

## Decommissioning of Nuclear Power Plants

June 2009

### Key Facts

■ After a nuclear power plant is closed and removed from service, it must be decommissioned. This entails the removal and disposal of radioactive components and materials such as the reactor and associated piping, and the cleanup of radioactive or hazardous contamination that may remain in the buildings and on the site.

■ The U.S. Nuclear Regulatory Commission has established regulations and associated guidance on nuclear power plant decommissioning. Each plant must file a post-shutdown activities report with the NRC prior to the expiration of its operating license or within two years after the plant has permanently shut down.

■ Nuclear power plants are required by the NRC to put aside funds for their decommissioning during operations. Companies work with federal and state regulators to ensure enough money is set aside. These funds are not under the direct control of the companies and cannot be used for purposes other than decommissioning.

■ Since 1960, more than 70 test, demonstration and power reactors have been retired throughout the United States.

These include 10 research and test reactors and 13 commercial and early demonstration nuclear power plants currently undergoing decommissioning or in long-term safe storage.

### Decommissioning: What's Involved?

After a nuclear power plant is permanently shut down, it must be decommissioned. This entails two steps. First, the company that operates the plant either decontaminates or removes contaminated equipment and materials. It also places the used nuclear fuel in dry storage until its final disposal. These materials and equipment account for more than 99 percent of the plant's radioactivity. Their removal lowers the level of radiation and thus reduces the exposure of workers during subsequent decommissioning operations.

Next, the company deals with the small amount of radioactivity remaining in the plant, which must be reduced to harmless levels through a cleanup phase—decontamination. In decontamination, workers remove surface radioactive material that has accumulated inside pipes and heat exchangers or on floors and walls that were not decontaminated during normal plant operations

because of inaccessibility or operational considerations. They are aided in decontamination activities by the records that plants are required to keep during operation. Workers use chemical, physical, electrical and ultrasonic processes to decontaminate equipment and surfaces. The removed radioactive material is concentrated, packaged and transported or stored for disposal at a designated site. Concentration cuts the volume of low-level radioactive waste, thus reducing the expense of disposal.

A wide range of decontamination techniques is available, including those developed by the U.S. Department of Energy, the Electric Power Research Institute and the decommissioning industry. Many are in use now at operating plants as part of standard preventive maintenance programs or general repair efforts.

Companies have three primary decommissioning options, as defined by the NRC:

■ **DECON** (Decontamination). In DECON, all components and structures that are radioactive are cleaned or dismantled, packaged, and shipped to a low-level waste disposal site, or they are stored temporarily on site. Once this



SUITE 400

1776 I STREET, NW

WASHINGTON, DC

20006-3708

202.739.8000

[www.nei.org](http://www.nei.org)

# Decommissioning of Nuclear Power Plants

Page 2 of 3—June 2009

task—which takes five or more years—is completed and the NRC terminates the plant's license, that portion of the site can be reused for other purposes.

■ **SAFSTOR (Safe Storage).** In SAFSTOR, the nuclear plant is kept intact and placed in protective storage for up to 60 years. This method, which involves locking that part of the plant containing radioactive materials and monitoring it with an on-site security force, uses time as a decontaminating agent by allowing the radioactive components to decay to stable elements. If a plant is allowed to sit idle for 30 years, for example, the radioactivity from cobalt-60 will be reduced to 1/50th of its original level; after 50 years, the radioactivity will be about 1/1,000th of its original level. Once radioactivity has decayed to lower levels, the unit is taken apart, similar to DECON.

■ **ENTOMB.** This option involves encasing radioactive structures, systems and components in a long-lived substance, such as concrete. The encased plant would be appropriately maintained, and surveillance would continue until the radioactivity decays to a level that permits termination of the plant's license, with little or no additional decontamination. The entombment option has been retained in regulation, but has not been implemented in either detailed regulatory guidance or in practice.

In addition to the nuclear energy industry's demonstrated ability to amass the funds and expertise needed for safe and timely decommissioning, the public and plant workers are further protected by a strict and comprehensive set of federal regulations.

## Regulating Decommissioning

Throughout the decommissioning process, regulatory oversight is provided by the NRC and also by the Occupational Safety and Health Administration, the Department of Transportation and the U.S. Environmental Protection Agency. A number of state agencies also play a significant role in the health and safety of the public and decommissioning workers. Beyond industrial safety, the NRC has established regulations that address funding and the submission of plans for decommissioning the facility.

## Advance Planning

Five years before a company plans to terminate plant operation, it must submit a preliminary decommissioning cost estimate to the NRC. Within two years following a plant's shutdown, its operator must submit a report on its post-shutdown decommissioning activities to the NRC and the affected states. The report must include a description of the planned decommissioning options (DECON, SAFSTOR or ENTOMB), a schedule for their completion, a discussion of how site-specific decommissioning activities will adhere to

previously issued environmental impact statements, and an estimate of expected costs. The licensee does not have access to the full amount of the decommissioning funds during operations until the site-specific cost estimate has been accepted by the NRC.

The NRC reviews the report and holds public meetings to discuss the company's plans and the regulatory oversight process. At the end of 90 days, if the NRC has no objections, the company may begin decommissioning.

Routine activities, such as maintenance and disposal of small radioactive components, may be performed before the end of the 90-day waiting period. Major decommissioning activities include the permanent removal of large radioactive components—such as the reactor vessel, steam generators or other components that are comparably radioactive—as well as permanent changes to the containment structure.

Unless the licensee receives permission to the contrary, the site must be decommissioned within 60 years. Until the license is terminated, the licensee remains accountable to the NRC. The licensee must submit a license termination plan at least two years before the proposed license termination date.

The NRC will make the plan available to the public for

# Decommissioning of Nuclear Power Plants

Page 3 of 3—June 2009

comment and schedule a public meeting near the facility to discuss its contents. The public also has the opportunity to request adjudicatory hearings. Once public concerns are addressed, the NRC will approve the plan—assuming it demonstrates that the remaining decommissioning activities will be performed according to federal regulations and that they will not adversely affect public health and safety or the environment.

Finally, if the NRC determines that all work has followed the approved license termination plan—and if the final radiation survey demonstrates that the facility and site are suitable for release—the agency will terminate the license, thus completing the decommissioning process.

## Funding Requirements

The NRC requires that companies establish a decommissioning fund for each reactor. NRC funding requirements are specifically related to that portion of a nuclear plant that has been contaminated by radioactive material. The NRC does not require companies to include funds for dismantling buildings and facilities (such as office buildings and switchyards) that do not pose a radiation hazard to workers or the public.

Decommissioning costs include three components: labor, energy, and the transportation and disposal of waste materials. The most reliable estimate of decommissioning

costs comes from an engineering study of a specific plant. The company must review annually and report to the NRC every two years on the amount of money required for decommissioning and the adequacy of the fund being used to accumulate it. The size of the fund is adjusted periodically to account for changes in the cost of labor, energy and low-level waste disposal, and to take into account technological advancements.

Every company that operates a nuclear power plant is required to amass the funds needed for decommissioning. Three types of decommissioning funds are acceptable to the NRC:

- An external sinking fund that builds up money for decommissioning gradually over the plant's operating lifetime. Revenues earmarked for decommissioning are collected from customers through rates and invested in a trust fund that is professionally managed.
- A prepayment account in which the company deposits money before the plant begins operation. The account may be a trust, escrow account, government fund, certificate of deposit or government securities. It is kept separate from a company's other assets and is outside its control.
- A surety bond, letter of credit or insurance, which guarantees that decommissioning costs will be paid if the company defaults on its obligation.

Companies typically have set up sinking funds to accumulate money to decommission nuclear plants. In the early years of a nuclear unit's operating life, decommissioning funds build up slowly, then accelerate more quickly as the compounded earnings on the trust fund's investments increase.

*This fact sheet also is available at*  
[www.nei.org/resourcesandstats/documentlibrary/nuclearwaste/disposal/factsheet/decommissioningnuclearpowerplants](http://www.nei.org/resourcesandstats/documentlibrary/nuclearwaste/disposal/factsheet/decommissioningnuclearpowerplants).