

fact sheet

Decommissioning Nuclear Power Plants

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Key Facts

Decommissioning is the process by which nuclear power plants are retired from service and terminate the operating licenses granted by the U.S. Nuclear Regulatory Commission. To ensure that decommissioning is safe and environmentally sound, the NRC established regulations and associated guidance outlining the requirements and process companies must follow. The NRC's decommissioning process facilitates participation by state and local authorities at several points along the way.

The process involves decontaminating the facility to reduce residual radioactivity, dismantling the structures, removing contaminated materials to appropriate disposal facilities, storing used nuclear fuel until it can be removed from the site for disposal or consolidated storage, and releasing the property for other uses. The owner remains accountable to the NRC until decommissioning has been completed and the agency has terminated its license.

To prepare for eventual decommissioning of a nuclear power plant, the NRC requires the companies that operate them to provide assurance that funds will be available to decommission the facility. Generally, this funding assurance is provided through a trust fund that is projected to grow throughout the plant's operating lifetime. Companies work with federal and state regulators to ensure that enough money will be available. Decommissioning trust funds are not under the direct administrative control of the generating companies, and use of the funds is limited to legitimate decommissioning expenses.

Ten reactors have completed decommissioning safely to either the point of license termination or the point where the remaining activities are limited to management of an Independent Spent Fuel Storage Installation (ISFSI). Currently, 18 commercial power reactors are in decommissioning, and several more will transition to this process over the next few years.



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After closure of a nuclear power plant, the licensee has to reduce the residual radioactivity to safe levels. This will allow the NRC to release the property and permanently terminate the facility's license. The site must be decommissioned within 60 years of the plant ceasing operations. The decommissioning process involves removing the used nuclear fuel from the reactor, placing it into the used fuel pool, and eventually into dry storage containers (which can be stored on-site or transported off-site); dismantling systems or components containing radioactive products (e.g., the reactor vessel); and cleaning up or dismantling contaminated materials from the facility. Contaminated materials can be disposed of in two ways: decontaminated on-site or removed and shipped to a waste-processing, storage or disposal facility.

Five years before a reactor reaches the scheduled expiration of its operating license, the company must provide the NRC with a decommissioning cost estimate. Within two years of shutting down the facility, the company must submit a post-shutdown decommissioning activities report (PSDAR) to the NRC and the affected states, which must include the site's planned option for decommissioning its facility.

The NRC reviews the PSDAR, and affected states may submit comments on the report. A company can begin major decommissioning activities 90 days after the NRC's receipt of the PSDAR, provided the NRC has no objections.

Aligning Site Programs With a Shutdown Plant's Low Risk Profile

The regulatory process for safely decontaminating and dismantling a reactor is well-understood and proven, as demonstrated by the 10 reactors that have completed the decommissioning process. However, current NRC regulations do not recognize the reduction in risk that occurs when nuclear plants transition from operating to a permanently shutdown, defueled status in preparation for decommissioning. Operating plant requirements in such areas as security and emergency preparedness remain in force even when the reactor has been rendered inoperable and permanently defueled.

To align staffing and programs with the low risk profile of a defueled reactor, plant owners must submit eight to 12 requests for exemptions and license amendments to the NRC for approval. The approval process normally takes about 12 to 18 months to complete. The total cost per plant ranges from \$13 million to \$19 million, which is drawn from the plant's decommissioning trust fund. The NRC recently granted exemptions and license amendments for five closed reactors.

The industry is seeking appropriate rulemaking to establish a more efficient process to minimize NRC and industry workload for repetitive exemptions and licensing actions, provide greater certainty to plant employees, and allow both licensee and NRC resources to be more effectively focused on safely decommissioning these facilities.

The Decommissioning Process

The companies that operate nuclear power plants can use one or both of two options¹ to decommission their facilities: SAFSTOR (Safe Storage) or DECON (Decontamination). Generally, sites must spend no longer than 50 years in SAFSTOR to allow up to 10 years for decontamination. The entire process must be completed within 60 years.

In SAFSTOR, a nuclear plant is kept intact and placed in protective storage for an extended period of time. This allows the radioactive elements in components to decay to stable elements while the trust fund accrues interest. During this time, the main components of the plant remain in place, including the reactor vessel, fuel pools, turbine and other elements. All fuel is removed from the reactor vessel and placed in fuel pools or dry storage on-site. The NRC continues to inspect the site and provides regulatory oversight of maintenance and security appropriate to the low risk profile of the site.

The plant is dismantled in a process similar to the DECON option once radioactivity has decayed to lower levels and the safety risk to workers is substantially reduced.

In DECON phase, the operator first decontaminates or removes contaminated equipment and materials. The removal of used nuclear fuel rods and equipment—which accounts for over 99 percent of the plant’s radioactivity—lowers the radiation level in the facility and significantly reduces the potential exposure to workers during subsequent decommissioning operations. DECON can take five years or more.

Both of these options allow companies to choose the optimal time and method for decommissioning their particular site. Companies can choose to start DECON at the beginning of the 60-year period. In reality, most plants use a combination of the two approaches, conducting some dismantlement while setting aside funds to pay for others later.

Eighteen commercial reactors are in the decommissioning process, including the recently closed Kewaunee, Crystal River 3, San Onofre 2 and 3, and Vermont Yankee nuclear power plants. Eleven of these reactors are using or will use the SAFSTOR option, six are using the DECON option, and one has not yet chosen a decommissioning option (Three Mile Island 2 in Pennsylvania—site of the 1979 accident—is in post-defueling monitored storage).

Reactors that completed decommissioning (ISFSI-only or license terminated):	
Big Rock Point	Rancho Seco
Fort St. Vrain	Shippingport
Haddam Neck	Shoreham
Maine Yankee	Trojan
Pathfinder	Yankee Rowe

Reactors in decommissioning:	
Crystal River 3	Millstone 1
Dresden 1	Peach Bottom 1
Fermi 1	San Onofre 1
GE ESADA Vallecitos	San Onofre 2*
GE Vallecitos BWR	San Onofre 3*
Humboldt Bay*	Three Mile Island 2
Indian Point 1	Vermont Yankee
Kewaunee	Zion 1*
LaCrosse*	Zion 2*

*DECON process

Terminating the NRC License, Releasing the Site

As the DECON phase nears completion, the company must submit a license termination plan to the NRC at least two years before the proposed license termination date. After the NRC receives the license termination plan, affected states, local communities and tribes may submit comments on the plan at a public meeting near the facility. The public also has the opportunity to request an adjudicatory hearing. Members of the public may observe any meeting the NRC holds with the company, unless the discussion involves proprietary, sensitive, safeguarded or classified information.

Once public concerns are addressed, the NRC will terminate the license if all work has followed the approved license termination plan and the final radiation survey shows that the site is suitable for release. Most plans envision releasing the site to the public for unrestricted use, meaning any residual radiation would be below NRC's limits of 25 millirem per year. This completes the decommissioning process.

Funding Requirements for Decommissioning

The decommissioning process begins when the facility operator ceases electricity production, but planning for decommissioning starts as soon as the facility begins operation. All nuclear facilities must comply with the NRC's decommissioning funding regulations, which are the product of a decade-long deliberative rulemaking that resulted in a 1988 rule and years of subsequent updates.

Decommissioning costs include three major components: labor, energy, and the transportation and disposal of waste materials. Specifically, the NRC's regulatory structure provides decommissioning funding assurance through multiple layers of requirements and limitations by:

- determining the minimum "decommissioning funds assurance" that are based on technical studies—
- which companies must provide during plant life
- requiring an annual adjustment of the minimum certification amount to account for inflation
- limiting funding assurance mechanisms to those considered appropriate by the NRC
- requiring companies to submit a report every two years on its decommissioning fund status during operation and annually once the plant comes within five years of the end of its operating life
- providing for updating of funding levels, if necessary
- requiring a site-specific decommissioning cost estimate within two years of shutdown
- limiting use of decommissioning funds to legitimate decommissioning expenses.

Under NRC regulations, licensees are required to submit their decommissioning funding estimates to the NRC every two years during operation. The NRC staff reviews the estimates and reports to the commission on the status of funding. Licensees have set aside nearly \$53 billion for decommissioning, a 15 percent increase from the previous reporting cycle two years earlier. All but three reactors had enough money set aside to cover their estimated costs, and these three resolved their shortfalls shortly after submitting their reports.

The NRC, the Occupational Safety and Health Administration, the U.S. Department of Transportation, and the U.S. Environmental Protection Agency maintain regulatory oversight throughout the decommissioning process. Many state agencies also play a significant role in the decommissioning process to ensure the health and safety of the public and decommissioning workers.

Conclusion

The nuclear energy industry has proven that it has the technology, resources and expertise to successfully decommission commercial nuclear reactors. The NRC has concluded that commercial reactor operators have adequate funds for decommissioning their facilities and that the agency's formula that determines the "minimum amount of required funding assurance" yields sound and conservative results. The decommissioning process is accomplished in a safe, secure and environmentally friendly manner.

¹ NRC regulations provide for a third option, ENTOMB; however, it has never been used and is unlikely to be used in the future.

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