

Environmental Report

SUMMARY

| 2018



The cover photographs are courtesy of Mike Baggett, a North Augusta, South Carolina photographer who graciously gave SRS permission to display his work.

Front Cover—A swallowtail at Audubon’s Silver Bluff Center and Sanctuary, Silver Bluff, Jackson, South Carolina
Back Cover and this page—A bee gathering pollen from a coneflower at Hopelands Gardens, Aiken, South Carolina



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Or, go to the SRS Environmental Report webpage at <http://www.srs.gov/general/pubs/ERsum/index.html> and under the *Environmental Report 2018*, complete the electronic customer satisfaction survey.

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Savannah River Site

Environmental Report Summary 2018

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Why This Report Is Important

This report is a summary of the impacts Savannah River Site (SRS) activities have on the environment and the local community. This summary report highlights SRS's

- Significant environmental accomplishments that support Site missions
- Compliance with environmental laws and regulations
- Public dose from SRS activities
- Monitoring that supports dose calculations and compliance requirements
- Community involvement

The full *Environmental Report 2018* provides the public with details on compliance, potential radiation dose, and monitoring as a result of SRS operations that potentially affect the well-being of the communities surrounding the Savannah River Site.

The dose and monitoring chapters provide time trend graphics for key monitoring and radiation dose measurements.

Many articles within this Summary report are based on the information provided in the full report. For those articles, a text box at the bottom of the page identifies the related chapters and sections from the full *Environmental Report 2018*.

OVERVIEW

Where is the Savannah River Site?



The Savannah River Site is a U.S. Department of Energy (DOE) facility in the western region of South Carolina, along the Savannah River. The Site is 310 square miles and covers parts of Aiken, Allendale, and Barnwell counties.

The Site is dedicated to environmental cleanup, nuclear weapons stockpile stewardship, and disposing of nuclear materials to support U.S. nuclear nonproliferation. SRS operates safely and efficiently to accomplish its mission while protecting public health and the environment.

The Site also develops and deploys technologies to improve the environment and treat waste leftover from the Cold War.

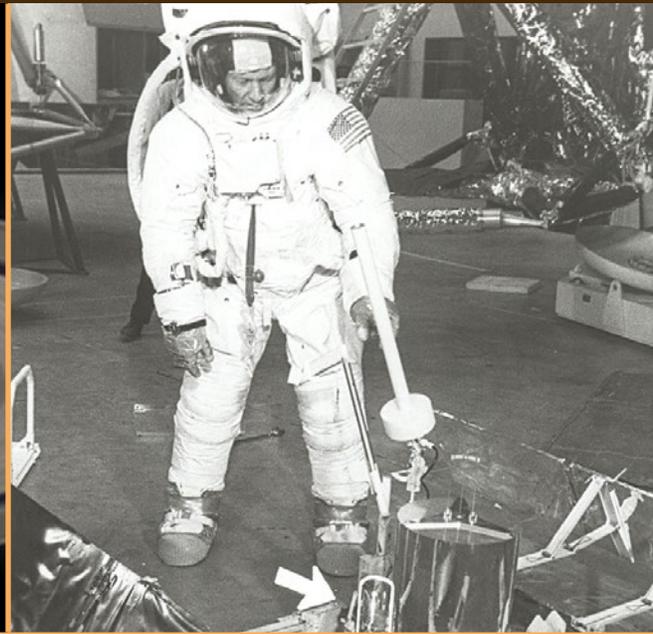
SRS supports diverse natural habitats, including pine and hardwood forests, riverine environments, and approximately 400 wetlands.

White-tailed deer, turkeys, eagles, alligators, and many species of snakes, amphibians, and songbirds thrive on the Site. SRS also manages endangered species populations of the red-cockaded woodpecker, pondberry, and smooth purple coneflower.

In 1972, the Atomic Energy Commission designated SRS the first National Environmental Research Park, which provided opportunities for studying the environmental impacts of energy and defense-related technologies.

Background photograph on this page is of SRS taken from the International Space Center, courtesy of NASA; background photography on facing page is of Saturn taken during Cassini mission, NASA; top right, Apollo 12 astronaut places SRS Pu-238 on the moon in 1969; bottom right, one of the RTGs that provided power to Cassini, NASA

The Story Behind Plutonium-238



The Atomic Energy Commission built the Savannah River Site in the 1950s with a focus on weapons material production for the nation's defense; however, the unique environment and workforce talent presented additional opportunities for atomic energy research for peaceful uses, such as manufacturing heat-source fuel to power United States space missions.

At the center of this historical and vibrant research was plutonium-238 (Pu-238), which along with neptunium-237, the SRS Environmental Monitoring Program still monitors today.

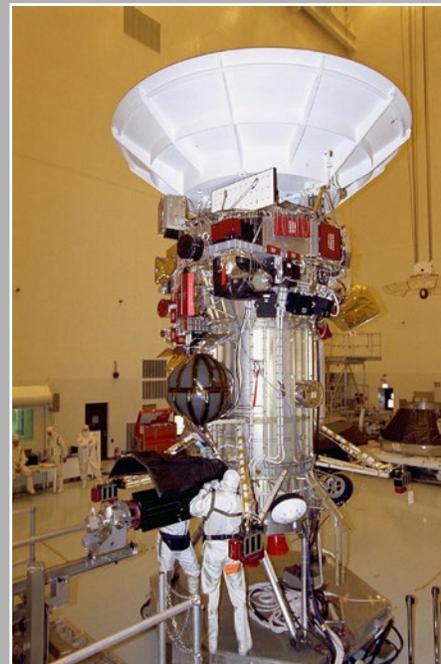
The National Aeronautics and Space Administration (NASA) found solar panels worked well for early space travel, but as missions went further from the sun, radioisotope thermoelectric generators, or RTGs, materialized as the best power source. RTGs work by converting heat, created from radioactive decay, into electrical energy. Radioactive decay produces constant heat-generating reliable power, which is useful for spacecraft equipment.

After researching different radioactive materials, Pu-238, manufactured from decayed neptunium-237, emerged as the selected heat-source fuel. Plutonium is a long-lasting, dependable source with a half-life of 87.7 years. It puts off the high heat necessary for the cold temperatures of deep space and has low-shielding requirements keeping it lightweight.

SRS produced about 660 pounds of Pu-238 between 1959 and 1988. The Pu-238 made at SRS was taken to offsite facilities to be packaged into the RTGs until the late 1970s. The Site built the Plutonium Fuel Form (PuFF) Facility in 1978 to complete the work onsite. At PuFF, SRS made spheres and pellets out of Pu-238 to electrically power the space missions. The Site packaged RTGs until 1988, when production stopped as the Cold War was ending.

SRS restarted the Pu-238 Oxide Line to produce the oxide for NASA's Cassini space mission in 1991, the space research mission that explored Saturn from 1997 to 2017. SRS's HB Line and H Canyon processed and produced Pu-238 to power NASA's New Horizons space probe that provided the first close-up views of Pluto in 2015. Earlier deep space missions that use Pu-238 manufactured at SRS include Viking I and 2 Mars Landers in 1975-1976, robotic probes Voyager 1 and 2 in 1977, unmanned spacecraft Galileo in 1989, and robotic space probe Ulysses in 1990.

SRS also provided plutonium for Pu-238 radioisotope heater units (RHUs), a heat source that does not produce electricity. NASA used RHUs to keep axle grease from freezing with Spirit and Opportunity, the solar-powered rovers that landed on Mars in 2004.



ACCOMPLISHMENTS



This page, award-winning D-Area Ash Basin Closure; facing page, DOE's Pam Marks gets an update at Salt Waste Processing Facility; and SDU 6 project

2018 *Environmental Accomplishments*

TANK CLOSURE

- Completed onsite startup testing for the **Tank Closure Cesium Removal** system
- Received two DOE awards for the **Saltstone Disposal Unit (SDU) 6** project: 2018 Project Management Excellence Award and 2017 DOE Project of the Year
- Began constructing **SDU 7**, the second of seven mega-volume SDUs to be built at SRS
- After completing melter replacement, the **Defense Waste Processing Facility** began filling canisters, immobilizing 61,000 curies of radioactivity

LOW-LEVEL WASTE MANAGEMENT

- Made one **transuranic (TRU) waste shipment** to the Waste Isolation Pilot Plant

RESOURCE CONSERVATION and RECOVERY ACT

- Received **TRU Pad 2 Closure Certification Approval** from South Carolina Department of Health and Environmental Control

WASTE SITE REMEDIATION and CLOSURE

- Restored 90 acres near to the former **D-Area coal-fired power plant** more than a year ahead of schedule, saving \$9 million
- Received the Project Management Institute 2018 PMI Award for Project Excellence for the **D-Area Ash Basins** project

Broad-based Experts

Key to Program Success

The Site performs its current missions safely and efficiently to protect public health and the environment. Although scaled down from its production days during the Cold War when SRS was key to the nation's defense, SRS's current activities focus on waste processing and treatment, environmental cleanup and remediation, tritium processing, and protecting nuclear material.

SRS accomplishes its missions through the efforts of the multiple organizations that work together. The main organizations operating at SRS include

- DOE
- National Nuclear Security Administration
- Savannah River Nuclear Solutions, LLC
- Savannah River National Laboratory
- Savannah River Remediation, LLC
- Centerra-SRS
- Ameresco
- Parsons Government Services, Inc.
- CB&I AREVA MOX Services, LLC
- The University of Georgia's Savannah River Ecology Laboratory
- University of South Carolina's Savannah River Archaeological Research Program
- U.S. Department of Agriculture's Forest Service-Savannah River



2018 Environmental Compliance

South Carolina Department of Health and Environmental Control (SCDHEC) issued one Notice of Violation and one Notice of Alleged Violation. SRS implemented corrective actions with no further actions required.

SRS had:

- **Zero** reportable releases
- **Zero** reportable events with Occurrence Reporting and Processing System (ORPS) Group 5 (Environmental), based on fiscal year reporting
- **Two** ORPS-reportable events within ORPS Group 9 (Noncompliance Notification), based on fiscal year reporting
- **Zero** regulatory self-disclosures

SRS received TRU Pad 2 Closure Certification Approval from SCDHEC

Onsite drinking water facilities complied with Safe Drinking Water Act requirements

621 of 669 National Environmental Policy Act (NEPA) reviews were identified as categorical exclusions that required the Site to take no further actions under NEPA

SRS had 560 construction and operating permits



SUSTAINABILITY

What Works at Home

Works at the Savannah River Site



The Site recycles fluorescent bulbs that have been replaced with LEDs

The everyday things practiced at home that save a few cents or dollars on utility bills have exponential impact and far-reaching benefits to the environment when incorporated across the 310-square-mile Savannah River Site by its 11,000 government and contractor employees.

One of the easiest things to do to save energy is to turn out lights when leaving a room, the house, or going to bed. Residential customers realize a savings on their electric bills correlating to the watt rating of the bulbs they use. For example, if the rating is 40 watts, consumers will save 0.04 kwh for every hour the bulb is off. Flipping a switch is now second nature whether it is manually, through home automation, or an automatic timer. SRS mimics this effort, but on a much larger scale, by choosing lamps and lighting that provide energy-efficient options.

As important to energy efficiency as the length of time a light is turned on, is what type of bulb or lamp is in use and that it is the right type of light for the job. In 2018, SRS continued installing energy-efficient fixtures and bulbs, such as light-emitting diode (LED) lighting as fluorescent lighting reached the end of its usefulness and needed to be replaced. The change from fluorescent to LED has saved the Site 50% in energy costs for lighting. LED lighting has become popular for home uses from Christmas lights to ceiling fan, lamp, and floodlight bulbs. While the life of a fluorescent lamp lessens based on how much they are turned on and off, LED lighting is not impacted, making them ideal to be used with occupancy or daylight sensors.

Recycling Hits the Road

The Savannah River Site has found an environmentally friendly and economical approach to paving its roadways, as well as helping a neighboring South Carolina county upgrade to safer and smoother roads.

Typically, SRS would consider the worn-out, tire-beaten top layer of asphalt on its network of roads to be waste, destined for the SRS landfill. Instead, focused on Environmental Stewardship, the Site is repaving primary Site roads by removing the old asphalt, grinding it up with a milling machine, and using it to resurface many of the Site's secondary roads.

The benefit onsite is twofold: the Site's roads are maintained and improved, and landfill space is freed.

Offsite, through a partnership between the U.S. Department of Energy at SRS, Savannah River Nuclear Solutions, LLC, and the Savannah River Site Community Reuse Organization (SRSCRO), SRS gave Orangeburg County 7,000 tons of these road-top millings to resurface its roads. Milled asphalt, commonly referred to as crushed or recycled asphalt, costs about \$25 a ton, while new asphalt can be as high as \$110 a ton. SRS assisted Orangeburg County in saving between \$175,000 and \$770,000 and helped future generations by reusing and recycling the millings instead of disposing of them in a landfill.

Recycled millings have provided a new surface for this secondary road onsite



Pearls of Environmental Wisdom

Oyster shells from the South Carolina Lowcountry around Charleston are being used to treat stormwater at Savannah River Site outfalls. Mounds of shells cover the ditches leading to the outfalls, trapping zinc. Because of this creative adaptive use of the shells, the Site does not have to monitor at the outfalls until 2021.

Startup of the project involved multiple groups at the Site: Procurement for purchasing, Construction for installing the oyster shells, and Environmental Compliance and Area Completion Projects for sampling.



TECHNOLOGY

No matter the depth, width, or clearness of the Savannah River Site's rivers and streams, or how quickly the surface waters flow downstream and into the Savannah River, the Site's Environmental Monitoring Program has the proper technology to determine the quantity of radionuclides reaching the environment and the communities surrounding the Site.



On this page,
environmental monitoring
flow meter and surface
water sampling devices

Flow Monitoring

Detailed for Every Situation

Measuring the flow rate of water through the waterways SRS monitors as part of the Environmental Monitoring Program is the backbone of calculating the total amount of radionuclides that contribute to the radiation dose associated with the liquid pathway.

The equipment used to measure flow rates is industry-proven, commercially available, and commonly used in both the public and private sectors. Manual and real-time data collection devices allow SRS to collect water samples and flow rates around the clock.





SRS uses an acoustic Doppler profile device to measure flow rate across deep waters of Upper Three Runs. Bottom from left, an example of a flow meter, area velocity sensor inside of a discharge pipe sensor



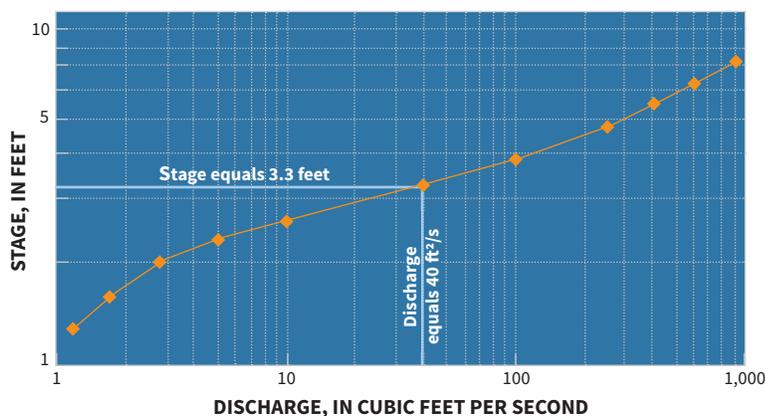
Determining Radionuclide Amounts in Monitored Waterways

SRS uses two pieces of information to determine the radionuclide quantity in a waterway: radionuclide concentration and the total volume of water moving through the area being monitored during the monitoring period. Before any water sample is collected, SRS must be able to reliably determine the flow rate, or the amount of water moving through the stream when a sample is collected.

In addition to the real-time data collection devices, SRS uses two types of equipment to manually determine the flow rate at the stream sampling locations it monitors. One is used in streams where it is possible to wade across the stream, and the other is used in deeper waters where it is not safe to walk across the stream channel. SRS measures flow rates during periods of high, moderate, and low stream water levels. These data are input into a rating curve, which is a graph that compares water level to the flow rate, or discharge. These rate curves are then entered into the portable programmable flow meters that continuously measure flow rates.

Because the physical attributes of stream channels change with time, potentially altering the stream flow rate, SRS confirms the rate curves annually in the field. SRS calculates the water volume (flow rate over sampling time period) using the rate curve that is programmed into the flow meter. Once the laboratory reports the water sample results, SRS uses the concentration data and the volumes to calculate the radionuclide amount in the stream location.

Area velocity devices collect instantaneous and continuous flow rates from facility discharge pipes. SRS determines the flow rate in this situation using the fixed diameter of the discharge pipe and measuring the water pressure within the pipe, which is converted into water level, and measuring the velocity of the water moving through the pipe. While rate curves are used to determine the stream flow rates, the data gathered from the measurement devices used in the discharge pipes calculates an instantaneous flow rate.



Example of a rating curve adapted from the United States Geological Survey

RADIOLOGICAL MONITORING and DOSE

What is

Radiation Dose?

Radiation dose to a person is the amount of energy the human body absorbs from a radioactive source located either inside or outside of the body. Radioactive sources typically transfer energy in the form of rays (such as gamma or X-rays) or high-energy particles (such as alpha or beta particles).

Humans, plants, and animals can receive radiation doses from both natural and man-made sources. Radiation can come from as far away as outer space and from as near as the ground on which you are standing. Because it is naturally all around us, we cannot eliminate radiation from our environment.

SRS typically reports radiation dose in a unit of measure called a “millirem” (mrem). The average annual dose for U.S. residents from these sources is 625 mrem. The average dose of naturally occurring radioactive minerals in the ground and water, and cosmic radiation from outer space is 311 mrem. Man-made sources of

background radiation include the following:

- Medical procedures (300 mrem)
- Consumer products (13 mrem)
- Industrial and occupational exposures (1 mrem)

DOE has established dose limits to the public so that Site operations will not contribute significantly to this average annual background exposure.

DOE Order 458.1, Radiation Protection of the Public and the Environment, establishes 100 mrem/year as the annual dose limit to a member of the public that can come from Site operations.

Exposure to radiation potentially occurs through:

- Inhaling through the air
- Ingesting through food and water
- Absorbing through the skin
- Experiencing direct (external) exposure to radionuclides in soil, air, and water

2018 Potential Radiation Dose

In 2018, SRS did not significantly increase potential radiation exposure to the public.

The potential doses from SRS radioactive discharges to air and water were well below regulatory standards for the public and the environment. Compliance with DOE Order 458.1 is discussed in Chapter 6, Radiological Dose Assessment, of the Environmental Report 2018. The potential radiation dose to the public is in that chapter.

The combined dose from air and water pathways—called the “all pathway” dose—was 0.27 mrem in 2018, which is well below the DOE public dose limit of 100 mrem/yr. Of this 0.27 mrem/yr dose, 0.19 mrem was from liquid releases, and 0.082 was from releases to the air.

The all-pathway dose for 2018 is slightly higher than the 2017 total dose of 0.25 mrem. SRS attributes this small increase to an increase in tritium releases to the air during 2018.



Assigning Dose to the Representative Person

The representative person is not someone you've met or even have much in common with, but this individual has a great influence on protecting your health, your quality of life, and safeguarding the environment you live in. This person represents **YOU**, but in a very unlikely scenario.

This unnamed, unfaced person exists only in calculations and dose models as a hypothetical human who is between you and the radiation originating from Savannah River Site projects and missions. The premise is if the dose the representative person receives is at or below the U.S. Department of Energy's dose limit prescribed as safe for the public, then you, a resident who does not seek out exposure pathways, would be at an even safer level.

The representative person's exposure is at the 95th percentile of national and regional data, meaning that this hypothetical person is participating in the exposure scenarios to an extent greater than 95% of the population.

How is the Representative Person's Exposure Significant?

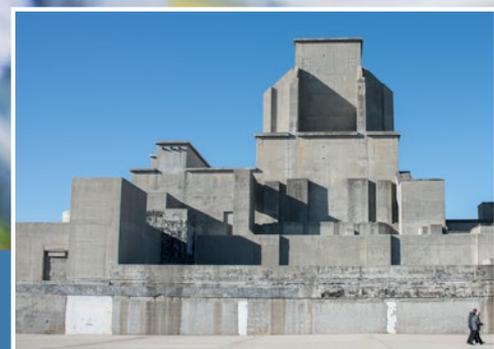
In each scenario below, which describe liquid and air pathway exposures based on location and duration, the representative person is in a position that maximizes the amount of potential radiation that a human could be exposed to.

1. Lives near the Site boundary all day, every day
2. Consumes milk, meat, vegetables grown or raised at the Site boundary
3. Drinks water and eats fish from the Savannah River
4. Participates in recreational activities on the river or spends time near the river every day

ENGAGING the PUBLIC



Attendees on the historical tour. Below, C Reactor



SRS Tours

Sharing History, Programs with the Community

The Savannah River Site hosted tours for both the public and local educators during 2018. Combined, these 172 tours allowed 1,500 people to see firsthand the historic and operational facilities at SRS that were responsible for producing plutonium and tritium during the Cold War.

SRS public tour groups learn about the Site's current missions and the focus on the future. Among many sights, tour participants get to view the animals at the University of Georgia's Savannah River Ecology Laboratory. In addition, there are a limited number of historic tours that include a tour of the SRS Curation Facility and also stops at the Dunbarton town site and C Reactor, which operated for 30 years before it shut down in 1985. The tour for educators, held as part of Nuclear Science Week in mid-August, provided educators from elementary, middle, and high schools insight into the operations and missions at the Site, in particular, the Liquid Waste mission. 2018 marked the sixth year SRS hosted this tour.

SRS holds the free public four-hour tours throughout the year. Each tour accommodates up to 34 people. Seats are filled through reservations on a first-come, first-served basis. Tour participants must be at least 18 years old and be U.S. citizens.

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Sign up: srs.gov/general/tour/public.htm 803-952-8994



Facilitating Environmental Justice

TREAT Workshop attendees discuss personal protection clothing for radiation contamination work

Mandated by DOE's Office of Legacy Management, the Environmental Justice program at SRS ensures no group of people should bear a disproportionate share of negative environmental consequences from Site operations.

The concerns these groups express can influence the EPA's decision-making process associated with setting standards, permitting facilities, awarding grants, and issuing licenses and regulations.

SRS uses various programs to enhance engagement from the target communities. One such program is the Teaching Radiation, Energy, and Technology (TREAT) workshop, which gives teachers the opportunity to learn more about radiation, energy, and technology from DOE experts.

Other programs at SRS include community outreach meetings that address job training, grants, environmental monitoring, and emergency response; student internships on environmental research projects; and acquiring cutting-edge environmental analytical laboratory equipment for the Savannah State University environmental sciences students as well as students in the DOE-Headquarters Environmental Scholars Program.

Making the Way for Stakeholder Involvement

Savannah River Site management is committed to keeping the public informed about Site projects. SRS has built long-term regional support through public and intergovernmental involvement.

The Site achieves stakeholder involvement through a variety of activities that are responsive to input from the public. Some of these are discussed in other articles in this section.

Specifically, SRS fosters communication and information exchange with groups with vested interest in the Site through

- Assisting stakeholder groups with analyzing environmental management plans



- Increasing public awareness of the impact of contaminant releases or potential releases during cleanup
- Allowing community groups to propose alternative plans that may achieve better results
- Explaining how the Site establishes priorities to promote cleanup and safety



CAB Enlists Citizen Input on Site Projects and Policies

Members
of the Citizens
Advisory Board
assemble at a meeting
venue

The SRS Citizens Advisory Board (CAB) provides advice and recommendations to DOE on environmental restoration, waste management, and other related issues of concern. Members meet publicly six times a year at locations in South Carolina and Georgia that have a proximity-vested interest in the impact of Site operations on their communities. The SRS CAB made seven recommendations to DOE-SR for 2018. These recommendations and DOE-SR responses are available on the CAB's webpage.

The board's membership is carefully considered to reflect a full diversity of viewpoints in the affected community and region. Board members are composed of people who are directly affected by DOE site clean-up activities.

The Citizens Advisory Board is headed by a chair and vice chair who represent the CAB at Environmental Management Site-Specific Advisory Board meetings and to the public. The remaining board members are divided into four issues-based committees, which include the Facilities Disposition & Site Remediation Committee, the Nuclear Materials Committee, the Strategic & Legacy Management Committee, and the Waste Management Committee.

The various committees within the CAB meet bimonthly to discuss topics such as environmental clean-up on the Site, budget management, materials handling, historic preservation, and plans for the future uses of the Site.

Agency liaisons from DOE, the U.S. Environmental Protection Agency-Region IV, and the South Carolina Department of Health and Environmental Control participate in CAB meetings.

Meeting schedule: cab.srs.gov 800-249-8155



SAVANNAH RIVER SITE

Department of Energy-Environmental Management

To Learn More About the Focus on Environmental Safety:

Visit the SRS website: <http://www.srs.gov/general/srs-home.html>

View or download the Savannah River Site *Environmental Report 2018*:

<http://www.srs.gov/general/pubs/ERsum/er18/index.html>

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