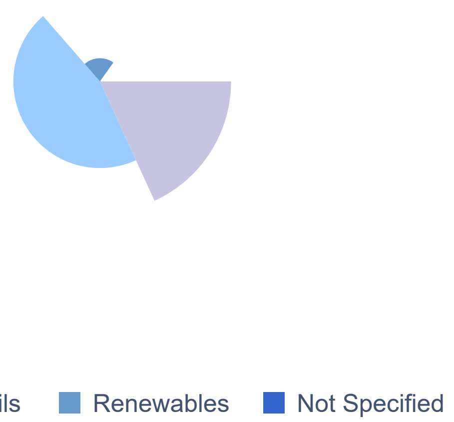
Energy statistics, projections and analyses are produced by the U.S. Energy Information Administration (EIA), which is the research agency within the United States Department of Energy (DOE). EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policy making, efficient markets, and public understanding about energy and its interaction with the economy and the environment. EIA is the USA's premier source of energy information and, by law, its data, analyses and forecasts are independent of approval by any other officer or employee of the Federal Government. A complete list of reports and publications that EIA produces is available at www.eia.gov/reports.

TABLE 1: INSTALLED CAPACITY AND ELECTRICITY PRODUCTION BY SOURCE

Energy Sources [Net]				
Energy Sources [Net]	Electricity Supplied		Installed Capacity	
	[GW(e)*h]	Share (%)	[GW(e)]	Share (%)
Total	4304039		1234.781	
Nuclear	781979	18.2	96.82	7.8
Fossils	1955224	45.4	709.351	57.4
---Coal (hard coal, lignite)	65276	1.5	171.514	13.9
---Gas	1864874	43.3	509.246	41.2
---Oil	25074	0.6	28.591	2.3
Renewables	914217	21.2	383.744	31.1
---Hydro (including tidal and wave)	242226	5.6	103.007	8.3
---Solar(PV)	218537	5.1	126.989	10.3
---Wind	453454	10.5	153.748	12.5
Others	65135	1.5	44.865	3.6
---Other	65135	1.5	44.865	3.6
Total				
Nuclear				
Fossils				
---Coal (hard coal, lignite)				
---Gas				
---Oil				
Renewables				
---Hydro (including tidal and wave)				
---Solar(PV)				

---Wind
Others
---Other
Data as of 2024-12-31 from IAEA Power Reactor Information System

CHART 1: ELECTRICITY PRODUCTION BY SOURCE



Electricity Supplied [GW(e)*h]

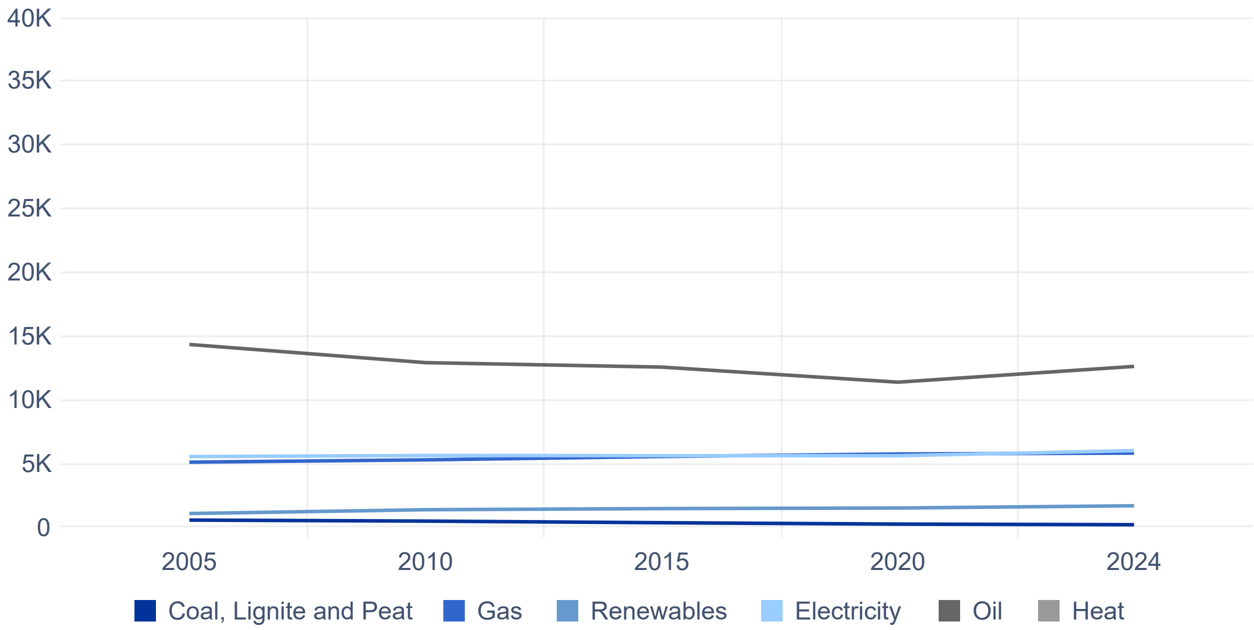
TABLE 2: ENERGY CONSUMPTION

Final Energy consumption [PJ]					
Final Energy consumption [PJ]	2005	2010	2015	2020	2024
Coal, Lignate and Peat	1306	1112	800	539	421
Petroleum products	34798	31328	30480	27605	30612
Natural gas	12350	12790	13435	13911	14082
Biomass and wastes	2333	2914	3164	3229	3634
Electricity	13414	13618	13591	13580	14553
Heat	223	368	335	378	402
Total	64424	62130	61805	59242	63704
Coal, Lignate and Peat					
Petroleum products					
Natural gas					

Biomass and wastes	
Electricity	
Heat	
Total	

Data as of 2024-12-31 from IAEA Referential Data Series 1

CHART 2: ENERGY CONSUMPTION



Final Energy consumption [PJ]

1.2. ELECTRICITY SYSTEM

The U.S. electric power sector is a complex market involving firms that generate, transmit and distribute electricity through intricate infrastructure networks involving a large number of participants. The electric power industry is the backbone of U.S. economic sectors, supplying energy for transport, water, emergency services, telecommunications, and manufacturing.

1.2.1. Electricity System and Decision-Making Process

The U.S. electric utility industry is regulated at federal and state levels. Several pieces of legislation were enacted to address national policies, end user needs and environmental protection. Legislation also forms the basis for federal regulation of transmission and wholesale electric power transactions. Section 3.2. contains a list of relevant electricity and nuclear power legislation.

1.2.2. Structure of the Electric Power Sector

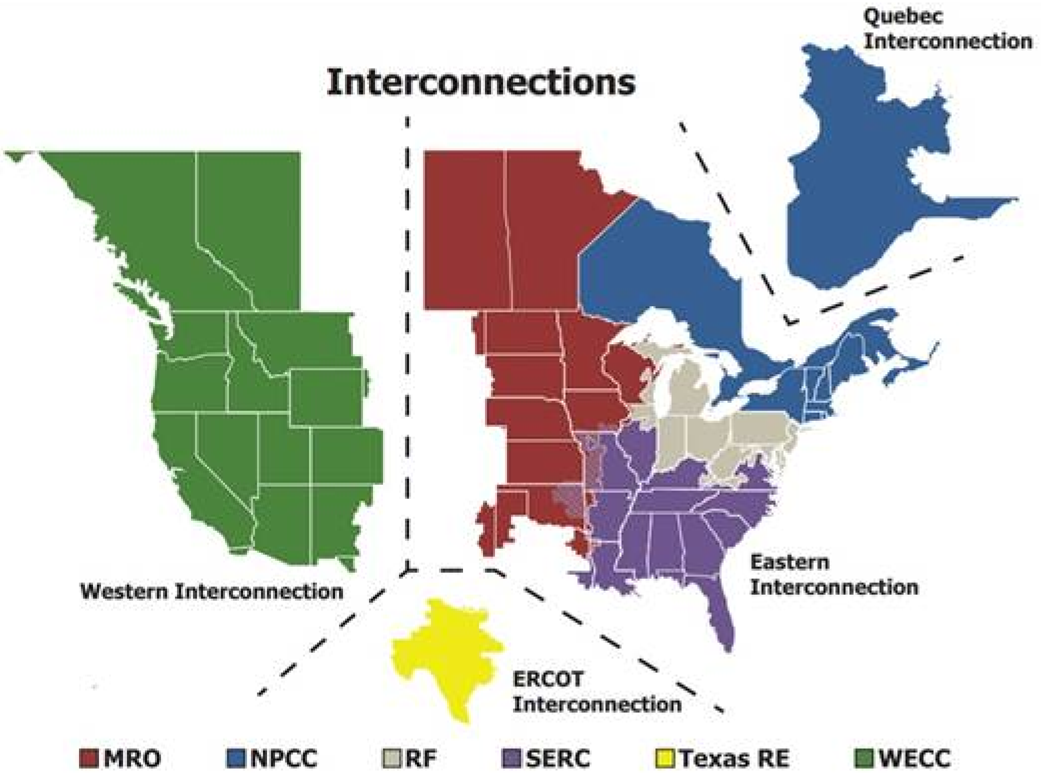
The electricity sector consists of regulated and unregulated markets. Some states have regulated markets in which generation, transmission and distribution of electric power are provided by a single utility. Other states have unbundled generation, transmission and distribution to allow for competitive wholesale and retail power market participation.

The structure of the U.S. electric power sector consists of four main components: generation, transmission, distribution and end users. The role of each component differs by state and region. Interstate electricity trade does occur; however, no single system or market structure dominates another. Most end users receive electricity from centralized power plants that use a variety of fuels to generate electricity. The largest sources of electricity generation are coal, natural gas, and nuclear power.

The electric power sector consists of a variety of participants, including public, private, and cooperative utilities; independent power producers; three regional synchronized power grids; eight electric reliability councils; and thousands of separate engineering, economic, environmental and land use regulatory authorities. Market participants include the following:

- Investor-owned utilities (IOUs): Large private companies financed by a combination of shareholder equity and bondholder debt governed by state regulatory authorities that set rates of recovery for ratepayers. Several IOUs have multi-fuel generators and multistate operations.
- Publicly owned utilities (POUs): Government or municipally owned utilities that are generally exempt from regulation by state regulatory commissions. POUs have an obligation to consider end user interests when setting rates and service standards.
- Independent power producers (IPPs): These IPPs generate electricity from a portfolio of power plants and do not provide local distribution services or retail sales to end users. Although an IPP may sell its power through brokers, it can also sell directly to the utilities and marketers. IPPs generally operate in the unregulated electricity markets.
- Cooperative utilities: These entities are owned by their end users and governed by a board of directors elected from the membership that sets the policies and procedures for the utility. Cooperative utilities are typically established in rural parts of the country where the end user base is small.
- Power marketing agencies: Federal entities that market wholesale power. Some agencies may also own power plants.
- Wholesale power suppliers: These suppliers do not own individual plants but buy power from multiple suppliers on a long term or spot market basis and then resell it. Brokers may be used to facilitate these transactions.
- Retail power marketers: Marketers buy and sell electricity but usually do not own or operate generation facilities. Electricity is sold directly to end users, such as households and small to medium sized commercial enterprises.

The power grid consists of three large, interconnected systems that synchronously move electricity around the lower 48 contiguous states: the Eastern Interconnection, the Western Interconnection, and the Texas Interconnected System. In general, these systems operate independently, with some limited electrical interconnection points. The Eastern Interconnection is the largest interconnected grid in the USA, connecting 39 states, the District of Columbia, and much of Canada (Fig. 1).



Source: North American Electric Reliability Corporation.

FIG. 1. Map of North American electricity grid interconnections.

Electrical transmission grids are coordinated, controlled, and monitored by electrical transmission system operators, which are traditionally non-profit organizations. Transmission line owners are required to supply transmission access to all electricity generators and wholesale energy customers in the service operator's area under standardized, open access tariff rates.

Electrical transmission system operators can be either independent system operators (ISOs), which can operate within a single state or across multiple states, or regional transmission organizations (RTOs) that cover wider areas crossing state lines. An ISO operates the region's electricity grid, administers the region's wholesale electricity markets and provides reliability planning for the region's bulk electricity system.

RTOs perform the same functions as ISOs but have greater responsibility for the transmission network, as established by the Federal Energy Regulatory Commission (FERC). RTOs coordinate, control and monitor the operation of the electric power system within their territories. RTOs also monitor the operation of the region's transmission network by providing fair transmission access. In addition, ISOs/RTOs engage in regional planning to make sure the needs of the system are met with the appropriate infrastructure (Fig. 2).

Sources: EIA, FERC, North American Electric Reliability Corporation.

FIG. 2. Map of U.S. wholesale electricity markets, ISOs and RTOs.

1.2.3. Electricity Statistics

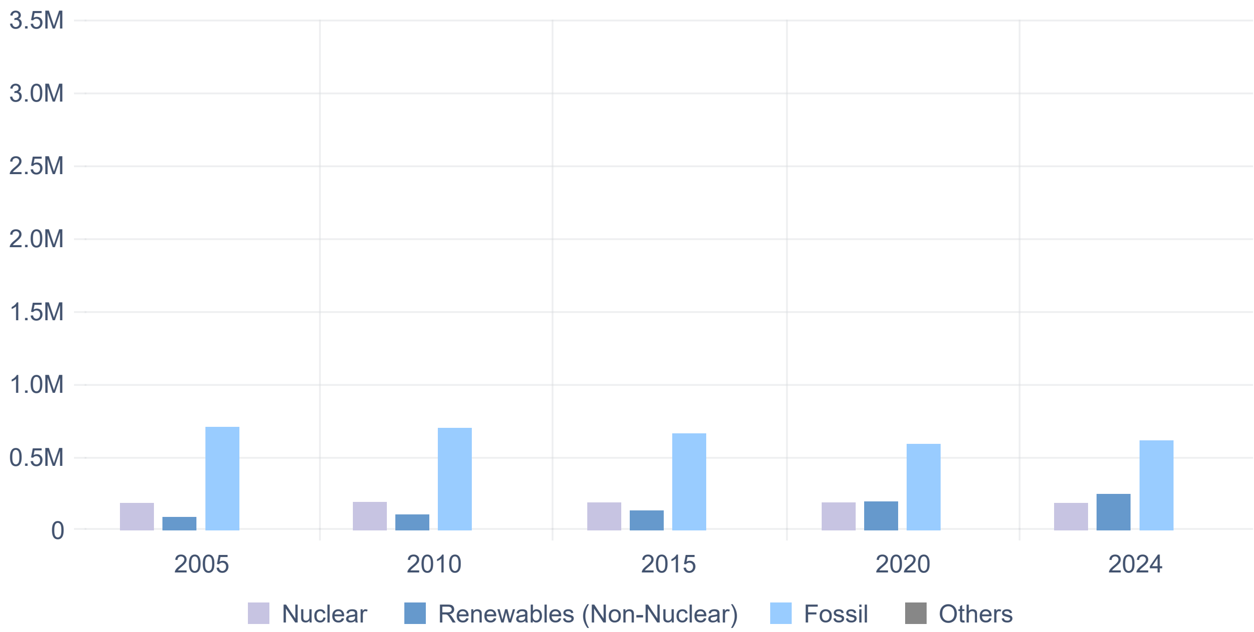
TABLE 3: ELECTRICITY PRODUCTION

Electricity production (GWh)					
Electricity production (GWh)	2005	2010	2015	2020	2024
Biomass and waste	71215	72606	80466	70514	59884
Coal, lignite and peat	2153956	1994194	1470997	855770	718295
Natural gas	782829	1017869	1372570	1680143	1923853
Oil	141290	48086	38837	37411	34455
Geothermal	16778	17577	18727	18831	18647
Hydro	297926	286333	271129	308213	265938
Nuclear	810726	838931	830288	823150	814545
Solar	1120	3942	35635	119329	276553
Tidal	0	0	0	0	0
Wind	17881	95148	192992	341818	458647
Others	647	3744	5518	4866	3478

Total	4294368	4378430	4317159	4260045	4574295
Biomass and waste					
Coal, lignite and peat					
Natural gas					
Oil					
Geothermal					
Hydro					
Nuclear					
Solar					
Tidal					
Wind					
Others					
Total					

Data as of 2024-12-31 from IAEA Referential Data Series 1

CHART 3: ELECTRICITY PRODUCTION



Electricity production (GWh)

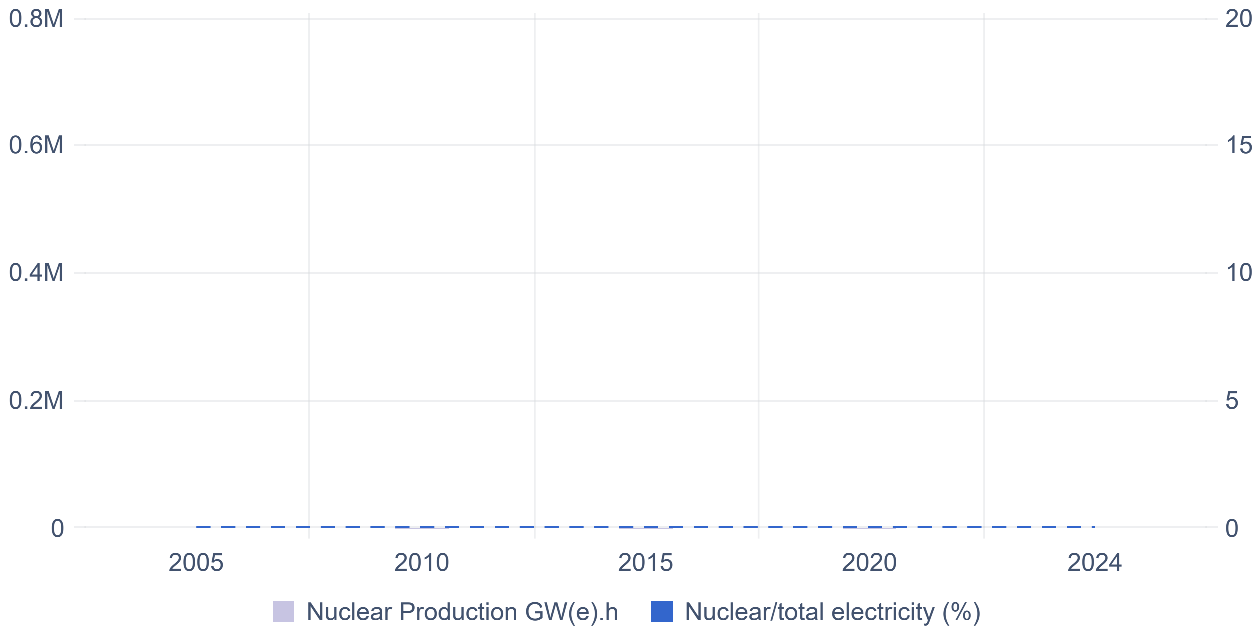
TABLE 4: NUCLEAR SHARE OF TOTAL ELECTRICITY PRODUCTION

	2005	2010	2015	2020	2024

Nuclear/total electricity (%)	19.3	19.6	19.5	19.7	18.2
Nuclear/total electricity (%)					

Data as of 2024-12-31 from IAEA Power Reactor Information System

CHART 4: NUCLEAR SHARE TREND



2. NUCLEAR POWER SITUATION

2.1. OVERVIEW

2.1.1. Historical Developments

The Atomic Energy Act of 1954 assigned the Atomic Energy Commission (AEC) the responsibility to explore the peaceful use of nuclear energy. The responsibilities of the AEC were both regulatory and developmental. Numerous joint industry–government groups were established to explore reactor design concepts. In 1957, the first large scale civilian NPP in the USA began operation in Shippingport, Pennsylvania. In 1960, the Dresden Nuclear Generating Station, in Grundy County, Illinois, became the nation's first full scale, privately financed commercial NPP.

Congress abolished the AEC in 1974 through the Energy Reorganization Act of 1974, in order to assign regulatory and energy development responsibilities to separate agencies. Under the Act, the NRC and the Energy Research and Development Administration (ERDA) were established. The NRC was established to serve as the independent regulatory authority tasked with assuring the safety and licensing of nuclear reactors and other facilities associated with the processing, transport, and handling of nuclear materials.

In 1977, the Department of Energy Organization Act was signed; ERDA was abolished, and the DOE was established to consolidate most federal energy activities under one department and thereby provide the framework for a comprehensive and balanced national energy plan.

The nuclear power industry grew dramatically during the 1960s and 1970s in response to strong electricity demand growth. During this period, the USA added 50 GW(e) of nuclear capacity. The capacity of nuclear units increased significantly during the 1970s and 1980s as utilities hoped to capture economies of scale. The nuclear industry ramped up the size of planned nuclear power units rapidly after the first round of commercial reactors.

Vogtle Unit 4 is the newest operating commercial nuclear reactor in the U.S. fleet. The 1114 MW(e) reactor was completed in 2024 and is an expansion of the Vogtle Electric Generating Plant in Waynesboro, Georgia. The four-reactor facility is owned and operated by Georgia Power. Along with Unit 3, which went online in July 2023, Unit 4 is a Westinghouse advanced passive (AP1000) pressurized water reactor. Vogtle already had two operating reactors, Units 1 and 2, with a capacity of approximately 1150 MW(e) each; construction on these two units began in 1976 and were respectively completed in 1987 and 1989.

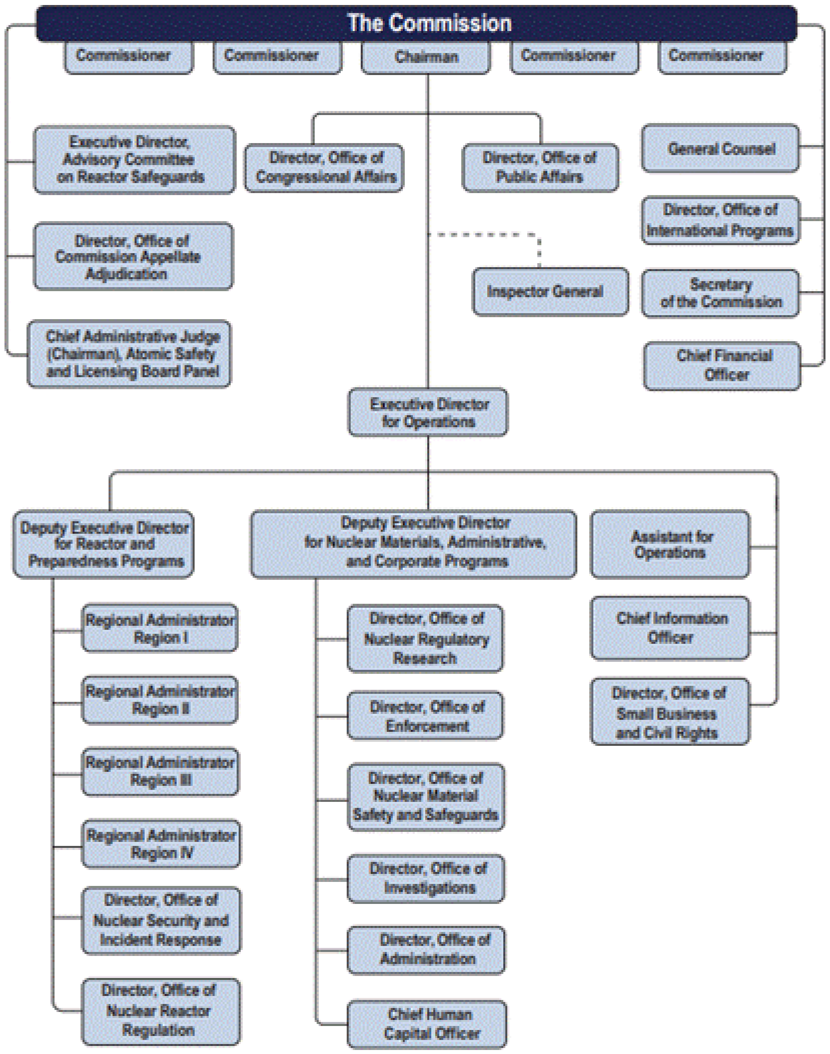
The Trump Administration demonstrated a commitment to the advancement of nuclear energy by re-issuing a $900 million solicitation to support the deployment of Generation III+ Small Modular Reactors to better align with the Trump Administration's goals. The goal of this program is to support the development of up to two light-water cooled SMR projects in the U.S. with associated support for the licensing, permitting, supply chain, and cost estimates for follow on SMR projects. The administration is also issuing the third loan disbursement of the up to $1.5 billion loan guarantee to Holtec for restarting the Palisades NPP, which was decommissioned in 2022, to meet the growing demand for affordable, reliable, and secure electricity. In addition to Palisades NPP, Three Mile Island Station, Unit 1 (renamed as the Crane Clean Energy Center), has requested approval to restart in 2028, and the Duane Arnold Energy Center has expressed interest in restarting. Two new commercial advanced reactors, TerraPower's Natrium and X-energy's Xe-100, are currently engaged in review activities for a construction permit with the NRC with the support from the DOE's Advanced Reactor Demonstration Program. Alongside commercial reactors, a number of test reactors are also on their way to being operational, such as Kairos Power's Hermes reactor.

In May of 2025, the Trump Administration issued four Executive Orders (EOs) (EOs 14299, 14300, 14301, and 14302) to support the U.S. nuclear industry. Some highlights from these EOs include:

- Ensuring the rapid development, deployment, and use of advanced nuclear technologies.
- Aligning incentives across the Federal Government to fully leverage federally owned uranium and plutonium resources, supply chain components, and research and development infrastructure.
- Increasing the deployment of new reactor technologies, such as SMRs, and microreactors.
- Expansion of U.S. nuclear energy capacity from approximately 100 GW(e) in 2024 to 400 GW(e) by 2050.
- Life extensions for the current nuclear fleet, as well as the reactivation of prematurely shuttered or partially completed nuclear facilities.
- Promoting to the fullest possible extent the production and operation of nuclear energy and building associated supply chains.
- Facilitating 5 GW of power uprates to existing nuclear reactors and have 10 new large reactors under construction by 2030.

2.1.2. Current Organizational structure

The NRC is part of the executive branch of the Federal Government and is the principal regulator of the nuclear power industry. The NRC is headed by five commissioners, who, along with the executive director for operations, formulate policies, develop regulations governing nuclear reactor and nuclear materials safety, issue orders for licences and adjudicate legal matters (Fig. 3).



Source: NRC

FIG. 3. U.S. Nuclear Regulatory Commission organizational chart.

The NRC leads consultations in cooperation with other government entities such as the Environmental Protection Agency (EPA), the Department of Transportation (DOT), the Occupational Safety and Health Administration (OSHA) and the Federal Emergency Management Agency (FEMA) to regulate nuclear safety standards and norms.

2.1.3. Development Strategy

The DOE Office of Nuclear Energy (DOE NE) works to advance nuclear energy science and technology to meet the country's energy and economic needs. DOE NE enables innovation, supports unique research infrastructure, and solves crosscutting challenges facing the nuclear energy sector to:

- Enable continued operation of existing U.S. nuclear reactors.
- Enable deployment of advanced nuclear reactors.
- Develop advanced nuclear fuel cycles.
- Maintain U.S. leadership in nuclear energy technology.
- Enable a high-performing organization.

The DOE Loan Programs Office also has the authority to issue loan guarantees for nuclear power. In February 2014, the DOE finalized the first federal loan guarantee for US $6.5 billion with Georgia Power Company and Oglethorpe Power Corporation for the construction and operation of two reactors at Vogtle, which have since been completed.

In early 2018, the deadline for the nuclear production tax credit for advanced NPPs was extended under a government budget bill. Section 40501 of the law allows reactors entering service after 31 December 2020 to qualify for the tax credits, with no established sunset provision for the credits at this time and enables the U.S. Secretary of Energy to allocate credits for up to 6000 MW(e) of new nuclear capacity which enters service after 1 January 2021. The extension means that the two new Vogtle units are eligible for the tax credits.

In April 2025, the Trump Administration issued the third release of the up to $1.52 billion loan guarantee to Holtec for the restart of the Palisades Nuclear Plant, which will provide 800 MW(e) of affordable, reliable baseload power when completed.

2.2. CONSTRUCTION

2.2.1. Project Management

Project management in the construction and operations of NPPs is the responsibility of the owners and operators of the NPPs. The Institute of Nuclear Power Operations (INPO) is an industry organization that undertakes the following activities, among other mission objectives, at the request of individual NPP owners or operators:

- Conducting plant evaluations;
- Supporting training and accreditation for nuclear power professionals;
- Assisting in the analysis of significant events at NPPs;
- Communicating lessons learned;
- Providing assistance with technical and management issues.

2.2.2. Project Funding

Nuclear utilities and, in some cases, public utility commissions are responsible for project financing decisions. Funding is secured from banks and through shareholder equity. The Federal Government, through the Energy Policy Act of 2005 (EPACT2005), provides incentives for the construction of new NPPs, including tax credits, loan guarantees, and standby support insurance related to regulatory delays. Section 2.1.3. provides further details on project funding options.

2.2.3. Sites

Though there are a number of sites that could be expanded, there are currently no plans being actively pursed. However, there are a number of advanced commercial and test reactors currently under review by the NRC as listed below (see Table 7). The NRC has issued construction permits for the Kairos Hermes-1 and Hermes-2 test reactors which will be sited in Oak Ridge, Tennessee, and for the Natura Resources LLC MSR-1, or Molten Salt Research Reactor, which will be built at Abilene Christian University in Abilene, Texas. In addition, there are more than 30 reactor designs currently in the pre-application process with the NRC. The NRC is currently reviewing the application for a construction permit for the TerraPower Natrium sodium fast reactor near a retiring coal plant in Kemmerer, Wyoming, which was submitted in June 2024; the review is progressing well. TerraPower also broke ground for construction of its non-nuclear Sodium Test and Fill Facility last year. Long Mott Energy, LLC has submitted its construction permit application to the NRC as the company prepares to construct XE-100 reactors at Dow's UCC Seadrift Operations manufacturing site in Seadrift, Texas. Holtec is also still in the process of recommissioning the Palisades NPP in Covert Township, Michigan, and the Trump Administration issued the third release of the $1.5 billion loan guarantee for the restoration of the plant. In addition to restoring the plant, Holtec is considering constructing two new SMRs at the site.

TABLE 5A: STATUS OF REACTORS UNDER CONSTRUCTION

Data as of 2024-12-31 from IAEA Power Reactor Information System

2.2.4. Organizations and Institutions

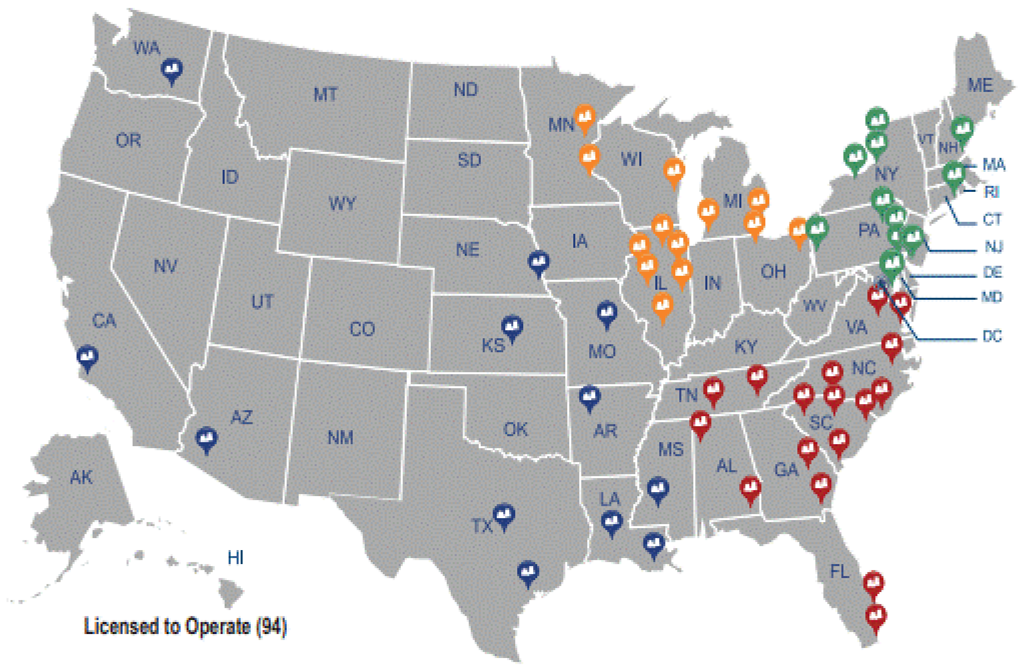
A large number of companies provide equipment and services to the U.S. nuclear power industry that cover the entire nuclear fuel cycle. Westinghouse Corporation built most of the PWR units, although Combustion Engineering and Babcock & Wilcox also built some. General Electric designed all of the boiling water reactors (BWRs) currently operating in the USA.

To help assure high quality products, the American Society of Mechanical Engineers (ASME) certifies nuclear equipment suppliers. To obtain a nuclear certificate of authorization (often referred to as an N-Stamp), a company must comply with quality assurance requirements set forth by the ASME, which is open to foreign companies. Presently, more than 200 foreign and U.S. companies hold ASME nuclear certificates of authorization.

2.3. OPERATION

2.3.1. Status and Performance of Nuclear Power Plants

The U.S. nuclear power industry is the largest in the world, with 94 operating commercial nuclear reactors, which have a total capacity of 96952 MW(e) (Table 5B). Most nuclear facilities are located in the central to eastern part of the USA (Fig. 4). In 2024, NPPs produced 781 TW·h of electricity, accounting for nearly 19% of total U.S. electricity generation. In 2024, the weighted average unit capability factor for the US nuclear fleet was 94.1% compared with a global median of 83.9%.



Source: US Nuclear Regulatory Commission

FIG. 4. U.S. Operating Commercial Nuclear Power Reactors

TABLE 5B: STATUS OF REACTORS IN OPERATION

Data as of 2024-12-31 from IAEA Power Reactor Information System

2.3.2. Plant Life Management, Plant Upgrades and License Renewals

Plant operators have implemented power uprates as to increase reactor output. Power uprates are expressed as a percentage of the original licensed capacity of a reactor and are classified by the NRC in three groups:

- Measurement uncertainty recapture uprates, which include enhanced techniques for calculating reactor power, are typically less than 2%.
- Stretch power uprates are typically less than 7% and do not usually involve major plant modifications.
- Extended power uprates require significant modifications to most plant equipment, might take place over several refueling outages and can be as much as 20%.

U.S. nuclear plants are licensed by the NRC to operate for 40 years, after which plants can extend their operating licenses for up to 20 years at a time. Most U.S. nuclear reactors have already renewed their operating licenses out to 60 years.

Several plants will be nearing the end of the first 20-year extension by 2029 and will be seeking to renew their licenses a second time for another 20-year period. As of 2024, the NRC has approved subsequent licence renewal (SLR) applications for Turkey Point Units 3 and 4, Peach Bottom Units 2 and 3, Surry Units 1 and 2, North Anna Units 1 and 2, Monticello Unit 1, and Oconee, Units 1, 2,and 3, and is currently reviewing SLR applications from eleven more power plants. The NRC is also currently reviewing initial license renewal applications from Perry Unit 1, Diablo Canyon Units 1 and 2, and Clinton Unit 1.

See Section 2.7 for U.S. nuclear plant safety upgrades post-accident at the Fukushima Daiichi NPP.

2.3.3. Organizations and Institutions

Most operating nuclear reactors in the USA are privately owned and operated, although nine are operated by government owned entities. Some NPPs are partially owned but not managed by municipal or electric cooperatives. Thirty-two companies or management organizations are licensed by the NRC to operate reactors.

2.4. DECOMMISSIONING

The retirement process for NPPs involves disposing of nuclear waste and decontaminating equipment and facilities to reduce residual radioactivity, making the process more expensive and time consuming than retiring other types of power plant.

Since 2013, 13 commercial nuclear reactors were retired. Most recently the Palisades Nuclear Generating Station stopped generating electricity in June 2022 when it retired Unit 1 after 50 years of operations since 1972. However, Holtec, who purchased the reactor from Entergy in 2018, is currently in the process of requesting NRC approval to restart in 2025. Additionally, Three Mile Island Station, Unit 1 (renamed as the Crane Clean Energy Center), has requested approval to restart in 2028, and the Duane Arnold Energy Center has expressed interest in restarting.

However, the nuclear share of total electricity generation has remained relatively constant over the years despite a decrease in the total number of operating reactors. This is largely the result of performance improvements such as power uprates and increased operator experience.

As of 2022, 11 commercial nuclear reactors have been successfully decommissioned, and another 22 reactors are currently in various stages of the decommissioning process (Table 6). Licensees can choose from the following three decommissioning strategies:

- DECON (immediate dismantling) begins soon after the nuclear facility closes. Equipment, structures, and the portions of the facility that contain radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the license.
- SAFSTOR, often referred to as deferred dismantling, is when a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay. Once the radioactivity reaches a safe level, the plant is dismantled, and the property is decontaminated.
- ENTOMB is when radioactive contaminants are permanently encased on site in structurally sound material such as concrete. The facility is maintained and monitored until the radioactivity decays to a level permitting restricted release of the property. To date, no NRC licensed facilities have requested this option.

The licensee may also choose to adopt a combination of the first two choices in which some portions of the facility are dismantled or decontaminated while other parts of the facility are left in SAFSTOR. The decision may be based on factors besides radioactive decay, such as availability of waste disposal sites.

Decommissioning must be completed within 60 years of the plant ceasing operations. An extension of that time would be considered only when necessary to protect public health and safety under NRC regulations. The decommissioning process is complete when the NRC determines that the dismantlement has been performed according to the plan submitted by the operator at the beginning of the decommissioning process.

The decommissioning process is paid for through a fund that each plant operator creates during construction with funds typically accumulated during the period of commercial operations. About two thirds of the total estimated cost of decommissioning all US nuclear reactors has been collected. The remainder will be collected as newer plants continue to operate and generate revenues. The utility must report to the NRC every two years on the status of funding until the plant is within five years of permanent shutdown, at which time reporting becomes annual.

2.4.1. Permanent Shutdown

TABLE 5C: STATUS OF REACTORS IN PERMANENT SHUTDOWN

Data as of 2024-12-31 from IAEA Power Reactor Information System

2.4.2. Decommissioning Plan and Process

TABLE 6: STATUS OF DECOMMISSIONING PROCESS OF NUCLEAR POWER PLANTS

Data as of 2024-12-31 from IAEA Power Reactor Information System
Please refer to RDS2 Publication Table 17 for more information on status of Decommissioned reactors

2.4.3. Organizations and Institutions

When a U.S. power company decides to permanently close an NPP, the facility must be decommissioned by safely removing it from service and reducing residual radioactivity to a level that permits the NRC to release the property and terminate the operating licence.

Federal agencies oversee the entire nuclear decommissioning process:

- The NRC establishes regulations and provides oversight of NPP decommissioning. The NRC maintains the highest level of decommissioning regulatory authority and collaborates with other agencies to supervise decommissioning.
- The EPA collaborates with the NRC to establish environmental standards and provide oversight of NPP decommissioning.
- OSHA collaborates with the NRC to ensure the safety of workers at NPPs undergoing decommissioning.
- The DOT regulates the shipment of radioactive materials, including those resulting from decommissioning an NPP.

State and local agencies are also involved as regulators of worker and public health and safety.

2.5. PLANNED DEPLOYMENT OF NUCLEAR POWER

2.5.1. Planned Nuclear Power Projects

There are multiple advanced reactor designs in various stages of deployment within the United States. Some examples include:

- Kairos Hermes 1 and Hermes 2 pebble bed fluoride salt-cooled, high temperature reactor anticipated to be built in Oak Ridge, Tennessee.
- Natura Resources, LLC MSR-1 and MSR-100 molten salt reactor, anticipated to be built at Abilene Christian University, Abilene, Texas and Texas A&M Univeristy, College Station, Texas respectively.
- TerraPower's Natrium sodium fast reactor, anticipated to be built in Kemmerer, Wyoming.
- X-Energy's XE-100 pebble bed high temperature gas reactor, anticipated to be built in Seadrift, Texas.

TABLE 7: CONSIDERED AND PLANNED NUCLEAR POWER PLANTS

Data as of 2024-12-31 from IAEA Power Reactor Information System
Please refer to RDS2 Publication Table 12 for more information on status of Planned reactors

2.5.2. Considered Technologies

There are multiple reactor technologies being considered for deployment. As indicated in Section 2.5.1, the following technologies are in various stages of deployment including:

- Pebble bed fluoride salt-cooled, high temperature reactors
- Molten salt reactors
- Sodium fast reactors
- Pebble bed high temperature gas reactors

Additionally, there are other reactor types being considered for deployment including:

- Sodium-cooled microreactors
- Gas-cooled fast reactors
- Generation III+ light water reactors

2.6. FUEL CYCLE AND WASTE MANAGEMENT

2.6.1. Fuel Cycle Activities

EIA publishes data on the nuclear fuel cycle (Fig. 5) in its Domestic Uranium Production Report and its Uranium Marketing Annual Report. The NRC publishes background and licensing information on fuel cycle operations.

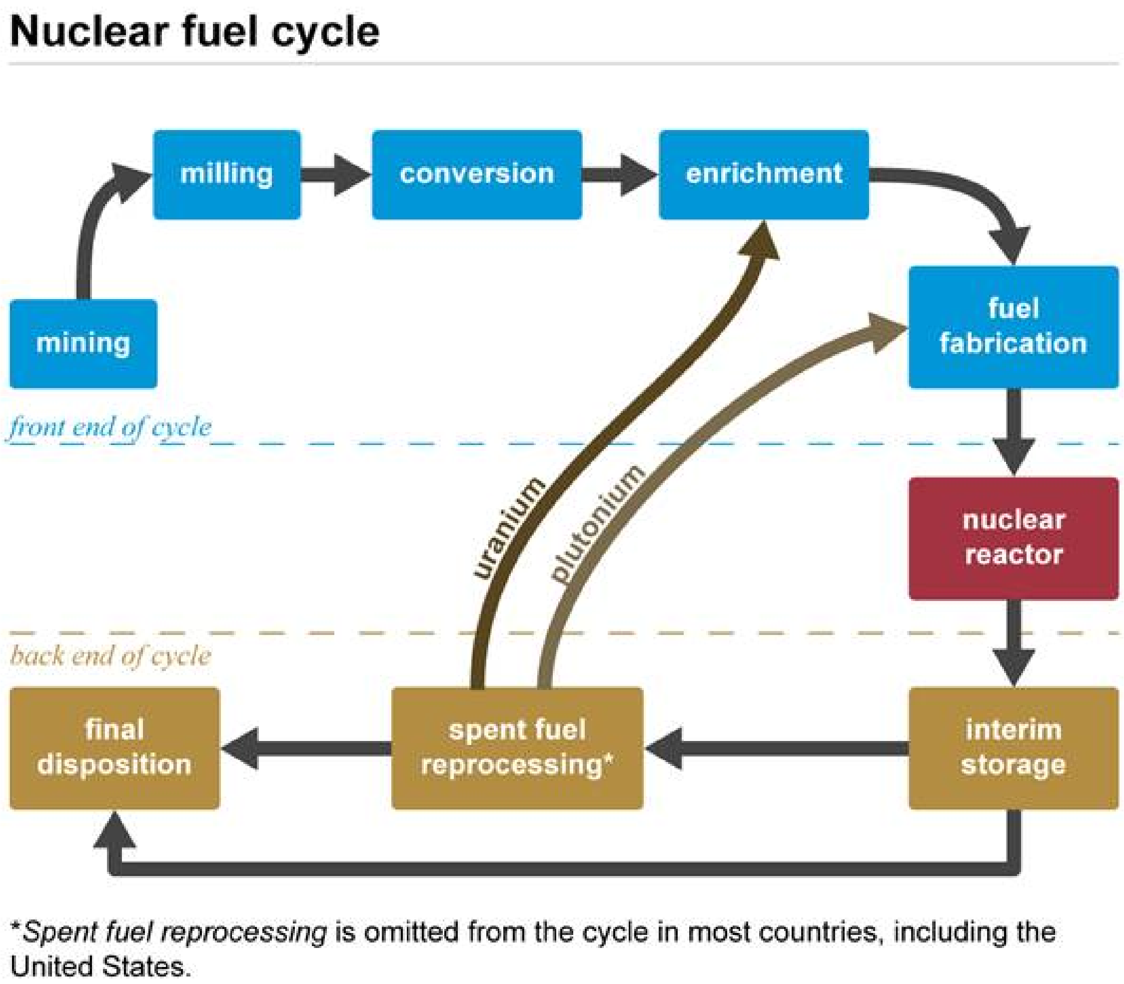


FIG. 5. The fuel cycle for nuclear reactors.

Source: Pennsylvania State University Radiation Science and Engineering Center (public domain)

Notes: Reprocessing of spent nuclear fuel (SNF), including mixed oxide (MOX) fuel, is not commercially practiced in the USA. The NRC has no regulatory role in mining uranium; regulations are primarily left to the states and the U.S. Department of Interior, Bureau of Land Management.

The following are some salient points:

- Drilling: In 2023, total uranium drilling was 1 930 holes with total footage of 326,000 meters, and expenditures for uranium drilling were US $28 million.

- Mining and production: The NRC has no regulatory role in mining uranium; regulations are primarily left to the states and the Bureau of Land Management.
- Conversion: The USA has one uranium conversion plant, located in Metropolis, Illinois, and operated by ConverDyn. The ConverDyn facility has a nameplate conversion capacity of approximately 15 000 tons of uranium per year to UF6.
- Enrichment: Uranium enrichment in the USA is accomplished by gas centrifuge, although laser separation technology is under development for possible use to enrich uranium. Currently, the only large-scale gas centrifuge commercial production plant is the URENCO USA facility licensed as Louisiana Energy Services in Eunice, New Mexico. American Centrifuge Operating, a subsidiary of Centrus Energy Corp., operates a small-scale enrichment facility in Piketon, Ohio. It is the first enrichment facility in the USA licensed to produce high-assay, low-enriched uranium (HALEU) (5 to 19.75% U-235).
- Fuel fabrication: Three companies fabricate nuclear fuel for light water reactors: Westinghouse Columbia Fuel Fabrication Facility in Columbia, South Carolina; Global Nuclear Fuel — Americas in Wilmington, North Carolina; and Framatome, Inc. in Richland, Washington. All three fabricators supply fuel for U.S. BWRs; Framatome and Westinghouse also supply fuel for U.S. PWRs. For advanced reactor fuels, the X-Energy TRISO-X, LLC facility in Oak Ridge, Tennessee is currently undergoing the licensing process to produce TRISO pebbles, and the TRISO-X, LLC and Global Fuels-America facilities are undergoing licensing review to be able to produce HALEU fuels..
- Spent nuclear fuel storage: Most SNF is safely stored in specially designed pools at reactor sites around the country. Plant operators may store SNF in dry cask storage systems when they approach their pool capacity limits at independent spent fuel storage facilities. Operators may also store SNF in dry cask storage systems away from the reactor at independent spent fuel storage facilities.
- Reprocessing: Commercial reprocessing of SNF, including mixed oxide fuel, is not practiced in the USA, although it has been conducted in the past.
- Spent fuel disposal: In 2011, federal funding for Yucca Mountain, the U.S. permanent disposal repository for SNF, was cancelled. Commercial nuclear power reactors store their SNF on site at the nuclear plants, although a very limited amount has been shipped to off-site facilities from a few reactors.

2.6.2. Waste Management

The U.S. produces and manages SNF from commercial NPPs, defense activities, and research reactors. All operating NPPs store SNF in NRC-licensed onsite spent fuel pools. All but one of the operating NPPs also store SNF in NRC-licensed Independent Spent Fuel Storage Installations (ISFSIs) located onsite.

Most NPPs that have been decommissioned or are undergoing decommissioning also have SNF stored onsite pending disposal. Most permanently-shutdown commercial NPPs currently have, or are planning to have, their SNF stored at onsite ISFSIs. NRC amended its regulations in 1990 to allow licensees to store SNF in NRC-certified dry cask storage systems at licensed NPPs under either a specific license or a general license tied to the reactor license. In the most used cask designs, SNF is loaded in canisters with inert gas and welded closed. The canisters are then placed in storage casks or vaults/bunkers. Some cask designs can be used for both storage and transportation. SNF is also stored at several research reactor sites licensed by the NRC

There are approximately 2,450 metric tons heavy metal (MTHM) of SNF stored in DOE-managed facilities in either wet or dry storage facilities. DOE manages SNF from defense activities and domestic and foreign research reactors, and limited quantities of SNF from commercial activities. Most of this SNF is stored at the Hanford Site in Washington State, the Idaho National Laboratory (INL) in Idaho, the Savanah River Site (SRS) in South Carolina, and the Fort St. Vrain Independent Spent Fuel Storage Installation (ISFSI) in Colorado prior to further disposition. DOE continues to receive SNF from foreign and domestic research reactors.

The Nuclear Waste Policy Act (NWPA) establishes the federal responsibility for the disposal of commercial SNF and commercial HLW. The NWPA assigns responsibilities for the disposal of commercial SNF and commercial HLW to three federal agencies:

- DOE for developing permanent disposal capability for SNF and HLW;
- EPA for developing generally applicable environmental protection standards for disposal;
- NRC for developing regulations at 10 CFR Part 60 to implement EPA standards, for deciding whether or not to license construction, operation, decommissioning, and closure of repositories for SNF and HLW, and for certifying packages used to transport SNF and HLW to the licensed repositories under 10 CFR Part 71.

Commercial generators of LLW in the USA must treat these wastes to remove free liquids and stabilize or destroy other hazardous components contained in the waste. Also, wastes are often treated to reduce the final disposal volume through compaction and incineration. Commercial companies provide processing (e.g., packaging and treatment) and brokerage services to facilitate safe storage, transportation, and, ultimately, disposal of commercial LLW. The commercial LLW can be disposed at one of the four currently licensed commercial LLW near-surface disposal facilities (i.e., a land disposal facility where radioactive waste is disposed within the upper 30 m of the Earth’s surface) or at approved alternative disposal sites in accordance with 10 CFR 20.2002.

Greater than Class C (GTCC) LLW is generated by NRC and Agreement State licensees and contains higher concentrations of long- and short-lived radionuclides than Class C LLW. GTCC LLW is generally grouped into the following three types: sealed sources, activated metals, and other waste. Other waste includes contaminated equipment, debris, filters, resins, and scrap metal from miscellaneous activities, such as production of medical isotope 99Mo.

The Low-Level Waste Policy Amendments Act (LLWPAA) assigned responsibility for the disposal of GTCC LLW to the Federal Government. Currently, there are no facilities licensed to accept GTCC LLW for disposal. NRC has developed a draft regulatory basis for GTCC LLW disposal at licensed facilities.

DOE manages transuranic waste (TRU) waste from former weapons production and R&D activities. TRU waste from atomic energy defense activities is disposed of in the Waste Isolation Pilot Plant (WIPP) geologic repository.

2.7. EMERGENCY PREPAREDNESS

Nuclear utilities; federal, state, and local governments; as well as volunteers and first responders work together in the event of an emergency at an NPP. Each plant is responsible for developing on-site and off-site emergency response plans. Federal oversight of emergency preparedness for NPPs is shared by the NRC and FEMA, which is part of the U.S. Department of Homeland Security.

The respective roles of the NRC, FEMA, and state and local governments are identified on the NRC’s federal, state and local responsibilities web site. The NRC has statutory responsibility for the radiological health and safety of the public by overseeing on-site preparedness and has overall authority for both on-site and off-site emergency preparedness.

As part of its reactor oversight process, the NRC reviews NPP emergency planning procedures and training. FEMA acts as the federal facilitator with state and local governments. State and local governments are responsible for determining and implementing appropriate public protective actions during a radiological emergency and are also responsible for notifying the public to take such protective actions.

Each utility is required to conduct emergency preparedness exercises with the NRC, FEMA and off-site authorities at least once every two years to ensure state and local officials remain proficient in implementing their emergency plans. Utilities also regularly conduct drills to test the emergency plans.

Detailed information about emergency preparedness is contained in NRC regulations and in a joint publication of the NRC and FEMA entitled Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants. Additional information is available on the NRC's emergency preparedness and response web site as well as FEMA's Radiological Emergency Preparedness Program web site.

The NRC has taken significant actions to enhance reactor safety based on the lessons learned from the accident at the Fukushima Daiichi NPP. These actions are related to accident mitigation strategies, reliable hardened containment venting capability, improved spent fuel pool instrumentation, seismic hazard re-evaluation, flooding re-evaluation, emergency preparedness, mitigation of beyond design basis events, and improvements to the NRC's regulatory process.

2.8. RESEARCH AND DEVELOPMENT

2.8.1. Development of Novel Technology and Applications

The DOE NE supports R&D to improve safety and reliability to help extend the life of current reactors and to develop improvements in the safety, affordability, and proliferation resistance of new reactors.

In the area of nuclear reactor technologies, the DOE NE's Light Water Reactor Sustainability Program focuses on developing the scientific basis to understand aging in reactors and research new technologies to enhance and extend NPP operating life while ensuring long term reliability, safety, and security. The Advanced Reactor Demonstration Program (ARDP) focuses private and federal resources on supporting the development of commercially promising advanced reactors that have the potential for near and mid-term demonstration projects through 50/50 cost-shared cooperative agreements that were competitively awarded. These projects are designed to facilitate development of U.S. private industry advanced reactors that are safe, reliable, licensable, and commercially viable. The two ARDP projects are:

- TerraPower, LLC, with plans to demonstrate a 345/500 MW(e) Natrium Sodium-Cooled Fast Reactor at their Kemmerer, Wyoming demonstration site. The design is coupled with a molten salt energy storage capability for flexible electricity output and peaking power requirements.
- X-energy with plans to demonstrate a 320 MW(e), four-unit Xe-100 High Temperature Gas-Cooled Reactor at the Dow, Long Mott Generating Station, Seadrift, Texas demonstration site. The plant will provide high-temperature process steam to support Dow's industrial operations.

ARDP also supports advanced reactor concepts with the potential for future demonstration through cost-shared competitively awarded projects that are designed to maximize the utility of the results across the nuclear energy industry. The projects are aimed at reducing risk and technical uncertainty for a broad range of reactor designs including the Kairos Power, LLC Hermes reduced-scale test reactor. Hermes is intended to lead to the development of Kairos Power's commercial-scale fluoride salt-cooled high temperature reactor that leverages TRISO fuel in pebble form and a low-pressure fluoride salt coolant.

In addition, the DOE NE supported the commercialization of US based SMR technologies through its SMR Licensing Technical Support Program, which has since been succeeded by the Advanced SMR R&D Program. The program promotes the accelerated commercialization of SMRs by supporting certification and licensing requirements through cooperative agreements with industry partners and through supporting the highest priority design maturation and supply chain needs necessary for the successful deployment of advanced reactors. The Tennessee Valley Authority (TVA) is planning an SMR demonstration project at its Clinch River site, for which the NRC has approved an early site permit. In addition, Holtec International is currently planning to construct two SMR-300 reactors at its Palisades site, which was previously under decommissioning.

INL's Demonstration of Microreactor Experiments (DOME) facility is being established to host fueled advanced reactor experiments up to 20 MW(th) with High Assay Low-Enriched Uranium (HALEU) fuels while providing safety-significant confinement for reactors to go critical for the first time. Westinghouse's eVinci Microreactor, Radiant's Kaleidos Microreactor, and the Antares R1 Microreactor are all planned to test in DOME. In addition, Oklo is planning to build their Aurora SFR at INL along with the Aalo Atomics Aalo-X sodium cooled reactor.

Finally, the DOE NE is supporting the development of advanced reactor technologies, including molten salt reactors, liquid metal-cooled reactors, high temperature gas-cooled reactors, and microreactors. The Advanced Reactor Technologies (ART) Program addresses technical and regulatory barriers to enable the deployment of advanced nuclear fission energy systems. Activities include design methods, materials qualification, energy conversion, experimental validation of models, and international collaborations, as well as support for competitively awarded projects to assist the progression of emerging advanced reactor designs and technologies.

The DOE NE's Office of Nuclear Fuel Cycle develops sustainable fuel cycle technologies and options and develops used nuclear fuel (UNF) management strategies and technologies to support meeting the responsibility of the Federal Government to manage and dispose of U.S. commercial UNF and high-level waste (HLW).

Within the office, the Fuel Cycle Research and Development Program conducts R&D to help develop sustainable fuel cycles to improve uranium resource utilization, maximize energy generation, minimize waste generation, improve safety and limit proliferation risk.

- The Material Recovery and Waste Form Development (MRWFD) subprogram conducts applied research and development (R&D) on advanced fuel recycle technologies that have the potential to improve resource utilization and energy generation, reduce waste generation, and limit proliferation risk. The subprogram focuses on developing advanced fuel recycling technologies and addressing fundamental materials separations and recovery challenges that present significant degrees of technical risks and financial uncertainties.
- The Mining, Conversion, and Transportation subprogram supports R&D that enables technological advances in uranium mining, conversion, and transportation capabilities in the United States as well as conducting evaluations and assessments related to these areas. This subprogram supports activities related to the front end of the nuclear fuel cycle and supply chain.
- The Accident Tolerant Fuels subprogram mission is enabling industry's development of one or more light water reactor (LWR) fuel concepts with significantly enhanced accident tolerance through cost shared research and development (R&D).
- The Fuel Cycle Laboratory R&D subprogram supports research activities that advance knowledge of nuclear fuel cycles and provide transformative innovations to accelerate development of civil nuclear technologies, including consideration of fuel cycle impacts from the potential deployment of advanced reactor technologies. It includes activities in Materials Protection, Accounting and Control Technologies (MPACT), Systems Analysis and Integration (SAI), Innovative Nuclear Materials (INM), and Innovative Process Control (IPC). Advanced reactor fuels R&D has joined other long-term fuel concepts in the new Next Generation Fuel subprogram.

- The Next Generation Fuels subprogram supports industry with financial assistance and lab-based R&D to continue to drive innovation over the long term. It lays the groundwork for fuels that significantly outperform today's fuel, focusing on long-term, high-risk, high-reward fuel concepts. This work features high-reward fuel concepts, including Advanced Coated Particle (TRISO) fuel and Silicon Carbide Cladding development.
- The Advanced Nuclear Fuel Availability subprogram will work to make available small quantities of HALEU from limited DOE uranium inventories and leverage the HALEU enrichment demonstration capability in the short term, in coordination with the National Nuclear Security Administration (NNSA), and work with the private sector to establish a commercial U.S. HALEU production and supply chain capability for the long term, including associated research and development activities.

2.8.2. Organizations and Institutions

Nuclear R&D is conducted by private industry, the Federal Government, and U.S. universities. Private companies are actively investigating reactor technology, enrichment technology, and nuclear fuel design. One of the main institutions for private research funding is the Electric Power Research Institute, which through membership fees, conducts R&D in many nuclear related areas as well as other areas of the electric power industry.

The Federal Government supports R&D through budget allocations for the NRC and for the DOE. Private companies, under contract with the DOE, operate a series of national laboratories. The DOE oversees 17 national laboratories, many of which are involved with nuclear technologies.

2.9. HUMAN RESOURCES DEVELOPMENT

The USA has reversed the trend of declining enrolment at nuclear engineering schools over the past five years. Generally, the workforce in the nuclear power industry is aging; many professional skills could be lost as the staff at NPPs, research facilities, universities and national laboratories retire. With limited NPP construction under way, the number of trained personnel the industry will require in the future is unclear. However, the long-term decline in the number of university programs offering nuclear engineering degrees reversed course in the late 1990s; several schools have added programs in the past few years.

The DOE NE has an active program to encourage the development of academic programs related to nuclear power through its Nuclear Energy University Program (NEUP). NEUP was created in 2009 to consolidate university support under one initiative and better integrate university research within the DOE NE's technical programs. NEUP engages U.S. colleges and universities to conduct R&D, enhance infrastructure, and support student education, thereby helping to build and sustain an advanced nuclear energy workforce capability. In 2024, DOE NE awarded more than $86 million for nuclear energy research, university nuclear infrastructure development, and undergraduate scholarships and graduate training at universities and colleges across the country.

In 2007, the nuclear industry developed and began implementing the Nuclear Uniform Curriculum Program (NUCP). The NUCP is managed by the Nuclear Energy Institute and is a standardized certificate program designed to ensure that a well-trained workforce is available when needed. Industry partners with two-year educational institutions permit certificate holders to be exempt from some initial training at an NPP.

The American Nuclear Society, a professional organization, also promotes the expansion of academic programs related to nuclear power at higher education institutions.

2.10. STAKEHOLDER INVOLVEMENT

Stakeholders in the USA include, but are not limited to, state and tribal governments, local communities, federal agencies, industry, and professional organizations. Communications are timely and open through formal and informal processes. From a regulatory perspective, formal processes may include:

- Information exchanges;
- Public comment on proposed regulations;
- Annual meetings with stakeholders at each reactor facility;
- Participation in legal proceedings.

The goal of formal regulatory stakeholder communication is to ensure that the public has the opportunity to enhance its understanding of the regulatory process. Stakeholders are provided with advance notice of regulatory meetings in a timely manner.

2.11. INTERNATIONAL COOPERATIONS AND INITIATIVES

The Federal Government collaborates with international partners to advance the safe, secure, and peaceful use of nuclear energy worldwide. The Office of Nuclear Energy engages both bilaterally and multilaterally to strengthen nuclear energy cooperation, drive innovation, and promote energy security.

Bilaterally, DOE NE works with partner countries on civil nuclear research and development and related policy issues through a variety of mechanisms. These include the International Nuclear Energy Research Initiative (I-NERI), negotiated R&D agreements, memoranda of understanding, technical action plans, and civil nuclear energy working groups, which convene regularly to coordinate joint activities and ensure policy alignment. These working groups serve as key platforms for identifying shared priorities, facilitating technical collaboration, and supporting the responsible development of nuclear energy programs.

To further support global capacity-building and sustainable development, DOE NE has established Regional Energy Training Centers (RETCs) in Europe and Africa. These centers offer regionally tailored leadership, technical, professional, and vocational training through collaboration with U.S. government agencies, national laboratories, industry, and academia. The RETCs provide hands-on learning opportunities and serve as regional hubs for workforce development, knowledge exchange, and the application of best practices.

Multilaterally, the United States participates in and provides leadership to major international partnerships such as the Generation IV International Forum, the OECD Nuclear Energy Agency, the International Atomic Energy Agency (IAEA), and the International Framework for Nuclear Energy Cooperation. These collaborations support coordinated research on advanced reactor systems, global nuclear policy development, stakeholder engagement, and the expansion of civil nuclear infrastructure and workforce readiness.

The Office of International Cooperation oversees and manages the DOE's international commercial nuclear fuel management initiatives and supports DOE and government initiatives that foster increased U.S. exports of nuclear fuel and services, as appropriate. It encourages international cooperation between governments and industry to provide commercially attractive fuel service options, including a comprehensive nuclear fuel services approach.

The NRC has close working relationships with 50 countries and conducts confirmatory regulatory research in partnership with nuclear safety agencies and institutes in more than 20 countries. Research includes, but is not limited to, the following programs:

- The Cooperative Severe Accident Research Program;
- The Code Applications and Maintenance Program;
- The Steam Generator Tube Integrity Program;
- The Radiological Computer Code Analysis and Maintenance Program.

3. NATIONAL LAWS AND REGULATIONS

3.1. REGULATORY FRAMEWORK

3.1.1. Regulatory Authority(s)

The NRC's mission is to regulate the nation's civilian use of by-product, source and special nuclear materials to ensure adequate protection of public health and safety, to promote the common defense and security and to protect the environment. The NRC has regulatory responsibility for the following:

- Commercial reactors used to generate electric power and non-power reactors for research, testing and training;
- Uranium enrichment facilities and nuclear fuel fabrication facilities;
- Uses of nuclear materials in medical, industrial and academic settings, and facilities that produce nuclear fuel;
- Transport, storage and disposal of nuclear materials and waste, as well as decommissioning of nuclear facilities.

The DOE serves a complementary, but highly significant, role in administering support to the nuclear power industry. The DOE NE serves to promote civil nuclear technology through research, development and demonstration. The National Nuclear Security Administration maintains and enhances nuclear safety and security and responds to nuclear and radiological emergencies in the USA and abroad. EIA provides statistical data and analysis for nuclear and uranium.

The North American Electric Reliability Corporation (NERC) is a non-profit regulatory authority that addresses the reliability of the US electrical system. The NERC develops and enforces reliability standards; annually assesses seasonal and long-term reliability; monitors the bulk power system through system awareness; and educates, trains and certifies industry personnel.

3.1.2. Licensing Process

There are two primary NRC licensing processes.

Under the first process, reflected in the 10 CFR 50 series of regulations, two licensing actions are required to deploy a new reactor. The NRC first issues a construction permit that authorizes construction. This is then followed by the issuance of an operating license, which approves fuel loading and plant operation.

Under the second licensing process, the NRC may issue a combined construction and operating license (COL). When the applicant uses an NRC certified design within this process, safety issues related to the design have already been resolved, and the focus of the licensing review is on the details of the site where the reactor facility will be constructed and operated. Before authorizing power operation at a reactor, certain requirements identified in the COL must be satisfied. These standards are called inspections, tests, analyses and acceptance criteria (ITAAC). Most of the ITAAC are from the reactor design certification; the remaining ITAAC are site specific and are included in the COL or early site permit (ESP) application.

3.1.2.1. Early site permit applications

Independent of an application for a construction permit (10 CFR 50 [4]) or a COL (10 CFR 52 [5]), the NRC may approve one or more sites for an NPP. An ESP remains in effect for 10 to 20 years and may be renewed for an additional 10 to 20 years. As of 31 December 2023, the NRC had issued ESPs for six sites.

3.1.2.2. Design certifications for new reactors

The NRC has issued design certifications for eight new designs: the Westinghouse AP600 and AP1000, System 80+, the General Electric nuclear energy advanced boiling water reactor (ABWR), the ABWR Design Certification Rule (DCR) Amendment, the GE–Hitachi economic simplified boiling water reactor (ESBWR), the advanced power reactor 1400 (APR1400), and the NuScale Small Modular Reactor (US600). Under current licensing regulations, an applicant who seeks to build a new reactor can use an off-the-shelf reactor design that the NRC has previously approved and certified. The streamlined process encourages standard or pre-approved reactor designs. Issuance of a design certification is independent of applications for a companion COL. Design certifications are valid for 15 years and may be renewed for an additional 10 to 15 years.

3.1.2.3. Combined construction and operating licenses

The NRC has issued fourteen COLs for commercial nuclear plant facilities, based on the above certified designs. The two Vogtle Units 3 and 4, utilizing the Westinghouse AP1000 design, have been completed and are operating. A COL is valid for 40 years and may be extended for additional periods of 20 years at a time.

3.2. MAIN NATIONAL LAWS AND REGULATIONS IN NUCLEAR POWER

US Congress has enacted several laws that delineate a comprehensive regulatory program governing the design, construction and operation of nuclear energy plants. Transport and disposal of radioactive waste is a major concern of the industry and the public, and there is specific legislation to address such activities as well.

This list is not exhaustive; additional national legislation affecting the nuclear industry also exists. Although the Federal Government has an extensive role in the nuclear industry, individual states and some local jurisdictions have a regulatory role.

- Consolidated Appropriations Act, 2024: This law allocates $2.72 billion to the DOE in order to promote enrichment and conversion services in the US in accordance with the Nuclear Fuel Security Act of 2023.
- The Inflation Reduction Act of 2022 (IRA): This act provides production tax credits (PTC) for existing NPPs and for new NPPs and specifically for advanced reactors and SMRs. The IRA amends the definition of a qualified facility eligible for a “clean PTC” to mean any plant placed into service after 31 December 2024, that produces zero greenhouse gas emissions.
- Bipartisan Infrastructure Law, 2021: This law includes continued funding for Advanced Reactor Demonstration Program (ARDP) projects, which are targeting deployments in the late 2020s. A DOE implemented US $6 billion Civil Nuclear Credit Program that would provide financial support to certain nuclear reactors that are at risk of closing due to insufficient valuation in electricity markets.
- Consolidated Appropriations Act, 2018: This act includes over US $1.2 billion in support for the DOE NE programs and US $922 million for the NRC. The bill also allows reactors entering service after 31 December 2020 to qualify for the tax credits (there is no established sunset provision for the credits at this time) and enables the US Secretary of Energy to allocate credits for up to 6000 MW(e) of new nuclear capacity which enters service after 1 January 2021.

- The American Recovery and Reinvestment Act of 2009 (ARRA 2009): The American Recovery and Reinvestment Act of 2009 directed funding for energy efficiency and renewable energy as well as loan guarantees for renewable energy, including nuclear power.
- The Energy Policy Act of 2005 (EPACT2005): EPACT2005 contained provisions affecting nuclear power, including the renewal of the Price–Anderson Act and incentives for building the first advanced NPPs. Incentives include tax credits, loan guarantees and standby support insurance related to regulatory delays.
- The Energy Policy Act of 1992 (EPACT1992) (Public Law 102-486): EPACT1992 created a new category of electricity producer, the exempt wholesale generator, which circumvented the Public Utility Holding Company Act's (PUHCA's) impediments to non-utility electricity generation. EPACT1992 also allowed FERC to open the national electricity transmission system to wholesale suppliers. Of EPACT1992's 30 titles, seven contain provisions related specifically to nuclear power and/or uranium.
- The Clean Air Act Amendments of 1990 (Public Law 101-549): These amendments established a new emissions reduction program that sought to reduce annual sulfur dioxide emissions by 10 million tons and annual nitrogen oxide emissions by 2 million tons from 1980 levels from all human-made sources. Generators of electricity were to be responsible for large portions of the sulfur dioxide and nitrogen oxide reductions.
- Low-level Radioactive Waste Policy Amendments Act of 1985 (Public Law 96-573, as amended): This act was an important step towards the development of new disposal capacity for low level waste (LLW). Each state was made responsible for providing, by itself or in cooperation with other states, for the disposal of LLW generated within the state. The act authorizes the states to form compacts to establish and operate regional LLW disposal facilities, subject to NRC licensing approval.
- Nuclear Waste Policy Act of 1982, as amended (Public Law 97-425): This act established federal responsibility for the development of repositories for the disposal of HLW and UNF. It was amended in 1987 to require DOE to begin evaluating the suitability of Yucca Mountain in Nevada as the US permanent HLW repository.
- The Public Utility Regulatory Policies Act of 1978 (PURPA) (Public Law 95-617): PURPA sought to promote conservation of electric energy in response to the unstable energy climate of the late 1970s. PURPA created a new class of non-utility generators (small power producers), from which, along with qualified co-generators, utilities were required to buy power.
- The Clean Water Act of 1977 (Public Law 95-217): The Clean Water Act of 1977 is the primary law governing the discharge of pollutants into all US surface waters. Under this law, the EPA requires that a National Pollutant Discharge Elimination System permit be obtained before any pollutant is released.
- Energy Reorganization Act of 1974 (Public Law 93-438): This act separated the licensing and related functions of the AEC from energy development and related functions. The NRC succeeded the AEC as an independent regulatory authority to ensure the safety and licensing of nuclear reactors and other facilities associated with the processing, transport and handling of nuclear materials.
- Price–Anderson Nuclear Indemnity Act of 1957 (Public Law 83-703, as amended): The Price–Anderson Act requires each operator of an NPP to obtain the maximum primary coverage of liability insurance. In the past, the annual premium paid by owners of NPPs was US $375 million per reactor. Damages exceeding that amount are funded with a retroactive assessment on all other owners of commercial reactors, based on the number of reactors they own and not to exceed about US $112 million.
- Atomic Energy Act of 1954 (Public Law 83-703, as amended): The Atomic Energy Act of 1954 encouraged private enterprise to develop and use nuclear energy for peaceful purposes. This act amended the Atomic Energy Act of 1946 to allow non-federal ownership of nuclear production and utilization facilities if an operating license was obtained from the AEC. This act enabled the development of the commercial nuclear power industry in the USA.

- The Federal Power Act of 1935 (Title II of PUHCA): The Federal Power Act of 1935 was passed at the same time as PUHCA. It provides a federal mechanism, as required by the Commerce Clause of the Constitution, for interstate electricity regulation. Before this act was passed, electricity generation, transmission and distribution were typically a series of intrastate transactions.

APPENDIX 1. INTERNATIONAL, MULTILATERAL AND BILATERAL AGREEMENTS

Agreements with the IAEA

Agreement : Additional Protocol to the U.S.-IAEA Safeguards Agreement (AP)
Countries : United States of America
Signature Date :
Ratification Date : 2009-01-06
In-Force Date :
Notes : The U.S. Additional Protocol, which entered into force on January 6, 2009, is a treaty between the U.S. and the IAEA that is appended to the U.S. –IAEA Safeguards Agreement. As with the U.S. –IAEA Safeguards Agreement, the U.S. brought the full text of the Model Additional Protocol2 into force to demonstrate that the U.S. will accept the same burdens on its commercial nuclear industry as is being required of the non-nuclear weapon states. Under the U.S. Additional Protocol, more U.S. facilities and companies are subject to the reporting requirements and expanded IAEA access rights than were under the U.S. –IAEA Safeguards Agreement alone.

Agreement : The Nuclear Non-Proliferation Treaty (NPT)
Countries : United States of America
Signature Date : 1968-06-12
Ratification Date : 1970-03-05
In-Force Date :
Notes : The NPT is an international treaty widely considered to be the cornerstone of the nonproliferation regime. It covers three mutually reinforcing pillars (disarmament, nonproliferation, and peaceful uses of nuclear energy). There are a total of 191 States that are Party to the Treaty, including the five declared nuclear-weapon States (China, France, the Russian Federation, the United Kingdom, and the United States). The fundamental principle of the NPT considers that the recognized nuclear weapon States will move towards disarmament; non-nuclear weapon States will not acquire them; and all countries can access nuclear technology for peaceful (civilian) purposes. The NPT entered into force in 1970, and in 1995, the Parties voted to extend it indefinitely. The Parties gather every 5 years for a Review Conference to review accomplishments and challenges in implementing the NPT. Between Review Conferences, they participate in Preparatory Committee meetings.

Agreement : United States-International Atomic Energy Agency (IAEA) Safeguards Agreement ("Voluntary Offer") and Additional Protocol to the U.S. –IAEA Safeguards Agreement (AP)
Countries : United States of America
Signature Date : 1977-11-18
Ratification Date : 1980-12-09
In-Force Date :

Notes : Through safeguards agreements with more than 180 countries, the IAEA verifies that governments are honoring their international legal obligations to use nuclear material and technology only for peaceful purposes. Under the voluntary offer safeguards agreement, select facilities in the United States report material accounting data on declared nuclear material to the IAEA, and, upon request, submit to IAEA inspections.

APPENDIX 2. MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

National Authorities

Nuclear Research Institutes

Associated Industry Partners

REFERENCES

	Number	Source	Link

Not Applicable

COORDINATOR INFORMATION

Coordinator
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