

★ Recent Legislative Actions:

- Feb: The Nuclear Fuel Security Act (NFSA) was introduced in the Senate. The bipartisan bill would authorize the Department of Energy to establish a Nuclear Fuel Security Program to expeditiously increase domestic production of both low-enriched uranium (LEU) and high-assay low-enriched uranium (HALEU) to ensure fuel security for the US light water reactor fleet and the development of advanced reactors.
- March: Four bills debuted in the House of Representatives to reshape the way our country uses and views nuclear energy. The bills include a resolution for Congress to support the expansion of domestic nuclear energy and advanced nuclear technology, the creation of a national strategy to use microreactors in the aftermath of natural disasters, deferment of Nuclear Regulatory Commission (NRC) regulatory fees for small businesses, and expansion of NRC employees' ability to provide anonymous feedback on existing challenges in the nuclear industry.
- March: A bipartisan effort in the Illinois General Assembly to repeal the state's decades-old prohibition on new nuclear plant construction made progress when the House Public Utilities Committee voted 18–3 to advance a bill lifting the ban. The ban originates in language in the Illinois Public Utilities Act, which prohibits nuclear plant construction in the state until a method of disposal for high-level nuclear waste is identified and approved. The bill, which has 31 co-sponsors, would remove the language from the act, paving the way for nuclear plants to replace Illinois coal and natural gas facilities likely to retire early due to climate change legislation passed in 2021.



- ★ February 9: The NRC presented its proposed 30-month licensing review timeline of TRISO-X's planned fuel fabrication facility at the project's first-ever public meeting in Oak Ridge, TN. TRISO-X, a subsidiary of X-energy, has requested as 40-year license to possess and use special nuclear material to manufacture advanced fuel. The facility would be the first-ever commercial-scale fuel fabrication plant focused on using HALEU.
- ★ February 28: Westinghouse Electric Company has filed a notice of intent to submit key licensing reports for its eVinci microreactor to the NRC and Canadian Nuclear Safety Commission for joint review. The two nuclear regulators signed a memorandum of cooperation in August 2019 to increase collaboration on the technical reviews of advanced reactor and small modular reactor technologies. Report topics for joint review include a common set of key requirements for the classification of eVinci systems, structures, and components.
- ★ March 1: Following remediation of a last-minute pipe issue, Vogtle-3 achieved initial criticality in the first week in March 2023. With Unit 3 criticality now reached, operators will continue to raise power to support synchronizing the generator to the electric grid and begin producing electricity. Operators will then further increase power through multiple steps, ultimately raising power to 100%.
- ★ March 1: Dow and X-energy announced that they have signed a joint development agreement (JDA) to demonstrate the first grid-scale advanced nuclear reactor at an industrial site in North America within a decade. As part of the agreement, Dow is now a sub-awardee under X-energy's Advanced Reactor Demonstration Program (ARDP) Cooperative Agreement with the Department of Energy (DOE). Dow and X-energy plan to install an Xe-100 high-temperature, gas-cooled reactor (HTGR) plant at one of Dow's U.S. Gulf Coast sites, where it would provide both power and steam heat for industrial processes. Working with the DOE, Dow and X-energy expect to finalize site selection—subject to the DOE's review and approval—in 2023. According to the companies, the JDA includes up to \$50 million in engineering work, up to half of

which is eligible for ARDP funding, with the other half funded by Dow. The JDA work scope also includes the preparation and submission of a construction permit application to the NRC.

- ★ March 10: The NRC has authorized the restart of a test reactor at the National Institute of Standards and Technology's Center for Neutron Research, in Gaithersburg, MD. The reactor was shut down in February 2021 when a fuel element became damaged during startup and approach to full power. The incident violated the NRC's fuel cladding temperature safety limit, although public health and safety were not affected, according to the agency.
- ★ March 16: A reoccurring leak of water containing tritium has led to the temporary shutdown of Xcel Energy's Monticello nuclear power plant in Minnesota. The initial leak of 400,000 gallons was reported to the NRC in November 2022 and the source was identified in December 2022. A temporary repair instituted in late 2022 did not capture all the leaking water, and Xcel Energy is currently working with state, federal, city, and county leaders to keep them apprised of further repair efforts.

Vendors and utilities that wish to certify a new reactor design or a potential site or construct and operate a new nuclear power plant must submit an application to the NRC, which will then conduct an in-depth review of safety and environmental aspects related to the design and / or site.

Reactor Design Certifications (DC)

By issuing a DC, the NRC approves a nuclear power plant design, independent of an application to construct or operate a plant. A DC is valid for 15 years from the date of issuance but can be renewed for an additional 10 to 15 years. A DC application (DCA) must include enough information to show the design meets NRC's safety standards and that the design resolves any existing generic safety issues and issues that arose after specific events in the nuclear industry such as the Three Mile Island accident. Applications must closely analyze the design's appropriate response to accidents or natural events, including lessons learned from the Fukushima accident. Applications must also lay out the inspections, tests, analyses, and acceptance criteria that will verify the construction of key design features. Certification reviews identify key information to consider in site-specific reviews for operating licenses. *(From NRC website)*

As of January 2023, six reactor designs that are being considered for future builds in the U.S. have been certified by the NRC. Two previously submitted designs have been withdrawn from consideration¹.

	VENDOR	TECHNOLOGY	STATUS
Issued	Westinghouse	AP1000	Issued: 12/30/2011
	Westinghouse	AP600	Issued: 12/1999, expired 01/2015
	General Electric-Hitachi	ESBWR	Issued: 11/14/2014
	NuScale Power	NuScale SMR Power Module	Issued: 02/21/2023
	Korea Electric Power Corp	APR1400	Issued: 9/19/2019
Renewal	General Electric-Hitachi	ABWR	Originally Issued: 5/12/1997 Final Safety Evaluation Report approved in March 2020

¹ AREVA US-EPR – Submitted December 12, 2007, and docketed February 25, 2008; review suspended at the request of the applicant. Mitsubishi Heavy Industries US-APWR – Submitted December 31, 2007, and docketed February 29, 2008; MHI has requested a deferral of the review due to their work on reactor restarts in Japan.

- ★ March 28: The NRC recently announced that it will begin reviewing most of the standard design approval (SDA) application for NuScale Power's uprated small modular reactor technology, with the remainder of the review on hold until the company provides additional details on a key safety topic. According to the NRC, portions of NuScale's application discussing steam generator safety performance under certain conditions require more information. If the SDA is approved, companies could reference the standard design approval when applying for a license to build and operate a similar reactor in the United States.

Early Site Permits (ESP)

By issuing an early site permit (ESP), the U.S. Nuclear Regulatory Commission (NRC) approves one or more sites for a nuclear power facility, independent of an application for a construction permit or combined license. An ESP is valid for 10 to 20 years from the date of issuance and can be renewed for an additional 10 to 20 years. In reviewing an ESP application, the NRC staff will address site safety issues, environmental protection issues, and plans for coping with emergencies, independent of the review of a specific nuclear plant design. During this process, the NRC notifies all stakeholders (including the public) as to how and when they may participate in the regulatory process, which may include participating in public meetings and opportunities to request a hearing on the issuance of an ESP. *(From NRC website)*

Six ESPs have been issued and one was withdrawn.³

	SITE/LOCATION		UTILITY	TECHNOLOGY REFERENCED	STATUS
Issued	Clinton	IL	Exelon	Plant Parameter Envelope (PPE)	Issued: 3/15/2007
	Grand Gulf	MS	Entergy	PPE	Issued: 4/5/2007
	North Anna	VA	Dominion Power	PPE	Issued: 11/27/2007 Amended 1/30/2013
	Vogtle	GA	Southern	AP1000/ Westinghouse	Issued: 8/26/2009
	Salem County	NJ	PSEG	PPE	Issued: 5/5/2016
	Clinch River	TN	TVA	PPE	Issued: 12/19/2019

³Victoria County Station, Texas (Exelon) was withdrawn from NRC review October 2012

Combined Construction and Operating Licenses (COL)

By issuing a COL, the NRC authorizes the licensee to construct and (with specified conditions) operate a nuclear power plant at a specific site, in accordance with established laws and regulations. In a COL application (COLA), NRC staff reviews the applicant's qualifications, design safety, environmental impacts, operational programs, site safety, and verification of construction with inspections, testing, analyses, and acceptance criteria. The staff conducts its review in accordance with the Atomic Energy Act, NRC regulations, and the National Environmental Policy Act. All stakeholders (including the public) are given notice as to how and when they may participate in the regulatory process, which may include participating in public meetings and opportunities to request a hearing on the issuance of a COL. Once issued, a COL is good for 40 years and can be renewed for an additional 20. A COL application may reference a certified design and/or an ESP, or neither. *(From NRC website)*

A COL is valid indefinitely. If a licensee chooses not to construct a plant immediately following the issuance of a COL, it must submit a COL update annually to the NRC to reflect the most recent regulatory requirements and any new or different environmental or design information, or it can request an exemption. To begin construction, the COL must be fully updated. Alternatively, a licensee can choose to withdraw their COL if they no longer wish to proceed with the plants.

A total of nineteen COL applications have been docketed by the NRC. Eight applications, totaling 14 reactors, have been issued COLs and one is under review. Eight applications were suspended and later withdrawn⁴ due to utility, economic or other considerations while two applications remain in “suspended” status⁵. After the COL was issued, three applications, totaling six reactors, were subsequently terminated.⁶

	SITE/LOCATION		UTILITY	REACTOR TECHNOLOGY/ NO. of REACTORS		STATUS
Issued	Vogtle	GA	Southern Nuclear	AP1000	2	Issued: 2/10/2012
	Fermi	MI	DTE Energy	ESBWR	1	Issued: 5/1/2015
	William States Lee	SC	Duke Energy	AP1000	2	Issued: 12/19/2016
	North Anna	VA	Dominion Energy	ESBWR	1	Issued: 6/2/2017
	Turkey Point	FL	Florida Power and Light	AP1000	2	Issued: 4/12/2018

⁴ Suspended and Withdrawn: Bell Bend; Bellefonte 3&4 Callaway 2, Calvert Cliffs 3, Grand Gulf 3, Nine Mile Point 3, River Bend 3, Victoria County 1&2,

⁵ Remains Suspended: Shearon Harris 2&3, Comanche Peak 3&4

⁶ Terminated: Levy 1&2, South Texas Project 3&4, V.C. Summer 2&3

⁷ Denied 1/6/2022: Oklo Power LLC, Idaho National Laboratory, Aurora 1

Construction Permit Applications

A construction permit application for a production or utilization facility submitted to the NRC under Title 10 of the Code of Federal Regulations Part 50, "Domestic Licensing of Production and Utilization Facilities" consists of two parts: an environmental report and a preliminary safety analysis report (PSAR).

After receiving the construction permit application, NRC staff begins its review by making an initial determination on completeness and acceptability of the application. Should the NRC staff determine that the application is incomplete or otherwise unacceptable, the staff will inform the applicant and explain how the application is deficient. The applicant will then have the opportunity to correct the deficiencies. Once the staff determines that it has enough information to continue with a thorough technical review of the submittal, the NRC will formally docket the application.

Following an application's acceptance for docketing, there are several significant review milestones including the following: issuance of a request or requests for additional information, preparation of a safety evaluation

report, development of either an environmental assessment or environmental impact statement, independent review of the application and safety evaluation report by the Advisory Committee on Reactor Safeguards (ACRS), potential contested hearing(s), mandatory hearing.

Finally, the Commission will make a decision to either grant or deny the construction permit based on the application, NRC staff's safety evaluation report, the recommendations of the ACRS, and the outcome of any contested hearings and the mandatory hearing. As of March 2023, two applications are under review, one of them a new submission as of August 2022.

The first application is for a low-power test reactor to support development of Kairos Power's fluoride salt-cooled, high-temperature reactor technology (KP-FHR). As of April 18th, 2023, the safety review process is approximately 92% complete, and the environmental review is approximately 90% complete.

The most recently accepted application, for a Molten Salt Research Reactor (MSRR) at Abilene Christian University (ACU) in Abilene, Texas, is the first ever application for an advanced university research reactor. ACU submitted the application for the Nuclear Energy eXperimental Testing Lab (NEXT), which includes the 1MW, non-power MSRR, in August 2022. The facility will provide a platform to research molten-salt technology, as well as educational opportunities in nuclear science and engineering. ACU is the lead university in the NEXT Research Alliance (NEXTRA), which includes Georgia Institute of Technology, Texas A&M University, and the University of Texas at Austin. The alliance has a \$30.5 million research grant agreement with Natura Resources to design and build a university based MSRR. ACU has worked through several aspects of the MSRR with the NRC over two years of pre-application activities. Due to this proactive approach, the NRC estimates a review schedule of 18 months, and expects that environmental and safety reviews will be complete by May 2024.

	SITE/LOCATION		VENDOR	REACTOR TECHNOLOGY/ NO. of REACTORS	STATUS	
Under Review	Abilene Christian University	Abilene, TX	NEXTRA	MSRR	1	Under Review
	East Tennessee Technology Park, ORNL	Oak Ridge, TN	Kairos Power, LLC	KP-FHR	1	Under Review

Fuel Facility License Applications

Fuel cycle facilities must comply with the regulatory requirements established by the NRC. The regulations contain the basic safety standards that the fuel cycle facilities need to meet. Each facility also has an NRC license which contains site-specific requirements that the facility is required to comply with. Each license is unique and is specific to the nuclear material and hazards present at the fuel cycle facility.

A total of five facilities have been docketed by the NRC. Two licensed facilities were terminated⁷, and one other facility was issued a construction authorization before it was terminated at the request of the company⁸. One facility has been licensed; however, construction is not currently proceeding⁹.

	SITE/LOCATION		VENDOR	FACILITY and FUEL TYPE		STATUS
Issued	American Centrifuge Plant	Piketon, OH	Centrus Energy Corp.	Centrifuge Enrichment	HALEU	Approved
Under Review	TF3	Oak Ridge, TN	TRISO-X, LLC	Fuel Fabrication	HALEU TRISO	Under Review

^{7,8} Terminated: Eagle Rock Enrichment Facility, GLE Uranium Enrichment Facility, Mixed-Oxide Fuel Fabrication Facility

⁹ Suspended: Fluorine Extraction Process and Depleted Uranium Deconversion (FEP/DUP) Plant

- ★ In late December 2022, the NRC accepted an application from X-energy's fuel subsidiary, TRISO-X, LLC, for a proposed TRISO-X fuel fabrication facility (TF3). A 30-month review schedule was presented in early February 2023 by the NRC that should be completed by June 2025, assuming no delays. Additionally, Kairos Power is still in pre-application discussions with the NRC for its Atlas fuel fabrication facility. Both facilities would be located in Oak Ridge, TN, and would manufacture HALEU TRISO particles and pebbles. TRISO-X, a subsidiary of X-energy, has requested a 40-year license to possess and use special nuclear material to manufacture advanced fuel. The facility would be the first-ever commercial-scale fuel fabrication plant focused on using HALEU.
- ★ Framatome and UltraSafe Nuclear announced on January 26th, 2023 that they intend to form a joint venture to manufacture commercial quantities of tri-structural isotropic (TRISO) particles and UltraSafe's proprietary fully ceramic microencapsulated (FCM) fuel. The companies have signed a nonbinding agreement to integrate their resources and bring commercially viable, fourth-generation nuclear fuel to market for UltraSafe's micro-modular reactor (MMR) and other advanced reactor designs. The companies expect to begin manufacturing TRISO particles and FCM fuel in late 2025.
- ★ On January 25th, 2023, Oklo submitted a licensing project plan to the NRC, outlining the company's plans for preapplication engagement activities that support the future licensing of a used nuclear fuel recycling facility. The first-of-a-kind facility is intended to produce fuel to support the deployment of Oklo's advanced reactor design power plants. According to Oklo, the preapplication engagement will identify and reconcile regulatory

requirements early, enabling an efficient and effective NRC license application review through a process equivalent to a staged licensing approach with the added benefits of flexibility and customization.

- ★ On March 14th, 2023, the NRC approved the use of Westinghouse Electric Company's Advanced Doped Pellet Technology (ADOPT) fuel pellets in U.S. pressurized water reactors. This approval brings the company a step closer to loading lead test assemblies containing ADOPT accident tolerant fuel pellets in Unit 2 of Southern Nuclear's Vogtle plant. Southern Nuclear announced in January 2022 that it would load four lead test assemblies into Vogtle-2, as the first planned installation of U-235 enriched to greater than 5 weight percent in a domestic commercial reactor (the pellets planned for Vogtle-2 are enriched to 6 weight percent). The goal of the agreement is to improve fuel cycle economics and extend the operating cycle of the plant.
- ★ In June 2021, the NRC approved a license amendment authorizing Centrus Energy Corp to demonstrate commercial production of HALEU at the American Centrifuge Plant. In September, installation of the HALEU demonstration centrifuges in cascade form was halted temporarily until a contract could be competitively awarded for the HALEU demonstration project. In November 2022, the DOE announced an approximately \$150 million cost-shared award with American Centrifuge Operating, LLC, a subsidiary of Centrus Energy Corp, to demonstrate the ability to produce HALEU. Advancing domestic capability to produce HALEU will set the stage for larger, commercial-scale HALEU production in the US, providing important fuel stability for advanced reactors to achieve smaller designs, longer operating cycles, and increased efficiencies over existing technologies.

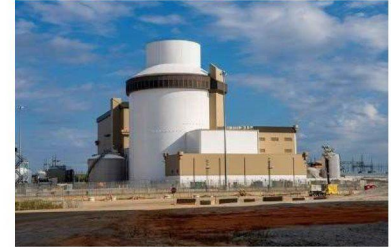
During the first year, some \$30 million of the cost-share will be used to start up and operate 16 advanced centrifuges in a cascade at a Department of Energy facility in Piketon, Ohio. The facility represents the only U.S. plant licensed to produce HALEU at present. The cascade is expected to meet the demonstration requirements by enriching uranium hexafluoride gas to produce 20 kilograms of 19.75% enriched HALEU by December 31, 2023. They will then continue production in 2024 at an annual rate of 900 kilograms of HALEU per year, subject to appropriations, with additional options to produce more material under the contract in future years.

On February 9th, 2023, Centrus announced that it had finished assembling the cascade of uranium enrichment centrifuges and most of the associated support systems ahead of its contracted demonstration of HALEU production by the end of 2023. When the 16-machine cascade begins operating inside the Piketon, OH, American Centrifuge plant, which has room for 11,520 machines, it will be the first new US-technology based enrichment plant to begin production in 70 years.

DOE is pursuing multiple pathways to produce HALEU through its HALEU Availability Program authorized by the Energy Act of 2020 to meet this pressing need. Following the HALEU demonstration, the centrifuge technology used at the facility will be available for commercial deployment.

NEW PLANT CONSTRUCTION**Vogtle**

Following authorization from the NRC that fuel loading and operation may commence at Unit 3, Southern Company loaded fuel in the fall of 2022, with the intent to begin operating in the first quarter of 2023. However, during preoperational testing for the unit, plant operator Southern Nuclear identified ‘vibrations associated with certain piping within the cooling system’, according to a January 11th filing by Southern Company and Georgia Power with the Securities and Exchange Commission. The issue was remediated in coordination with the NRC and Vogtle-3 achieved initial criticality in the first week in March 2023.



*Vogtle Unit 3 (Courtesy of Georgia Power/
Southern Company, October 2022)*

With Unit 3 criticality now reached, operators will continue to raise power to support synchronizing the generator to the electric grid and begin producing electricity. Operators will then further increase power through multiple steps, ultimately raising power to 100%.

Georgia Power announced on December 7th that cold hydro testing of Unit 4 has been completed. The cold hydro testing confirmed that the AP1000's coolant system functions as designed and verified that the welds, joints, pipes, and other components of the system and associated high-pressure systems do not leak when under pressure. As part of the testing, the coolant system was filled with water and pressurized to above-normal operating conditions, then lowered to normal design pressure while inspections were conducted to verify that the systems met design standards. Hot functional testing is expected to follow and is conducted by running plant systems at normal operating pressure and temperature to ensure the reactor systems and components function as designed prior to loading fuel into the core.

However, in first quarter of 2023, Southern Company announced a possible pushback of Vogtle-4's expected start from the end of 2023 to the end of the first quarter of 2024. Funding these extensions, the Southern chairman has said, will increase Georgia Power's share of the project total capital cost by \$201 million. Georgia Power owns 45.7% of Vogtle; other owners include Oglethorpe Power Corporation (30%), Municipal Electric Authority of Georgia (22.7%), and Dalton Utilities (1.6%).

VC Summer

At the time of its August 2017 cancellation, the V.C. Summer project was about 65% complete. All four steam generators for Units 2 and 3 were being installed, while two of the four reactor coolant pumps for Unit 2 reactor are on site. Units 2 and 3 were planned to come online in April 2020 and December 2020, respectively.

As the pioneer of nuclear power development, the United States is the world's largest producer of nuclear power, accounting for approximately 25% of worldwide nuclear generation of electricity. Currently, there are 93 reactors operating in the United States. In 2022, the fleet produced approximately 772 million Megawatt-hours (kWh), approximately 20% of America's total electrical output and 47% of our emissions-free electricity. Since the early 1970s, the U.S. nuclear industry has significantly improved its safety and operational performance. By the turn of the century, it was among world leaders with a record-breaking capacity factor in 2019 of over 94%. Nuclear power plants operated at full capacity more than 92% of the time in 2022, making it the most reliable energy source in America (natural gas had a reliability rating of 56.7% and coal had a reliability rating of 47.8% in 2022).

In deregulated electricity markets, nuclear power plants are facing financial challenges from zero marginal cost variable power sources and a reduction in the price of natural gas. While increased focus on nuclear energy as a critical part of a clean-energy future for the country, significant collaboration will be necessary from government and industry to maintain and grow the U.S.'s nuclear power generating capabilities.

On a related note, in January 2023 the DOE increased the funding level for its community engagement on consent-based siting funding opportunity announcement (FOA) from \$16 million to \$26 million. The DOE first announced in September 2021 that it was making funding available to communities interested in learning more about consent-based siting, management of spent nuclear fuel, and interim storage facility siting considerations. The additional funding raises the number of awards that can be competitively selected to communities interested in learning about consent-based siting. The previously extended FOA application period closed on January 31, 2023.

OPERATING FLEET STATUS

Nation-Wide Status Updates

On March 3rd, 2023, the NRC issued the 2022 assessment letters to operators of the nation's commercial nuclear reactors, noting that of the 93 units in the agency's Reactor Oversight Process, 87 "reached the highest performance category in safety and security," known as Licensee Response. Those reactors, including Vogtle-3—which achieved initial criticality in early March—remain in Licensee Response at this writing.

Six reactors, however, have slipped into the second, more highly scrutinized performance category, "Regulatory Response," and continue to reside there. Units under additional NRC oversight include the following:

- Calvert Cliffs-1, for failing to implement foreign material exclusion practices in accordance with site procedures. Specifically, the licensee failed to prevent the introduction of foreign material into the 1A emergency diesel generator (EDG), which led to an EDG automatic trip and consequential failure on February 20, 2022, during routine testing.
- Davis-Besse, for a security-related finding originating in the third quarter of 2021. (Details of security findings are not divulged to the public.)
- Peach Bottom-2, for the performance of a procedure inappropriate to the circumstances, causing a reactor scram, primary containment isolation system Group I isolation, safety-relief valve actuation, and loss of the normal heat sink, which required emergency core cooling systems to maintain level and pressure.

- Quad Cities-2, for the failure of one of the four electromatic relief valves associated with the automatic depressurization subsystem to actuate during surveillance testing. As a result, the valve was inoperable from April 7, 2020, until March 21, 2022.
- V.C. Summer, for failing to identify and correct a condition adverse to quality that resulted in the inoperability of the B emergency diesel generator.
- Waterford, for errors associated with the main condenser wide range gas monitor (WRGM), which introduced the potential to overclassify radiological emergencies and made the results of dose assessment using the main condenser WRGM inaccurate.

Individual Status Updates

- ★ On February 11th, 2023, Entergy's River Bend nuclear power plant began its 22nd scheduled refueling and maintenance outage. The plant, located in St. Francisville, LA, is a 967-MWe General Electric boiling water reactor. More than 12,000 activities are scheduled for the outage, including but not limited to replacement of all the main condenser tubes (nearly 70,000 total), reactor water cleanup, nonregenerative heat exchanger replacement, high pressure turbine inspection, and a recirculation pump motor replacement.
- ★ On February 17th, 2023, the Tennessee Valley Authority took Browns Ferry Unit 2 offline for a refueling and maintenance outage, following a nearly two-year, breaker-to-breaker run– the first in the Alabama nuclear plant's history. According to the utility, the unit established a new record for itself with 665 days of continuous operation, producing more than 20 billion KWh of electricity.
- ★ Constellation Energy announced in February 2023 that it intends to invest \$800 million in new equipment at the Braidwood and Byron nuclear plants in Illinois to raise their combined output by a total of about 135 MW. Both plants are pressurized water reactors with similar power generation levels (between 1,158 MWe and 1,212 MWe). The project will involve replacing the plants' main turbines with "state-of-the-art, high-efficiency units," the announcement stated, and is expected to create work for thousands of skilled union workers during construction while expanding economic activity for surrounding businesses in the plant communities. Constellation anticipates an increased output at Braidwood and Byron as early as 2026, with the full uprated output available by 2029. Work on the uprates is set to be performed in stages during scheduled refueling outages.
- ★ On March 7th, 2023, Texas-based Vistra Corporation, owner of the Comanche Peak nuclear plant, announced a \$3.43 billion deal to acquire Energy Harbor, the Ohio-based owner and operator of the Beaver Valley, Davis-Besse, and Perry nuclear facilities. The transaction, which has been approved by both companies' boards of directors, will merge Vistra's nuclear and retail businesses and its Vistra Zero renewables and storage projects with Energy Harbor's nuclear and retail businesses under a new subsidiary holding company dubbed Vistra Vision. With the addition of Energy Harbor's four units (sporting a total net capacity of 4,053 MWe), the new firm will have the second-largest competitive nuclear fleet in the nation, according to the announcement. Vistra will not acquire Energy Harbor's legacy conventional generation fleet, the announcement noted, as definitive agreements have been signed to sell those assets to third parties.
- ★ On March 2nd, 2023, the NRC announced that it will grant a timely renewal exemption to California's Diablo Canyon nuclear plant to allow the plant to continue operating while its new license renewal application was under review. The exemption came after the NRC denied in January plant owner Pacific Gas & Electric's request for the agency to resume review of its original license renewal application. The NRC's "Effect of timely renewal application" rule (10 CFR 2.109[b]), requires license renewal applications to be submitted at least five years prior to a reactor's closing date. Because of the exemption, PG&E now has until December

31, 2023, to submit the application to extend the plant's two units past their current closure dates of 2024 and 2025.

- ★ Holtec Decommissioning International, the owners of the Palisades nuclear power plant, met with the NRC on March 20th, 2023, to discuss the proposed regulatory path to reauthorize operations at Palisades and restart the shuttered plant. If it were restarted, Palisades would return 800 megawatts of power back to the Michigan electricity grid. After purchasing the nuclear plant, Holtec applied for funds from the Department of Energy to aid in its reopening, through the Civil Nuclear Credit Program in late 2022, but was denied. Holtec acknowledges that there are multiple hurdles to reopening the plant, including financial commitment from the state, procuring a power purchasing agreement, upgrading the switchyard, partnering with a licensed operator, rehiring qualified staff, and maintenance and delayed capital investments of the facility.

License Renewal and Uprate Status

- ★ On March 24th, the NRC announced that it will hold four hybrid meetings around the US as it seeks comment to a proposed rule to update its license renewal generic environmental impact statement (GEIS). The proposed rule is in response to a 2022 NRC order, CLI-22-02, that concluded that the license renewal GEIS did not analyze the environmental impacts of a subsequent license renewal term (from 60 to 80 years of operation). The proposed rule amends the relevant rule language to account for initial license renewal and one term of subsequent license renewal, redefines the number and scope of the environmental issues that must be addressed during the review of each application for license renewal, and updates related guidance to fully address subsequent renewal.

License Renewal

Sixty-one reactors have received 20-year extensions of their operating licenses from the NRC, including Kewaunee, Vermont Yankee, Fort Calhoun, Oyster Creek, and Pilgrim, which are now permanently closed.

On December 8, 2022, the NRC docketed the license renewal application for Comanche Peak Units 1 and 2.

Applications for License Renewal

- ★ Issued Renewals:
 - No recently issued applications.
- ★ Applications Currently Under Review:
 - Comanche Peak Units 1 & 2
- ★ Anticipated Future Renewal Submittals:
 - Clinton Power Station Unit 1
 - Perry Unit 1
 - Diablo Canyon Units 1 & 2

Subsequent (Second) License Renewal

The NRC staff has defined subsequent license renewal (SLR) to be the period of extended operation from 60 years to 80 years.

Applications for Subsequent License Renewal

- ★ Issued Subsequent Renewals¹⁰:
 - Surry Units 1 & 2 (Issued: 12/04/19)

- Turkey Point Units 3 & 4 (Issued: 03/05/20)
- Peach Bottom Units 2 & 3 (Issued: 05/04/21)

¹⁰ On February 24th, 2022, the NRC revised the requirements for environmental reviews of SLR applications. The Generic Environmental Impact Statements used on SLRs were deemed invalid beyond 60 years of operation, and applicants will be required to complete an "adequate NEPA review for each application."

★ Applications Currently Under Review:

- North Anna Power Station Units 1 & 2 (Received: 08/24/20)
- Point Beach Units 1 & 2 (Received: 11/16/20)
- Oconee Nuclear Station Units 1, 2, & 3 (Received: 06/07/21)
- St. Lucie Units 1 & 2 (Received: 08/03/21)
- Monticello Unit 1 (Received 01/09/2023)

★ Applications Received and Under Acceptance Review:

- No pending applications

★ Anticipated Future Subsequent Renewal Submittals:

- Browns Ferry Units 1, 2, & 3 (Estimated: December 2023)
- Virgil C. Summer Unit 1 (Estimated: Oct-Dec 2023)
- Edwin I. Hatch Units 1 & 2 (Estimated: Oct-Dec 2025)
- Dresden Units 2 & 3 (Estimated: Apr-June 2024)

Operating Fleet Uprate Activities

U.S. nuclear power plants have submitted power uprate applications to the NRC since the 1970s, accounting for an additional 8,010 MWe of output.

★ Recently Approved

- Farley Units 1 & 2 (Approved: 10/09/20)
- Watts Bar Unit 2 (Approved: 10/21/20)
- Oconee Units 1, 2, & 3 (Approved: 1/26/21)
- Millstone Unit 3 (Approved: 11/09/21)

★ Pending Applications:

- No pending applications

★ Expected Applications

- As of March 18, 2022, there are 0 expected applications for power uprates (per NRC). However, several plants have announced their intentions to submit an application.

Supportive Federal and State Action

Initiatives are taking place at the national and state level to ensure a more competitive market for nuclear power. For example, the states of New York, Illinois, New Jersey, Colorado, Ohio, Pennsylvania, and California have taken action to level the playing field and include nuclear energy in their clean energy policies and have averted the closure of ten power plants.

- ★ On March 13th, 2023, 10th U.S. Circuit Court of Appeals in Denver has dismissed a petition by the state of New Mexico challenging the NRC's licensing of Interim Storage Partners' (ISP) consolidated interim storage facility (CISF) in Andrews County, Texas, citing a lack of jurisdiction. The decision follows a U.S. Court of Appeals for the D.C. Circuit rejection of a lawsuit brought by several environmental and industry groups against the ISP license. That order was issued on January 25, 2022.

ISP, a joint venture of Orano USA and Waste Control Specialists, with additional support from NAC International, submitted a revised CISF license application to the NRC in June 2018. The NRC-approved license was issued in September 2021. The proposed facility will eventually store a total of 40,000 metric tons of used nuclear fuel.

- ★ A nuclear-powered hydrogen production facility has commenced operation at Constellation Energy's Nine Mile Point plant on March 10th, 2023. The facility is the first of its kind in the United States to generate hydrogen using nuclear power, courtesy of the New York plant's two boiling water reactors, the 620-MWe Unit 1 and 1,287-MWe Unit 2. The milestone is part of a \$14.5 million cost-shared project between Constellation and the Department of Energy—with \$5.8 million coming from the DOE—aimed at demonstrating how nuclear plants can help lower the cost and scale up clean hydrogen production. (Other nuclear plant owners working with the DOE on hydrogen production projects include Energy Harbor, at Davis-Besse; Xcel Energy, at Prairie Island; and Arizona Public Service, at Palo Verde.)

Using 1.25 MW of zero-carbon energy per hour, the Nine Mile Point hydrogen generation system's proton exchange membrane electrolyzer produces 560 kg of clean hydrogen per day, more than enough to meet the plant's operation hydrogen use, Constellation said, also noting that the system helps set the stage for potential large-scale deployments at other clean energy centers in the company's fleet that would couple clean hydrogen production with storage and other on-site uses.

In addition, according to the announcement, Constellation is working with public and private entities to pursue development of regional hydrogen production and distribution hubs and has committed to investing \$900 million through 2025 for commercial hydrogen production using nuclear power. This includes participation in the Midwest Alliance for Clean Hydrogen, Northeast Clean Hydrogen Hub, and Mid-Atlantic Hydrogen Hub, all of which are exploring projects to develop hydrogen infrastructure in collaboration with the DOE, the company said.

- ★ In September 2022, California legislature voted to provide funds to ensure the continued operation of the Diablo Canyon nuclear plant. The Bill reversed the State's 2016 decision to retire the plant by 2025 and approved a \$1.4 billion government loan to extend its operation to 2030. In addition to this funding, in November 2022, the plant was formally selected as a beneficiary of the CNC program and will receive additional federal funding to ensure it continues to operate.

Thirteen plants (19 reactors) had previously announced they intended to close prior to their license expiration date but have been saved due to Federal and State Actions:

ORIGINALLY PROPOSED CLOSURE YEAR	SITE / LOCATION		UTILITY	LICENSE EXPIRATION (TERM)	POWER (MWe)
2017	FitzPatrick	NY	Entergy	2034 (60)	852
	Ginna	NY	Exelon	2029 (60)	582
	Clinton	IL	Exelon	2026 (40)	1,065
2017-18	Nine Mile Point – 1 & 2	NY	Exelon	2029 / 2046 (60)	1,780
2018	Quad Cities 1 & 2	IL	Exelon	2032 (60)	1,820
2020	Davis-Besse	OH	Energy Harbor	2037 (60)	893
2021	Perry	OH	Energy Harbor	2026 (40)	1,261
	Beaver Valley	PA	Energy Harbor	2036 / 2047 (60)	1,872
	Byron – 1 & 2	IL	Exelon	2044 / 2046 (60)	2,300
	Dresden – 1 & 2	IL	Exelon	2029 / 2031 (60)	1,773
2022	Salem – 1 & 2	NJ	PSEG	2036 / 2040 (60)	2,304
	Hope Creek		PSEG	2046 (60)	1,172
2024-2025	Diablo Canyon 1 & 2	CA	PG&E	2024/2025(40)	2,240
				Total Saved	19,914

Premature Closure

Some of the nuclear plants now closing are doing so because of state policy pressure (as with New Jersey's Oyster Creek, and New York's Indian Point), and some have had maintenance issues that were too costly to fix. However, most plants are closing or threatening closure because—given the economics in some regions—they have become unable to compete against primarily low-cost, gas-fired generation and, to a lesser extent, subsidized and mandated "variable renewable energy," such as wind- and solar-power.

- ★ Twelve plants (14 reactors) have closed prior to their license expiration date:

CLOSURE YEAR	SITE / LOCATION		UTILITY	LICENSE EXPIRATION (TERM)	POWER (MWe)
2013	Crystal River 3	FL	Duke	2016 (40)	860
	San Onofre 2 & 3	CA	SoCal Edison	2023 / 2024 (40)	2,150
	Kewaunee	WI	Dominion	2033 (60)	566
2014	Vermont Yankee	VT	Entergy	2032 (60)	620
2016	Fort Calhoun	IN	Omaha Power	2033 (60)	479
2018	Oyster Creek	NJ	Exelon	2029 (60)	610
2019	Pilgrim	MA	Entergy	2032 (60)	685
	Three Mile Island 1	PA	Exelon	2034 (60)	803
2020	Indian Point 2	NY	Entergy	2024 (60)	998
	Duane Arnold	IA	NextEra	2034 (60)	615
2021	Indian Point 3	NY	Entergy	2025 (60)	1,030
2022	Palisades ⁷	MI	Entergy	2031 (60)	789
Total Closed since 2013:					10,205

⁷On May 20, 2022 The Palisades Nuclear Power Plant shut down operations and ownership was transferred to Holtec International, with plans to decommission the plant. However, on June 28, 2022, Holtec applied for funds under the CNC Program, with the intention to eventually reopen the plant.

- ★ Currently, no reactors have announced plans to retire prior to their license expiration date.

PENDING CLOSURE YEAR	SITE / LOCATION	UTILITY	LICENSE EXPIRATION (TERM)	POWER (MWe)
Total Pending Closures:				0

INTERNATIONAL NUCLEAR ACTIVITIES

- ★ February 8, 2023: The Belgian government is exploring the idea of extending the operational life of its three oldest reactors by two years. Those reactors – Units 1 and 2 at the Doel facility and Unit 1 at Tihange, sporting a combined capacity of 1,852 MWe – were slated to be permanently shuttered in 2025 in keeping with the country's planned nuclear phase-out policy. Belgium has already closed two of its nuclear units; Doel-3 in September 2022 and Tihange-2 in January 2023, removing 2,014 MWe from the grid.
- ★ February 14, 2023: Energoatom, Ukraine's nuclear operator, made a statement that the current water level in the Kakhovka Reservoir in Southern Ukraine was at its lowest point in three decades, 13.8 meters, down from its normal 16-meter level. The Reservoir provides drinking water to hundreds of thousands of residents, irrigation to nearly half-a-million acres of farmland, and the cooling system at the Zaporizhzhia Nuclear Power Plant. The IAEA's Director General said in a statement that while the decreased water level does not pose an immediate threat to nuclear safety and security, it may become a source of concern if it is allowed to continue. Ukrainian Prime Minister Denys Shmyhal called on international partners to put pressure on Russia to close the sluice gates on a critical hydroelectric power plant controlled by Russian forces.
- ★ February 16, 2023: The Finnish government granted a new operating license to Fortum Power and Heat Oy for its two Loviisa reactors – twin 507-MWe VVER-440/V213 units – providing them with an additional 20 years of operational life. The reactors' previous license sanctioned operations through December 31, 2027, for Unit 1 and through December 31, 2030, for Unit 2. Fortum projects that with the new license, Loviisa will produce up to 170 TWh of electricity from 2030 to 2050. The reactors entered service in 1977 and 1980, respectively.
- ★ February 27, 2023: The third of four Korean-designed APR-1400 reactors at the United Arab Emirates' Barakah nuclear power plant has begun commercial operation, Emirates Nuclear Energy Corporation (ENEC) announced. Barakah-3 joins units 1 and 2, which commenced operation in April 2021 and March 2022, respectively. The new unit brings another 1,345 MWe to the UAE's national grid, bring the plant's total to 4,035 MWe. The commercial start of the fourth and final unit is expected in 2024.
- ★ March 6, 2023: Westinghouse Electric Company last week signed a memorandum of understanding with Kozloduy NPP-Newbuilds (KNPP-NB), establishing a working group to initiate planning for the potential deployment of one or more of the American company's AP1000 reactors at Bulgaria's Kozloduy nuclear power plant. KNPP-NB was established in 2012 to commission new nuclear power capacity at Kozloduy. The working group will evaluate regulatory, licensing, and design bases to ensure compliance with applicable regulations as well as developing a streamlined execution path to enable Bulgaria to achieve its nuclear energy goals.
- ★ March 16, 2023: GE Hitachi Nuclear Energy's BWRX-300 technology has completed phases 1 and 2 of the Canadian Nuclear Safety Commission's (CNSC) vendor design review process. According to a CNSC executive summary, the BWRX-300 review was based on information provided by GEH in more than 200 documents, technical presentations, a design process evaluation, and written responses to commission questions spanning 19 focus areas. With site preparation and related work currently underway at the Darlington nuclear plant site in Clarington, Ontario, the SMR's construction is expected to be completed by the fourth quarter of 2028.

- ★ March 16, 2023: EDF Energy, owner and operator of the United Kingdom's nuclear reactor fleet, announced that it intends to keep its Hartlepool and Heysham-1 stations in operations until March 2026 – two years past their previously scheduled 2024 retirement dates. EDF added that they are contemplating an additional 12 months of operation beyond 2026. Both stations have been operational for 40 years, and together the two stations provide about 5% of Britain's power supply.
- ★ March 30, 2023: Belgium-based engineering firm Tracetebel and the Netherlands' NRG Pallas have signed a memorandum of understanding to provide engineering services in support of a new reactor construction at the Borssele nuclear power plant, located near Borssele in the Dutch province of Zeeland. Borssele is the Netherlands' sole nuclear power facility, housing one 482-MWe PWR that entered commercial operation in October 1973.
- ★ March 28, 2023: The United States and Indonesia have announced a strategic partnership to help Indonesia develop its nuclear energy program, supporting its interest in deploying small modular reactors to meet energy security and climate goals. A memorandum of agreement – along with affiliated grants and contracts – was signed during the Indo-Pacific Chamber of Commerce and Industry Business forum held in Bali. The agreement is considered a deliverable under the Partnership for Global Infrastructure and Investment, a program established at the 2022 G7 summit in Germany to fund infrastructure projects in developing nations.