



U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD

DEPARTMENT OF ENERGY-MANAGED SPENT NUCLEAR FUEL AT THE SAVANNAH RIVER SITE

OVERVIEW¹

The U.S. Department of Energy (DOE) manages approximately 2,500 metric tons of heavy metal (MTHM)² of spent nuclear fuel (SNF) that resulted mostly (85% by mass) from defense-related nuclear activities (primarily weapons plutonium production reactors and naval propulsion reactors). Nearly all the SNF is stored at four locations: the Hanford Site in Washington State, the Idaho National Laboratory in Idaho, the Savannah River Site (SRS) in South Carolina, and the Fort St. Vrain Independent Spent Fuel Storage Installation in Colorado (see the Board's fact sheet on [DOE-Managed Spent Nuclear Fuel](#)).³ Approximately 30 MTHM of SNF are stored at SRS, a 310-square mile site about 20 miles southeast of Augusta, Georgia (Figure 1). Beginning in the early 1950s, five nuclear reactors on the site produced nuclear materials (mainly tritium and plutonium) for nuclear weapons (Savannah River Nuclear Solutions 2017). The reactors ended operations in the late 1980s; however, SRS continues to receive, inspect, and store SNF from domestic and foreign research reactors. All SNF at SRS is stored at the L area in the L Basin building (Figures 1 and 2).

SPENT NUCLEAR FUEL AND STORAGE FACILITIES AT THE SRS

Spent Nuclear Fuel. Information on the predominant types of stored SNF, such as the source, fuel type, cladding type, and amount,

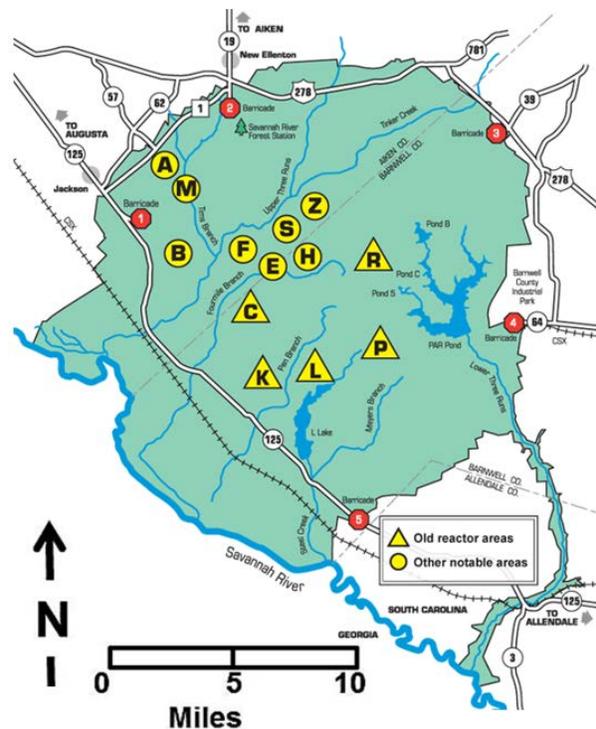


Figure 1. Savannah River Site Map (modified from DOE 2020).

¹ Unless explicitly stated, this fact sheet does not present Board findings, conclusions, or recommendations and none should be inferred from its content.

² Metric ton of heavy metal is a commonly used measure of the mass of nuclear fuel. Heavy metal refers to elements with an atomic number greater than 89 (e.g., thorium, uranium, and plutonium) in the fuel. The masses of other constituents of the fuel, such as cladding, alloy materials, and structural materials (and fission products in spent nuclear fuel), are not included in this measure. A metric ton is 1,000 kilograms, which is equal to about 2,200 pounds.

³ Fact sheets providing summary information on DOE-managed SNF stored at the Hanford Site, Idaho National Laboratory, and Fort St. Vrain can be found at the Board website: <http://www.nwtrb.gov/our-work/fact-sheets>. A more detailed description of DOE-managed SNF and SNF storage facilities is provided in the Board report, *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel* (NWTRB 2017).

Table 1. Characteristics of SNF stored at SRS*

SNF Source	Description#	Amount (MTHM)	Storage System
Foreign and domestic research reactors, test reactors, and other reactors	Aluminum-based: aluminum-clad uranium oxide, aluminum-clad uranium-aluminum alloy	~10 [†]	4 or 5 SNF assemblies per aluminum tube in vertical tube storage; ~13,000 assemblies total
Research and test reactors	Non-aluminum-based: zirconium-alloy clad, stainless-steel clad, and declad‡ thorium oxide and uranium oxide or uranium-zirconium alloy	~20	Various, including oversized isolation cans; ~2,000 assemblies total
<p>*Because of the wide variety of SNF types within the aluminum-based and the non-aluminum-based SNF groups (>30 types in each group), only the predominant types are included in the table. #From Rose (2013) and DOE (2000). †Does not include aluminum-clad SNF being processed in H Canyon (see below). ‡Declad SNF is SNF from which the metal cladding has been removed.</p>			

is presented in Table 1 [additional details are provided in NWTRB (2017)]. DOE groups the SNF into “aluminum-based SNF” and “non-aluminum-based SNF.”

Approximately 13,000 aluminum-based SNF assemblies and 2,000 non-aluminum-based SNF assemblies are stored at SRS. The aluminum-based SNF is primarily research reactor fuel assemblies (DOE 2000) that were transported to SRS from other countries under the “Foreign Research Reactor Program” and from U.S. research reactors under the “Domestic Research Reactor Program” (DOE 1996). The aluminum-based SNF includes aluminum-clad uranium oxide SNF and aluminum-clad uranium-aluminum alloy SNF. The non-aluminum-based SNF includes zirconium-alloy-clad and stainless-steel-clad thorium and uranium oxide or uranium-zirconium alloy SNF. The cladding from some of the non-aluminum-based SNF has been removed.

L Basin Storage Facility. At the L Basin building (Figure 2), the majority of SNF is stored underwater in the L Basin⁴ (Figure 3). The remaining SNF, which is not described in Table 1, is stored in two small, dry storage areas in the L Basin building (Gillas 2011).

L Basin is divided into an upper (North) and a lower (South) basin. The upper basin is mostly 30-ft (9.1-m) deep and includes the vertical tube storage area that contains bundles of SNF (Figure 3). It also includes the dry cave basin, machine basin, and emergency basin



Figure 2. L Basin Building (from Hixson 2015).

⁴ L Basin is a reinforced concrete structure with walls 2.5- to 7-ft (0.76- to 2.1-m) thick and holds ~3.4 × 10⁶ gal (~12.9 × 10⁶ L) of water (Maxted 2014). The basin is approximately 160 by 230 ft (48.8 by 70 m) in plan

areas. The lower basin is mostly 17-ft (5.2-m) deep and includes the horizontal tube storage area, the bucket storage area, the monitor basin, and the transfer bay. Sindelar and Deible (2011) provides details of the storage systems in the L Basin.

PATH FORWARD FOR MANAGING AND DISPOSING OF SRS SNF

Historically, SNF from the five nuclear material production reactors at SRS was processed in the F Canyon and H Canyon chemical separations plants to recover plutonium and other materials. In September 2014, DOE began a new processing effort at H Canyon to dissolve 3.3 MTHM of aluminum-based SNF from the L Basin and recover highly enriched uranium to be isotopically diluted and used to fabricate fresh fuel for commercial nuclear reactors. DOE plans to complete processing this SNF by Fiscal Year 2024 (Lofton 2019). This processing will reduce the SNF inventory in the L Basin, which will allow SRS to continue to accept and store foreign and domestic research reactor SNF and other SNF that is of concern for proliferation reasons.



Figure 3. Spent Nuclear Fuel Storage in the Vertical Tube Storage area at the L Basin (from Hixson 2015).

The program for accepting foreign research reactor SNF expired in 2019, but the National Nuclear Security Administration has proposed extending the program through 2029 (NNSA 2019). The program for accepting domestic research reactor SNF extends through 2035 (DOE 1996).

DOE recognizes that a departmental decision is needed on the future direction of SRS SNF management. It has started the process to define appropriate disposition paths for the entire inventory of DOE-managed SNF, including SNF stored at SRS (Rovira 2020). DOE has initiated the development of roadmaps that identify reasonable disposition pathways based on the characteristics and potential challenges of the SNF. The potential disposition pathways for the long-term management and disposition of DOE-managed SNF that DOE identified are: (i) direct disposal, (ii) existing processing, and (iii) alternate processing pathways (Rovira 2020). Pending a decision, the SRS SNF will be stored in the L Basin indefinitely, except for the 3.3 MTHM being processed in H Canyon (DOE 2013).

REFERENCES

DOE (U.S. Department of Energy). 1996. "Revision to the Record of Decision for the Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel." *Federal Register*, 61, 38720, July 25.

dimensions and has seven interconnected sections that are 17- to 50-ft (5.2- to 15.2-m) deep and configured for SNF storage (Sindelar and Deible 2011).

DOE. 2000. *Savannah River Site, Spent Nuclear Fuel Management Final Environmental Impact Statement*. DOE/EIS-0279. Aiken, SC: U.S. Department of Energy, Savannah River Operations Office. March.

DOE. 2013. “Amended Record of Decision for Spent Nuclear Fuel Management at the Savannah River Site.” *Federal Register*, 78, 20625, April 5.

DOE. 2020. *Savannah River Site Virtual Tour*. Accessed June 16, 2020. <https://www.srs.gov/general/tour/online.htm>.

Gillas, D. 2011. *SRS Used Nuclear Fuel Management*. Presentation to the Savannah River Site Citizens Advisory Board, July 26, 2011. Accessed April 30, 2020. http://www.srs.gov/general/outreach/srs-cab/library/meetings/2011/fb/201107_unf.pdf.

Hixson, L. 2015. “Savannah River Restarting Reprocessing Operations.” *Enformable*. April 27, 2015. Accessed April 30, 2020. <http://enformable.com/2015/04/savannah-river-restarting-reprocessing-operation/>.

Lofton, K. 2019. *Spent Fuel Project Overview: Nuclear Material System Plan*. Presentation to the Savannah River Site Citizens Advisory Board, March 26, 2019. Accessed April 30, 2020. <https://cab.srs.gov/library/meetings/2019/nm/Spent-Fuel-Program-CAB-updates-Lofton.pdf>.

Maxted, M. 2014. *SRS L-Basin Used Nuclear Fuel Program Update*. Presentation to the U.S. Nuclear Waste Technical Review Board, October 29, 2014.

NNSA (National Nuclear Security Administration). 2019. *Supplement Analysis for the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program*. DOE/EIS-0218-SA-8. Washington, D.C.: National Nuclear Security Administration. April.

NWTRB (Nuclear Waste Technical Review Board). 2017. *Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel*. Arlington, VA: U.S. Nuclear Waste Technical Review Board. December.

Rose, D.B. 2013. *Spent Fuel Management at Savannah River Site*. Presentation at the Institute of Nuclear Materials Management Spent Fuel Management Seminar XXVIII, January 15, 2013. Accessed April 30, 2020. <https://rampac.energy.gov/docs/default-source/education/q25.pdf>.

Rovira, J., B. Carlsen, and E. Moore. 2020. “Spent Nuclear Fuel Exploratory Roadmaps.” Paper 20054. Waste Management 2020 Conference, Phoenix, AZ, March 8–12, 2020.

Savannah River Nuclear Solutions. 2017. *Facts from the Savannah River Site*. 16CC00020KP. Accessed April 30, 2020. http://www.srs.gov/general/news/factsheets/srs_overview.pdf.

Sindelar, R.L. and R.W. Deible. 2011. *Demonstration of Long-Term Storage Capability for Spent Nuclear Fuel in L Basin*. SRNL-STI-2011-00190. Aiken, South Carolina: Savannah River National Laboratory. April.

The U.S. Nuclear Waste Technical Review Board

is an independent federal agency established in the 1987 amendments to the Nuclear Waste Policy Act (NWPA).

The Board evaluates the technical and scientific validity of U.S. Department of Energy activities related to implementing the NWPA and provides objective expert advice on nuclear waste issues to Congress and the Secretary of Energy.

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