

Nuclear Power Plants and Radioactive Waste Management in Wisconsin



This brochure presents basic information about the status of Wisconsin's current nuclear power plants, the radioactive wastes produced by these plants, how the wastes are handled, and what would happen to the waste if a nuclear plant were shut down.

Introduction

Nuclear power in Wisconsin produces approximately 14 percent of the state's electricity on an annual basis. Currently in Wisconsin, there are three nuclear power plants, Point Beach, Kewaunee, and the La Crosse Boiling Water Reactor (BWR). Only the Point Beach nuclear power plant is currently operational. The two units at Point Beach have a total capacity of 1,030 megawatts (MW) and are located near the city of Two Rivers, in Manitowoc County. Florida Power and Light (FPL) purchased the plant from Wisconsin Electric Power Company (WEPCO) in 2007. The Kewaunee nuclear plant is owned by Dominion Energy Kewaunee, Inc. (DEK) and was permanently shut down in 2013. DEK purchased Kewaunee from Wisconsin Public Service and Wisconsin Power and Light in 2005. The La Crosse BWR in Genoa is owned by the Dairyland Power Cooperative (DPC) and was permanently shut down in 1987.

Current Nuclear Licenses

Point Beach Units 1 and 2 are licensed by the Nuclear Regulatory Commission (NRC) to operate until 2030 to 2033, respectively.

Role of the Public Service Commission of Wisconsin

The Public Service Commission of Wisconsin (PSCW) has no direct jurisdiction over license renewal, safety, nuclear wastes, or the transportation of those wastes. These issues are regulated by the NRC. Because the nuclear units in Wisconsin are owned by independent power producers rather than regulated investor-owned utilities, the PSCW has only limited jurisdiction over the state's nuclear facilities. The PSCW's jurisdiction is set out in the sale orders for the two nuclear plants, docket 6630-EI-113 for the sale of Point Beach to FPL and docket 05-EI-136 for the sale of Kewaunee to DEK. These orders can be viewed electronically through the PSCW's web site at <http://psc.wi.gov>.

Low-Level Radioactive Wastes

Nuclear power plants produce two kinds of radioactive wastes, low-level and high-level.

Low-level radioactive wastes are produced by nuclear power plants, hospitals, medical and educational research institutions, biomedical companies, and other commercial activities that use radioactive materials. The three classes of low-level radioactive wastes are shown in the following table.

Classes of Low-Level Radioactive Waste

Waste Class	Contents	Percent of Waste in 1995	Decay	Special Disposal Concerns
A	Mostly short half-life elements in protective clothing, paper, and lab trash.	97	Intruder to the disposal area would not receive excessive radiation exposure after 100 years.	No
B	Short and long half-life elements, in greater quantities.	2	Intruder would not receive excessive radiation after 100 years.	Waste must remain stable for 300 years. Usually stabilized in concrete trenches.
C	Nuclear reactor shell, sealed sources, other high activity industrial waste.	1	Intruder would not receive excessive radiation exposure after 500 years.	Waste must remain stable for at least 300 years and protected from intruders for 500 years.

Low-Level Radioactive Waste Disposal Facilities

There are three existing low-level waste disposal facilities in the United States that accept various classes of low-level waste. In 1980, Congress passed the Low Level Waste Policy Act, which made low-level radioactive waste disposal a state responsibility. The purpose of the act was to encourage states to construct and manage low-level disposal facilities. In order to accomplish this task, the states organized themselves into 10 regional compacts, leaving nine states unaffiliated. Wisconsin is a member of the Midwest Compact, along with Minnesota, Iowa, Missouri, Indiana, and Ohio. Missouri recently dropped out of the Midwest Compact.

The Low Level Waste Policy Act was amended in 1985 to give states more time to build new disposal sites. Since the formation of these compacts, no new low-level radioactive waste disposal facilities have been sited or constructed.

The existing low-level disposal facilities are Hanford in Washington, Barnwell in South Carolina, and Envirocare in Utah. Hanford accepts wastes from the ten states in the Northwest and Rocky Mountain compacts. Hanford accepts class “A”, “B”, and “C” wastes.

Barnwell also accepts class “A”, “B”, and “C” radioactive wastes. As of 2008, Barnwell only accepts waste from the Atlantic compact states.

The third disposal site, Envirocare, accepts only class “A” radioactive wastes but from any U.S. generator.

In Wisconsin, as well as other states, Class “B” and “C” radioactive wastes are being stockpiled because there is no approved disposal facility.

Siting a New Low-Level Radioactive Waste Disposal Facility

There are numerous issues associated with siting a new low-level radioactive waste disposal facility. They should not, for instance, be where population growth or mineral exploration would affect the ability of the site to meet performance objectives. Sites must be free of flooding and far enough above the water table to prevent water intrusion into the disposal area. Siting should avoid geological risks such as volcanoes, earthquakes, landslides, slumps, or massive erosion. Passive controls (markers, land records, soils, geology, containers) would need to meet performance objectives for the next 400 years. At the disposal site, waste might be put inside concrete cylinders or boxes to reduce site worker radiation exposure and to prevent future soil slumping if a container fails.

As fees for disposal have increased, low-level radioactive waste generators have moved to reduce waste volumes and save money. Some of the techniques used to reduce the volume of low-level waste used include:

- more rigorous monitoring and separation of contaminated from non-contaminated wastes
- compaction
- incineration
- cleaning with acid

As waste volumes have decreased, the economics of opening a new regional disposal site have become more questionable. The cost of identifying, constructing, licensing, and operating a site must be recovered from fees charged for disposal.

Some new disposal siting activities are on hold or being challenged. Siting efforts in North Carolina, the Appalachian Compact, Connecticut, Massachusetts, and New York have all been redirected or halted in part because of questions about the need for new sites. The Midwest Compact which includes Wisconsin is not currently developing a site of its own. More information on the Midwest Compact, including annual reports, can be found online at <http://www.midwestcompact.org>.

High-level Radioactive Waste – Spent Fuel

Fuel used in nuclear power plants is routinely used for three cycles of reactor operation, until it can no longer produce enough heat to generate electricity. When fuel is removed from the reactor for the last time, it is stored in a “spent fuel” pool at the power plant for a minimum of five to seven years. The spent fuel is considered high-level radioactive waste.

After being stored in the spent fuel pool for five to seven years, a typical spent fuel assembly is cool enough (in terms of both heat and radioactivity) to be put into dry storage, if necessary. Ultimately, the U.S. Department of Energy (DOE) is responsible for disposal or intermediate storage for spent fuel.

However until the DOE accepts the spent fuel, each utility that operates a nuclear plant is responsible for the spent fuel it produces. The utility must store the fuel in a spent fuel pool and/or NRC-approved dry casks.

Status of Spent Fuel Storage at Wisconsin Nuclear Power Plants

Point Beach Nuclear Power Plants

In 1995, the PSCW authorized WEPCO to use up to 12 “dry storage casks” for spent fuel storage and to construct concrete pads capable of holding another 48 casks. Use of the spent fuel pool and 48 casks would have allowed Point Beach to operate each of its units until the end of its operating license which would have expired on October 10, 2010, and March 8, 2013, respectively. The extended licenses were authorized by the NRC in December 22, 2005.

Kewaunee Nuclear Power Plant

The Kewaunee spent fuel pool was originally designed to serve two units instead of the existing one unit. Thus, the spent fuel canal that connects the spent fuel pool to the reactor has a “dead end” section extending to where the second reactor was expected to be located. Spent fuel storage racks were placed in this section in 2000.

A dry cask storage facility was constructed at Kewaunee and began operation in 2009.

La Crosse Boiling Water Reactor

The La Crosse BWR was shut down in 1987 after operating for almost 20 years. DPC has been conducting dismantlement and decommissioning activities. The spent fuel storage pool is inside the containment building. This plant cannot be fully decommissioned until all of the spent fuel has been removed from the pool. There are a total of 333 spent fuel assemblies on site. A dry cask storage facility began operation at the La Crosse BWR site in 2012.

Safety Issues Related to Spent Fuel Pool Storage

A couple of major safety issues related to storing spent fuel in a pool are the possibility of dropping a heavy load of fuel on a fuel rack as it is being moved over the spent fuel pool and the loss of water from the spent fuel pool to the extent that spent fuel is exposed.

If heavy loads are moved across the top of the spent fuel pool, a dropped load could damage spent fuel, the pool structure, or the piping connected to the pool. Using fail-safe hooks, proper rigging, and avoiding unnecessary movement of heavy loads near the spent fuel pool can prevent such events.

Spent fuel is stored in pools of water so that the heat generated by the fuel is effectively dissipated and as a means to attenuate the radiation levels in the spent fuel pool area. In an operating plant, the improper operation of the piping systems can cause a loss of water from the spent fuel pool. Water can also be lost through the fuel transfer canal to the reactor refueling cavity, which is at a lower elevation than the spent fuel pool itself. In a closed plant, pipes can freeze and break, if heating is not maintained. If pipes break at an elevation below the pool water level, the volume of water in the pool could be reduced. Lowered water levels in the pool could expose the spent fuel.

Spent Fuel Storage in Dry Casks

As the pools began to fill up with spent fuel in the late 1970s, alternative storage technologies were sought. The goal was a modular system that might facilitate later transport to a permanent disposal site.

In 1982, the Nuclear Waste Policy Act was enacted. It directed the NRC to approve a means of dry storage for the period before DOE begins accepting the spent fuel for permanent storage. The NRC developed procedures to review dry cask designs for safety. Once a dry cask has a general NRC license, a utility can use the cask at its reactor site without obtaining a site-specific NRC license for dry cask use.

Casks are licensed by the NRC for use as transportation only containers, storage only containers, and as dual-use containers (for storing and transporting spent nuclear fuel). All utility actions related to use of dry storage casks are subject to NRC oversight and inspection.

Information about the casks currently licensed for use by the NRC can be found on the NRC web site at www.nrc.gov/waste/spent-fuel-storage/designs.html

Transportation of Spent Fuel

Transportation-Approved Casks

The NRC regulates the safety of the transport casks in which spent fuel is shipped. The NRC licenses cask design and inspects cask fabrication plants. Each license lasts five years and can be renewed. Casks used for transportation are designed to provide a barrier to radiation that prevents unsafe exposure to the driver, train crew, and the public. The cask's shields block gamma rays and neutrons. The casks are also designed to transfer heat to the outside.

In case of accident, casks approved for transportation are designed to prevent a release of radioactive material to the environment. They must be able to withstand being dropped from 30 feet, landing on a vertical rod six inches in diameter, being exposed for 30 minutes to a 1,475 °F fire, being immersed under 50 feet of water for 8 hours, and under 655 feet of water for 1 hour.

Sandia National Laboratories conducted a series of tests on several transport cask designs. None of the tested spent fuel casks were damaged enough to release radioactivity to the environment. The tests involved:

- A tractor-trailer rig carrying a cask and crashing into a concrete barrier at 60 and 80 mph.
- A 120-ton locomotive going 80 mph and colliding with a cask on a truck at a crossing.
- A high-speed impact followed by a 30-minute diesel fire.

Regulating the Transport of Spent Nuclear Fuel

Spent fuel can be transported by truck or by train. The NRC and the U.S. Department of Transportation (USDOT) regulate the shipment of spent nuclear fuel. The USDOT is responsible for route selection, vehicle condition, vehicle labeling, driver training, and package marking. The NRC approves transportation routes and requires protection measures such as notification of the NRC in advance of shipment. State governors or their designees are also notified prior to the shipment. The DOE has proposed satellite tracking of shipments.

The USDOT has identified preferred routes for truck transport of spent fuel and has identified guidelines for states and tribes to use in selecting alternative routes. The preferred routes are interstate highways between centers of population, unless the affected state specifies a different route. The state determines the route around major cities. In Wisconsin, the state agency with oversight responsibility for the transport of spent nuclear fuel is the State Patrol.

Train routes are determined by the shipper and the railroad. Track conditions are considered when picking a route. If a dedicated train is used, the train stops only for fuel, to change crews, and sometimes to change or add locomotives, as it would when approaching mountains.

The USDOT administers grants for planning and emergency training on transport of hazardous materials, including spent nuclear fuel. The DOE plans to make additional training money available to states, counties, and tribes three to five years prior to shipping spent nuclear fuel to the designated repository or an interim storage site.

Current Shipments of Spent Nuclear Fuel

Spent nuclear fuel is sometimes shipped to another nuclear facility with more spent fuel storage space. Spent nuclear fuel is also shipped to research facilities for testing. Over the last 30 years, there have been thousands of shipments of spent nuclear fuel by both truck and rail throughout the United States. Though there have been some accidents, none have caused a radiological release to the environment or harm to the public. The number of spent nuclear fuel shipments is expected to significantly increase if the high-level waste repository at Yucca Mountain is completed.

Permanent Federal Repository of Spent Nuclear Fuel

As of mid-2008, approximately 56,000 metric tons of spent fuel has accumulated at the nation's utility reactors. If all reactors were to operate for their full 40-year license period, the amount of nuclear wastes would more than double.

The DOE is responsible for developing a system to manage the disposal of high-level radioactive waste and spent nuclear fuel. According to 10 CFR Part 960 of the federal code, the DOE must develop a repository for high-level waste and spent nuclear fuel.

The Nuclear Waste Fund

Under the Nuclear Waste Policy Act of 1982 as amended in 1987, a contract was created between the electric utilities and the federal government. Electric utilities would pay into a Nuclear Waste Fund, 10 cents for every 100 kW of electricity generated by nuclear power plants. The money would be paid in advance and in return, the federal government would develop a permanent repository to receive spent fuel from the utilities. The utilities' payments were intended for studying, licensing, constructing, and operating a spent nuclear fuel repository. The DOE was supposed to begin accepting spent fuel from the utilities on January 31, 1998. So far, the nation's electric utilities have paid over \$28 billion dollars (with interest) to the Nuclear Waste Fund. As of September, 30 2008, Wisconsin nuclear power plants have paid \$400.5 million. Interest accumulated on the Wisconsin portion of the Nuclear Waste Fund has added another \$294.0 million. Congress has released some of the funds to DOE through the federal budget appropriations process. The rest of the fund (the amount collected but not released to DOE) is currently being used to offset the federal deficit.

When the January 31, 1998, deadline passed, a combination of utilities and state agencies sued the DOE, requesting the court to order the DOE to begin taking spent fuel. The court ordered the DOE to begin performing the actions required by terms of the act, to begin taking the spent fuel. The DOE has not yet accepted spent fuel from any utilities. It has taken, and is storing, spent fuel from Navy vessels and foreign research reactors where the U.S. government supplied the fuel. Most nuclear operators are suing the DOE for breach of contract and for recovery of the resulting financial damages.

Regulatory Responsibilities for Spent Fuel Repository

The regulatory responsibility for spent nuclear fuel disposal is as follows:

- Department of Energy (DOE) is responsible for developing permanent disposal capacity for spent fuel and other high-level radioactive waste.
- The Environmental Protection Agency (EPA) is responsible for developing environmental standards to evaluate the safety of a geologic repository.
- NRC is responsible for developing regulations to implement the EPA safety standards and for licensing the repository.

The EPA contracted with the National Academy of Sciences to advise them of the appropriate technical basis for public health and safety standards for the Yucca Mountain repository. NAS issued this study, entitled “Technical Bases for Yucca Mountain Standards,” on August 1, 1995.

According to 40 CFR Part 197, the EPA is responsible for developing appropriate radiation protection standards for management and disposal of high-level radioactive waste and spent nuclear fuel. It was directed to issue standards a year after the NAS study was published in 1996. The proposed EPA standards went out for public comment in 1999. Challenges in court have delayed finalizing the standards. The EPA issued final standards for Yucca Mountain in 2008.

The NRC technical criteria specified in 10 CFR Part 63 must be consistent with the new EPA standards. Otherwise, NRC must issue new standards within a year of the publication of the revised EPA standards. The NRC is the organization that will issue a license for the spent fuel repository and ensure that the DOE meets the EPA standards. The NRC must find that public health and safety has been adequately protected. The regulations in 10 CFR Part 63 govern pre-licensing activities, authorization to begin construction of a facility, a license to receive and place spent fuel and high-level waste in a facility, and a license to close a facility. The NRC would also license any interim storage facility for spent fuel, and licenses spent fuel transportation casks. The NRC amended 10 CFR Part 63 to incorporate the new EPA standard in March of 2009.

The U.S. General Accounting Office (GAC) must audit the DOE’s programs and its progress in licensing a high-level waste and spent fuel repository. The GAC must then publish the findings of the audit.

The Nuclear Waste Technical Review Board is independent of the DOE and other governmental agencies and provides an independent review of DOE work products. It was created to advise Congress and the Secretary of Energy on issues related to high-level waste and spent fuel disposal.

Yucca Mountain Repository

In 1983, the DOE selected nine potential sites for the nation’s first long-term geologic repository for spent nuclear fuel and high-level radioactive wastes. The repository would store the spent fuel from utility and research reactors and waste from military reactors. These wastes are currently being

stored at 131 different sites in the nation. In 1986, three sites were approved by the president for further study: Yucca Mountain, Nevada; Deaf Smith County, Texas; and Hanford, Washington.

The only site being currently investigated as a permanent repository is Yucca Mountain. Yucca Mountain is located in southern Nevada, about 100 miles northwest of Las Vegas. The DOE began studying Yucca Mountain in 1978.

Several aspects of the Yucca Mountain repository site (water movement, effects of heat on water movement, and chemistry, for example) are still being studied. A viability assessment that identified where more work is needed was issued in December 1998.

On July 9, 2002, the U.S. Senate cast the final legislature vote approving the development of a nuclear waste repository at Yucca Mountain. On July 23, 2002, President Bush signed House Joint Resolution 87, allowing the DOE to take the next step in establishing a safe repository in which to store our nation's nuclear waste.

DOE submitted a license application to the NRC on June 3, 2008. It was accompanied by an Environmental Impact Statement (EIS) in support of receiving construction authorization and, ultimately, a license to receive and possess waste. In early 2010, the White House moved to terminate Yucca Mountain. DOE filed a motion with the NRC to withdraw the Yucca Mountain application and the Secretary of Energy was directed to appoint a blue ribbon commission to study how best to dispose of nuclear waste.

New Nuclear Power Plants in Wisconsin

Wisconsin Statute § 196.493 essentially says that the PSCW may not approve a new nuclear power plant unless it finds the following to be true:

- That there is a federally licensed facility or facility outside the United States available for the disposal of high-level nuclear waste; and
- That the new plant is economically advantageous to ratepayers when compared with feasible alternatives, taking into account the capital, decommissioning, and waste disposal costs associated with a nuclear facility.

As it stands today, there is no federally-licensed nuclear waste disposal facility in the United States, nor is it expected that one will be licensed in the near future. As a result, current Wisconsin law operates as a “moratorium” on the construction of new nuclear power plants.

Nuclear Power Plant Decommissioning

End-of-Life Options for Nuclear Plants

When a nuclear power plant becomes uneconomic to operate or reaches the end of its 40-year license with the NRC, the plant either: (1) begins “decommissioning” and is dismantled; or (2) is put into storage, called SAFSTOR, for decommissioning at a later date. As an alternative to ceasing operation of the plant, the licensee may apply to the NRC for a 20-year extension of the license. The NRC states that decommissioning must be completed within 60 years of when the nuclear power plant shuts down. An overview of the decommissioning process can be found on the NRC’s web site at www.nrc.gov/about-nrc/regulatory/decommissioning.html.

In deferred decommissioning, or SAFSTOR, the facility is kept in a safe, non-operating, environmentally sound condition while the radiation decays and until it is ready to be dismantled. SAFSTOR is most commonly used when one unit at a multi-unit site shuts down. One advantage of SAFSTOR is that some of the radioactivity has decayed so that occupational radiation exposures associated with decommissioning the plant are less than with immediate decommissioning. The disadvantages of SAFSTOR are that equipment needed during decommissioning may degrade in storage, costs of low level radioactive waste disposal will be higher, and insurance premiums must be paid for a longer time.

The advantages of immediate dismantlement are that experienced plant workers participate in the decommissioning, costs of low-level radioactive waste disposal are known, equipment needed for decommissioning is in good shape, and insurance premiums are paid for a relatively short time.

The Status of Decommissioning in Wisconsin

Kewaunee Nuclear Power Plant

On February 28, 2013, DEK submitted to the NRC, a post-shutdown decommissioning activities report (PSDAR) for the shutdown of the Kewaunee nuclear plant. In the PSDAR, DEK stated it would use the SAFSTOR method to decommission the plant. On May 7, 2013, DEK permanently ceased power operations at Kewaunee.

La Crosse Boiling Water Reactor

The La Crosse BWR in Genoa was shut down on April 30, 1987. The NRC approved a SAFSTOR decommissioning plan for this plant on August 7, 1991. The plant is currently undergoing decommissioning activities and is developing plans for an independent spent fuel storage installation.

The Public Service Commission of Wisconsin is an independent state agency that oversees more than 1,100 Wisconsin public utilities that provide natural gas, electricity, heat, steam, water and telecommunication services.



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