

An Overview of the Savannah River Site

NATIONAL SECURITY • ENVIRONMENTAL STEWARDSHIP • CLEAN ENERGY

a U.S. Department of Energy site located in Aiken, S.C.

The Savannah River Site

Dedicated to maintaining the highest possible safety and security standards, the Savannah River Site (SRS) is a key U.S. Department of Energy (DOE) industrial complex responsible for environmental stewardship, environmental cleanup, waste management and disposition of nuclear materials.

Safety

SRS is committed to its people, missions and the future. SRS has a long track record of being one of the safest sites in the DOE complex and one of the safest major industrial sites in the world. Protecting workers, the public, the environment and national security interests are our highest goals.

Missions

SRS processes and stores nuclear materials in support of national defense and U.S. nuclear nonproliferation efforts. The Site also develops and deploys technologies to improve the environment and treat solid and liquid nuclear and hazardous wastes left from the Cold War. While current missions remain the highest priority, SRS leadership places great importance on developing broader missions for SRS that use its unique capabilities in order to address critical national missions.

History

During the 1950s, SRS began to produce materials used in nuclear weapons, primarily tritium and plutonium-239. Five reactors and support facilities were built to produce these nuclear materials. Irradiated materials were moved from the reactors to one of the two chemical separations plants. In these facilities, known as "canyons," the irradiated fuel and target assemblies were chemically processed to separate useful products from waste. After refinement, nuclear materials were shipped to other DOE sites for final application. SRS produced about 36 metric tons of plutonium from 1953 to 1988.

Environment

Originally farms and swamp land, SRS now encompasses a timber and forestry research center managed by the U.S. Forest Service-Savannah River. In 1972, SRS was designated as the first National Environmental Research Park. Today, the vast forests of SRS are home to rare and endangered species including wood storks, bald eagles and red cockaded woodpeckers, as well as wild turkeys, white-tailed deer and otters.



SRS is owned by the U.S. Department of Energy.

Federal agencies at SRS include:

Department of Energy: Savannah River Operations Office

National Nuclear Security Administration: Savannah River Field Office, Office of Fissile Materials Disposition and MOX Project Office

U.S. Forest Service-Savannah River

U.S. Nuclear Regulatory Commission

U.S. Army Corps of Engineers

6

major contractors

Savannah River Nuclear Solutions, LLC
Management and operations of SRS and Savannah River National Laboratory

Savannah River Remediation LLC
Liquid waste operations

CB&I AREVA MOX Services
Mixed Oxide Fuel Fabrication Facility construction

Parsons
Salt Waste Processing Facility

Centerra Group, LLC
SRS security

University of Georgia
Savannah River Ecology Laboratory

10,000

current employees
(contractors and federal agencies)



310

square-mile site
Located near Aiken, S.C. on the Savannah River, which borders South Carolina and Georgia. SRS covers 198,344 acres, including parts of Aiken, Barnwell and Allendale counties in South Carolina.

\$1.9

billion
annual budget

1950

President Harry S. Truman authorizes construction of SRS

Six towns were moved to make way for the Savannah River Plant (now SRS).

\$2.6

billion
annual regional economic impact across the two-state area

5

reactors originally constructed

Also, two chemical separations plants, a heavy water extraction plant, a nuclear fuel and target fabrication facility, a tritium extraction facility and waste management facilities.

\$200

million
spent annually in local procurements

Our Missions

55%
EM

Management, stabilization and disposition of nuclear materials
Management and disposition of solid, liquid and transuranic wastes
Spent fuel management
Environmental remediation and cleanup

Environmental Management
National Nuclear Security Administration

NNSA

Tritium operations and extraction
Helium-3 recovery
Nonproliferation support
Mixed Oxide Fuel Fabrication Facility
Uranium blending and shipping
Foreign fuel receipts

45%

The 'City' of SRS

To support operations, SRS maintains an infrastructure similar to a small city.



- fire department and emergency services
- medical facilities
- 230 miles of roads and first S.C. cloverleaf
- water and electrical utilities
- weather center
- information technology networks
- locomotive and train tracks
- biofuels plant for power generation



A cask receipt in L Basin

Nuclear Materials Management

Spent Fuel Operations

Spent nuclear fuel (SNF) is nuclear fuel that has been irradiated in a nuclear reactor. SNF from the Site's former production reactors and from foreign and domestic research reactor programs is currently safely stored in an underwater storage facility in L Area, called a disassembly basin. L Basin has concrete walls two and a half to seven feet thick and holds approximately 3.4 million gallons of water, with pool depths of 17 to 50 feet. The basin water provides shielding to protect workers from radiation. Since 1964, SRS has received more than 2,335 casks containing over 46,500 SNF assemblies.

2,335
spent nuclear fuel casks received at SRS since 1964

3.4
millions of gallons of water in L Basin



Activities in the K Area Complex

K Area Complex

Operations at SRS's K Area Complex (KAC) provide for the handling and interim safe storage for much of DOE's excess plutonium and other special nuclear materials (SNM). The principal operations building formerly housed K Reactor, which produced nuclear materials to support the U.S. during the Cold War for nearly four decades. It was DOE's last operating production reactor, shutting down in 1992. A DOE decision in 2000 allowed K Reactor to go through significant seismic, structural and security upgrades to become DOE's only Category 1 SNM storage facility. Since that time, SRS has assisted DOE in saving millions of taxpayer dollars through the safe receipt and storage of nuclear materials from the Rocky Flats Environmental Technology Site, SRS's FB Line, the Hanford Site, Lawrence Livermore National Laboratory and Los Alamos National Laboratory. Verification measurements and other surveillance examinations ensure the security of SNM in K Area. In the future, stabilization and repackaging capability can be added to the KAC to further enhance DOE's ability to manage excess plutonium and other SNM until a final disposition path is achieved.

4,117
verification measurements completed since 2002

1,016
Radio-Frequency Tamper Indicating Devices changed out since 2009

by the numbers H Canyon

1955

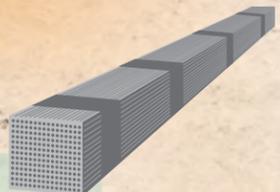
H Canyon began operations. The facility is still in use.

30

NASA deep-space explorations powered by plutonium-238 recovered in H Canyon

22

hours to dissolve a fuel bundle in nitric acid



335

trailers of low enriched uranium sent to the Tennessee Valley Authority since March 2003. That's enough to power:

all S.C. homes for **8.5** years



all U.S. homes for **47** days

100

feet tall, or about 10 stories high

22

metric tons of highly enriched uranium downblended to low enriched uranium. That's the equivalent of:



206 million barrels of oil

1,028

feet long, more than three football fields

H Canyon



An operator (right) in the H Canyon (top) control room



SRS's two primary separations facilities, called "canyons," are located in F and H Areas. F Canyon and H Canyon—together with FB Line and HB Line, which are located atop the canyons—are where nuclear materials historically have been chemically recovered and purified. F Canyon and FB Line have been deactivated and await further disposition decisions.

H Canyon is the only production-scale, shielded chemical separations facility still in operation in the U.S. The facility's operations historically recovered uranium-235 and neptunium-237 from spent nuclear fuel rods from Site production reactors and from domestic and foreign research reactor programs.

More recently, SRS has used H Canyon to downblend highly enriched uranium, which can be used in nuclear weapons, into low enriched uranium (LEU). LEU is not desirable for weapons use and can be used to make fuel for the Tennessee Valley Authority's (TVA) commercial power reactors. Since March 2003, over 330 trailers of LEU have been shipped to TVA, providing enough LEU to provide power for all the homes in South Carolina for over 8.5 years or every home in the U.S. for approximately 47 days.

Along with HB Line, H Canyon supports the DOE Enriched Uranium and Plutonium Disposition Programs by reducing the quantity of fissile materials in storage in the U.S. This supports both environmental cleanup and nuclear nonproliferation efforts and a smaller, safer, more secure and less expensive nuclear weapons complex.

HB Line

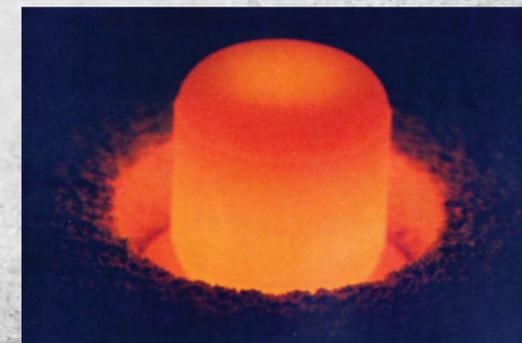
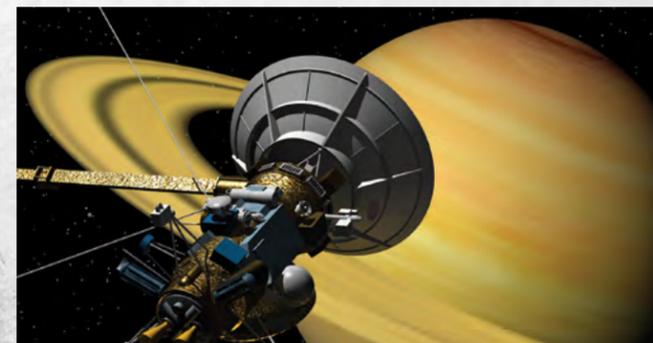
HB Line, located on top of H Canyon, is the only chemical processing facility of its kind in the DOE complex.

HB Line has produced plutonium-238 for the National Aeronautics and Space Administration (NASA). In 1995, SRS completed a five-year campaign to supply plutonium-238 for NASA's Cassini mission. The unmanned expedition to Saturn was launched Oct. 13, 1997, and arrived on July 1, 2004. Cassini's missions will run through 2017.

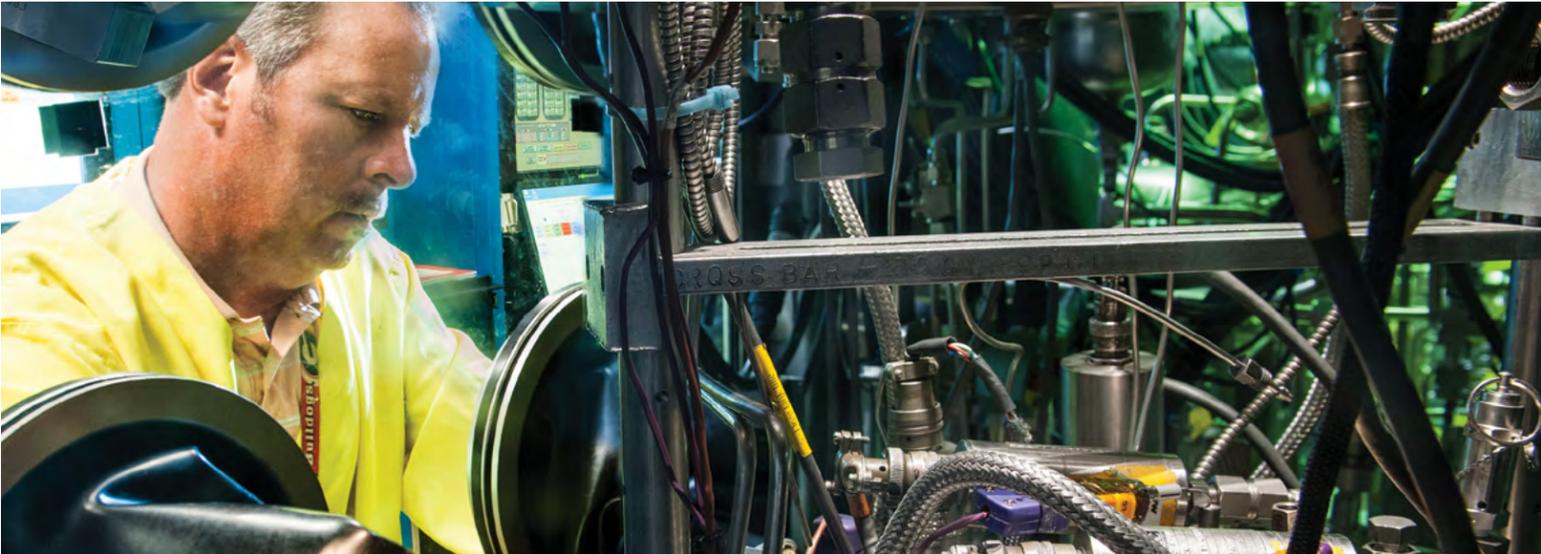
HB Line has more recently been used to make plutonium oxide, a non-weapons usable form of plutonium. After leaving HB Line, the plutonium oxide will be sent to a different facility to be made into fuel for commercial nuclear power reactors.



(Clockwise from left) A shipment of low enriched uranium on its way to TVA; plutonium-238; an artist's rendering of the Cassini spacecraft



National Nuclear Security Administration



Mixed Oxide Fuel Fabrication

SRS is one of the primary DOE sites with missions to address issues of national security and nonproliferation, including legacy material disposition.

Plutonium and nuclear material management missions conducted at SRS have been expanded to include materials from dismantled weapons and surpluses from other DOE sites. These missions are focused on the disposition of excess weapons-grade material consistent with the U.S.-Russian agreement on nonproliferation. The Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) will convert excess weapons-usable plutonium to a form that can be used in commercial power reactors.

In 2007, construction began for the MFFF, which will be operated by CB&I AREVA MOX Services. The Waste Solidification Building, which was constructed by Savannah River Nuclear Solutions, will handle the waste generated by the MFFF.

The Waste Solidification Building at SRS

Savannah River Tritium Enterprise

SRS is the nation's only facility for extracting, recycling, purifying and reloading tritium, a radioactive isotope of hydrogen that is a key element of modern nuclear weapons.

SRS supports five tritium and gas transfer system-related missions on behalf of NNSA: tritium supply, stockpile maintenance, stockpile evaluation, helium-3 recovery, and research and development (R&D).

Photo: Gas transfer system testing

Missions

- 1 With a half-life of only 12.3 years, tritium must be continually replenished. SRS accomplishes this in two ways: by recycling it from existing warheads and by extracting it from target rods that have been irradiated in a Tennessee Valley Authority commercial power nuclear reactor.
- 2 SRS helps maintain the U.S. nuclear stockpile by replenishing gas transfer systems, which ensure performance of nuclear weapons; reservoirs are loaded with a mixture of tritium and deuterium gases, finished, assembled, inspected, packaged and shipped.
- 3 In the absence of nuclear weapons testing, designers must rely on SRS evaluation data to certify the reliability of U.S. nuclear weapons; samples of nuclear weapons are removed from the active stockpile, and their gas transfer systems are sent to SRS for testing.
- 4 Helium-3, which is a by-product of SRS tritium processing, is a precious commodity used in neutron detection equipment and other applications, and SRS is its sole U.S. source.
- 5 SRNL researchers use their expertise in tritium to conduct R&D that enhances processing in the SRS Tritium Facilities. SRNL researchers also work in partnership with NNSA's weapon design laboratories, conducting R&D that supports new gas transfer system designs.





Savannah River National Laboratory

Savannah River National Laboratory (SRNL) is a multi-program national laboratory that puts science to work to provide practical, cost-effective solutions for our nation's environmental cleanup, nuclear security and clean energy challenges.

The laboratory has a staff of more than 800, including many internationally recognized experts. SRNL researchers have made significant scientific and technological advances in glass technology, hydrogen storage technology, nonproliferation, environmental characterization and cleanup, radioactive waste treatment, sensors and probes and other fields.

SRNL is the national laboratory for DOE's Environmental Management program. In this capacity, SRNL applies its expertise and applied technology capabilities to assist sites across the DOE complex in meeting cleanup requirements.

SRNL's unique facilities include laboratories for the safe study and handling of radioactive materials, a field demonstration site for testing and evaluating environmental cleanup technologies, laboratories for ultra-sensitive measurement and analysis of radioactive materials, and the world's only radiological crime investigation laboratory.

While the laboratory continues to provide the science and technology support for SRS operations, much of SRNL's work comes from non-SRS customers, including DOE, NNSA, other DOE sites and federal agencies such as the Department of Homeland Security and the Federal Bureau of Investigation.

To maximize the nation's return for its investment in the laboratory, SRNL forms strategic partnerships with private industry, academia and government agencies to apply the laboratory's unique expertise to challenges of mutual interest. The laboratory also shares its expertise by licensing private companies to manufacture and market technologies created at SRNL, a move that helps American businesses sharpen their competitive edge and provides taxpayers a second return on their investment.

Underpinning the laboratory is a world-class culture of safety and security that enables SRNL to tackle some of the nation's most difficult challenges in environmental stewardship, nuclear security and clean energy, and to provide leadership for DOE in nuclear chemical manufacturing.

Photo: SRNL research on advanced separation processes



Research in radiation detection devices (above) and for glassification of radioactive materials



SRNL by the numbers



24

states where SRNL works



20

U.S. federal office and agency clients



52

countries where SRNL works

7

R&D 100 awards received

437

patents issued since the 1950s



800

FBI personnel trained in radiological forensic operations

15 million pounds of radioactive glass produced in DWPF since 1996

6 of 51 radioactive liquid waste tanks operationally closed since 1997

1,650 shipments of transuranic waste from SRS to WIPP from 2001 through 2013



Waste Management Liquid Waste Operations

Past SRS nuclear material production created unusable by-products, such as radioactive waste. About 36 million gallons of radioactive liquid waste are stored in 45 underground tanks at SRS.

The Defense Waste Processing Facility (DWPF) is processing the high-activity waste by encapsulating radioactive elements in borosilicate glass, a stable storage form. Since DWPF began operations in March 1996, more than 15 million pounds of radioactive glass have been produced.

Much of the liquid waste in the tanks is separated as a decontaminated salt solution through an innovative approach to waste removal, called the Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit. The facilities use the same unit processes as those in the SRS Salt Waste Processing Facility (under construction). SWPF will be the key liquid waste facility for processing approximately 90 percent of the 36 million gallons of tank waste. SWPF will separate the salt waste into a low-volume, high-radioactivity fraction for vitrification in the DWPF and high-volume, decontaminated salt solution to the Saltstone Facility for disposal as low-level waste.

Decontaminated salt solution from salt treatment processing is sent to the Saltstone Production Facility, where it is mixed with cement, ash and furnace slag and poured into above-ground, cylindrical concrete vaults called Saltstone Disposal Units (SDU). SDU-6 is currently under construction, is 10 times larger than the other SDUs, and will hold approximately 30 million gallons of grouted decontaminated salt solution. Filled units will be capped with concrete, isolating them from the environment. SRS is the first site in the DOE complex to disposition salt waste.

SRS waste tanks have provided nearly 60 years of safe storage for nuclear waste. Removing waste from the tanks will allow for operational closure of the Site's high-level waste tanks. To date, six waste tanks have been closed.



Top: Construction in progress at the Salt Waste Processing Facility
Above: Moving a canister at the Defense Waste Processing Facility

Liquid Radioactive Waste Tank Closure

SRS is home to the first two liquid radioactive waste tank operational closures in the nation. These two closures were followed with two in 2012, two in 2013, and two more on track for 2015 and 2016, respectively.

Tank 20, the first closed, was certified closed by the South Carolina Department of Health and Environmental Control (SCDHEC) and applicable DOE Orders in July 1997. SCDHEC certified closure of Tank 17 in December 1997. Both tanks were constructed in 1958 and first used in 1960.

The DOE, SCDHEC, the U.S. Environmental Protection Agency, SRS workers and the public worked closely together to establish strict closure requirements that supported all state and Federal regulations.

Closure activities for the tanks begin years before the actual operational closing of the tanks. Initially, once agreements and closure plans with state and federal regulators are finalized, radioactive waste is removed from each tank to the extent practical. The final closure activities begin with workers pouring specially formulated grout (a cement-like substance) into the 1.3 million-gallon tanks. This special grout stabilizes the tank and is used to impede the leaching and migration of the waste. Over the course of several weeks, the tanks are filled with grout and tank top penetrations are sealed.

The old-style waste tanks are being closed in accordance with the Federal Facility Agreement. This process reduces risks to human health and the environment by securing residual waste in the tanks, which minimizes the potential for groundwater contamination.

F Area tank farm in process of closure



A TRU PACT III waste container at SRS

Solid Waste

Solid Waste Management is responsible for the disposition of SRS solid wastes, which include sanitary, construction and demolition (C&D), and low-level radioactive and transuranic wastes. Sanitary is household wastes that are recycled or disposed at the Three Rivers Landfill. C&D wastes are generated by the Site's construction activities and are disposed in a SCDHEC-permitted landfill.

Radioactive wastes are classified into two categories, the majority of which is low-level radioactive waste (LLW). This waste is disposed on Site in engineered facilities. LLW wastes are contaminated with predominately short-lived isotopes.

The second type of radioactive waste is transuranic (TRU) wastes. These wastes typically consist of protective clothing, tools, rags, equipment and miscellaneous items contaminated with small amounts of plutonium. TRU wastes are collected, characterized and packaged for offsite shipping to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, N.M.

When the SRS TRU Ship-to-WIPP program began, over 30,000 containers of TRU waste were stored at SRS. SRS has made over 1,650 shipments to WIPP through 2014. WIPP waste receipts were stopped in February 2014. All remaining legacy TRU waste at SRS is packaged and ready to be shipped upon WIPP's reopening.

9,000 environmental and groundwater samples collected annually both on and off Site

77 percent of the 515 inactive waste units where remediation is complete

85 percent reduction in the SRS industrial footprint made possible by ARRA funds

2 production reactors (R and P) decommissioned “in situ”

Environmental Compliance and Area Completion Projects

SRS Environmental Compliance and Area Completion Projects (EC&ACP) coordinates and provides environmental support and compliance-based oversight of SRS operations. EC&ACP ensures that SRS activities are conducted in accordance with state and federal environmental regulations and have minimal impact on workers, the public and the environment.

EC&ACP also manages extensive environmental and groundwater monitoring programs to determine impacts, if any, from SRS operations to the public, surrounding communities and the environment. More than 9,000 environmental and groundwater samples are collected at SRS and in neighboring areas each year, and are analyzed for radionuclides, metals or other chemicals that could be in the environment because of SRS activities.

Since approximately 2003, extensive SRS cleanup and closure work has been completed under a concept known as Area Completion, which streamlines and accelerates the cleanup process. EC&ACP has removed excess facilities and remediated soil and groundwater, with the full support of DOE, the U.S. Environmental Protection Agency and SCDHEC.

EC&ACP cleans up environmental contamination by treating or immobilizing the contamination source, and by cleaning up or slowing the movement of contamination migrating from the source. Fieldwork is a top priority, including closure of inactive seepage basins, rubble pits, rubble piles and disposal facilities. Major groundwater cleanup systems have operated in nearly every area at SRS.

Site remediation continues with more than 77 percent of the 515 inactive waste units completed, and over 25 percent of 126 excess facilities safely dispositioned to date.

Cleanup and decommissioning will continue until all areas at SRS are completed. Units at which waste is left in place will be under institutional controls including access restrictions, inspection, maintenance and long-term monitoring. Soils will be remediated to an acceptable residual risk for industrial workers. Groundwater will be achieved over time to cleanup levels approved by regulators. SRS Area Completion work was accelerated in 2009 through a significant investment of \$1.6 billion from the American Recovery and Reinvestment Act.

Photo: A nesting box for waterfowl on L Lake at SRS

Acronyms

C&D
construction and demolition

DOE
Department of Energy

EC&ACP
Environmental Compliance and Area Completion Projects

EM
Environmental Management

FBI
Federal Bureau of Investigation

HEU
highly enriched uranium

LEU
low enriched uranium

LLW
low-level waste

KAC
K Area Complex

MFFF
Mixed Oxide Fuel Fabrication Facility

MOX
mixed oxide

NASA
National Aeronautics and Space Administration

NNSA
National Nuclear Security Administration

R&D
research and development

SDU
Saltstone Disposal Unit

SNF
spent nuclear fuel

SNM
special nuclear materials

SRNL
Savannah River National Laboratory

SRS
Savannah River Site

TRU
transuranic waste

TVA
Tennessee Valley Authority

USDA
United States Department of Agriculture

WIPP
Waste Isolation Pilot Plant

In an ever-changing and always-challenging world, SRS looks toward the future with anticipation. It is our priority that each employee arrives, works and goes home safely, and our nation's valuable nuclear materials are protected.

Our employees will be at the heart of a successful future. Engaging our employees in developmental opportunities and increasing our recruitment will ensure a diverse workforce with priceless expertise and enthusiasm.

As always, SRS will strive to earn the community's support, trust and respect, with reliable stewardship of the environment and the nation's assets.

If you are interested in seeing SRS first-hand, we offer 22 public tours each year. For more information on the tours or to sign up, please visit www.srs.gov/general/tour/public.htm.

For general information about SRS, we invite you to visit www.srs.gov. We're also on social media, including Facebook, YouTube, Twitter and Flickr.



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The Savannah River Site is owned by the U.S. Department of Energy.

The management and operating contract is held by Savannah River Nuclear Solutions, LLC.

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