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Spent Nuclear Fuel Discharges from U.S. Reactors 1994

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Executive Summary

The Energy Information Administration of the U.S. Department of Energy (DOE) administers the Nuclear Fuel Data survey, Form RW-859, for the Office of Civilian Radioactive Waste Management. This form is used to collect data on fuel assemblies irradiated at commercial nuclear power reactors operating in the United States, and the current inventories and storage capacities of those reactors. The data are important to the design and operation of the equipment and facilities that DOE will use for the future acceptance, transportation, and disposal of spent fuel. The information presented in this report summarizes the detailed data collected on Form RW-859 that focuses on commercial light-water reactor (LWR) spent nuclear fuel reported as discharged as of December 31, 1994. The report identifies trends in discharged spent fuel, burnup levels, spent fuel inventories, and site capacities.

Spent Nuclear Fuel Discharges

A total of 104,742 assemblies, with an initial loading weight of 30,003.3 metric tons of uranium (MTU) (Table ES1), have been discharged from 118 commercial LWR's from 1968 through 1994. Electric utilities also reported 172 temporarily discharged assemblies at pressurized-water reactors (PWR's) and 626 temporarily discharged assemblies at boiling-water reactors (BWR's). Approximately 36 percent (10,901.3 MTU) of total discharges (by weight) are from BWR's; 64 percent 19,102.0 MTU) from PWR's. Reprocessed spent fuel, fuel from the damaged Three Mile Island Unit 2 reactor, and discharges from Fort St. Vrain (the only commercial high-temperature, gas-cooled reactor in the United States), are not within the scope of this report.

The characteristics of the permanently discharged spent fuel have changed over time. Prior to 1972, most spent commercial nuclear fuel discharged was reprocessed. Since that time, the annual average burnup for discharged BWR assemblies has shown a fairly steady increase to reach a new high of 33.1 gigawattdays thermal per metric ton of uranium (GWDt/MTU) in 1994. The average burnup has also continued to increase for PWR's, reaching a new high of 40.0 GWDt/MTU in 1994.

Table ES1. Total U.S. Commercial Spent Nuclear Fuel Discharges, 1968-1994

Reactor Type	Stored at Reactor Sites	Stored at Away-from-reactor Facilities	Total
	Number of Assemblies		
Boiling-Water Reactor	57,187	2,957	60,144
Pressurized-Water Reactor	44,107	491	44,598
Total	**101,294**	**3,448**	**104,742**
	Metric Tons of Uranium		
Boiling-Water Reactor	10,347.3	554.0	10,901.3
Pressurized-Water Reactor	18,909.4	192.6	19,102.0
Total	**29,256.7**	**746.6**	**30,003.3**

Notes: A number of assemblies discharged prior to 1972 were reprocessed and are not included in this table. A total of 2,208 high-temperature, gas-cooled reactor (HTGR) fuel elements, with initial uranium content equal to 24.2 metric tons of uranium (MTU), were discharged. These HTGR fuel elements are not included in the above table. Totals may not equal sum of components because of independent rounding.
Source: Energy Information Administration, Form RW-859, "Nuclear Fuel Data" (1994).

At the end of 1994, a total of 3,448 of the assemblies covered ' 's report were in storage at five away-from-reactor : facilities. Typically, assemblies were moved either to free up space in the discharging reactor's storage site or for use in a research program.

Site Capacities and Inventories, 1994

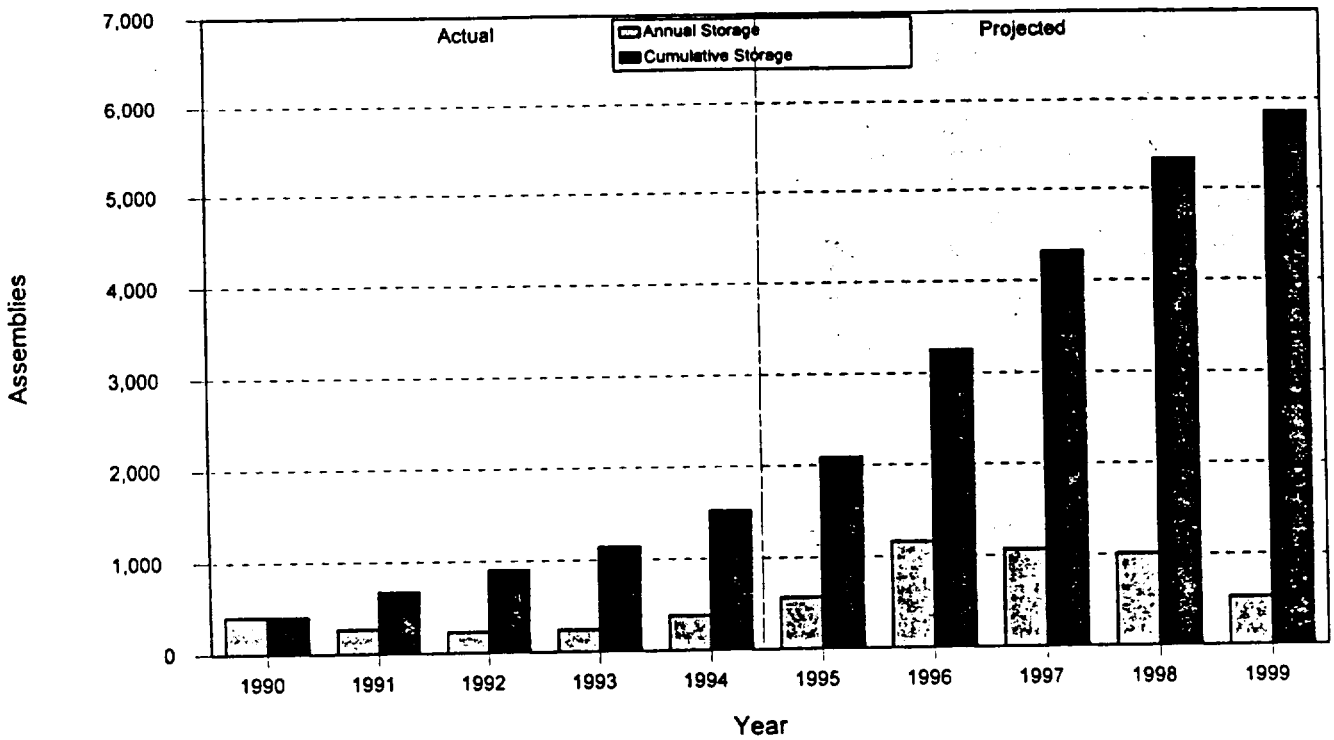
The total inventory of discharged LWR spent nuclear fuel in storage in the United States, as of December 31, 1994, was 104,742 assemblies. The majority of spent nuclear fuel is stored in water-filled pools, but 1,525 assemblies are in dry storage at Independent Spent Fuel Storage Installations (ISFSI's) at Baltimore Gas and Electric Company's Calvert Cliffs plant, Carolina Power and Light Company's Robinson 2 plant, Consumers Power Company's Palisades plant, Duke Power Company's Oconee plant, and Virginia Power's Surry plant. This section includes a fold-out map showing the location of the commercial nuclear reactors as well as planned and existing ISFSI's. The current licensed storage capacity is 218,803 assemblies. The total maximum storage capacity of all storage sites, as reported by electric utilities and off-site storage, is 218,967 assemblies. However, the excess of total maximum capacity over current total inventory does not reflect the shortage of pool storage in many individual cases. Of the 110 reactors expected to be in operation by the year 2000, 9 reactors appear to require expansion above current pool maximums before 2000.

The quantities of spent nuclear fuel in storage at nuclear power plants and away-from-reactor facilities are aggregated to the state level in Figures ES1 and ES2. The data account for all permanently and temporarily discharged assemblies from commercial nuclear reactors in the United States.

Figure ES1. Commercial Spent Nuclear Fuel in Storage at U.S. Nuclear Power Plants and Away-from-reactor Facilities by State (Assemblies)

Notes: A total of 2,208 high-temperature, gas-cooled reactor (HTGR) fuel elements are in storage (744 in Idaho and 1,464 in Colorado). These HTGR fuel elements are reflected on this map but are not included in Table ES1. Numbers in the above map represent assemblies stored at nuclear power plant sites and away-from-reactor facilities, and include both permanently and temporarily discharged assemblies.
Source: Energy Information Administration, Form RW-859, "Nuclear Fuel Data" (1994).

Figure 9. Dry Storage Inventories and Projections



Source: Energy Information Administration, Form RW-859, "Nuclear Fuel Data" (1994).

Arkansas Power and Light Company

In 1994, the Arkansas Power and Light Company's Arkansas Nuclear 1 & 2 plants finalized a contractual agreement with Sierra Nuclear for 14 VSC-24 casks that can hold up to 24 PWR assemblies.

Construction of the concrete casks began in October 1994. The cask storage will be on a concrete pad located within the existing security protected area at the Arkansas Nuclear plants. The pad is designed to hold 26 casks, but can be expanded to provide space for an additional 50 casks. Existing rail lines and a new rail car specifically designed for the VSC will transport the casks from the plant's Auxiliary Building to the storage pad.

Baltimore Gas and Electric Company

The ISFSI at Baltimore Gas and Electric Company's Calvert Cliffs station is the NUHOMS-24P. The Calvert Cliffs ISFSI has been designed as a life-of-plant storage facility. The ISFSI will have the capacity to store all spent fuel discharged from Calvert Cliffs 1 & 2, beyond the spent fuel pool capacity, up to the 40-year plant life, if necessary. The exact capacity needed is uncertain, and to limit capital investment until necessary, the ISFSI will be constructed in up to five phases. The ISFSI required the preparation of a 10 CFR 72 License Application, Safety Analysis Report, Environmental Report, and a Security Plan for NRC review and approval. The license material was prepared and submitted to the NRC in December 1989. Construction of the ISFSI west of the plant began in April 1991 after NRC approved the Environmental Report. The facility and its pre-operational testing were completed in October 1992. The ISFSI was licensed by the NRC on November 25, 1992.

The license allows Baltimore Gas and Electric Company to place as many as 2,880 assemblies in casks to be placed in ISFSI's. Each NUHOMS cask at Calvert Cliffs can hold 24 assemblies, and there are currently 120 planned storage modules. On November 30, 1993, the dry storage facility became fully operational with the successful loading of the first cask of fuel. As of September 1995, a total of 240 assemblies were stored in 10 modules.

Carolina Power and Light Company

The ISFSI for Carolina Power and Light Company's Robinson 2 plant is composed of 8 NUHOMS-7P horizontal storage modules (HSM's). Each HSM is a steel-reinforced concrete structure which holds 7 intact assemblies in each module. The ISFSI was licensed by the NRC in August 1986 to hold 56