Introduction

CHAPTER 1

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The Savannah River Site (SRS), one of the facilities in the U.S. Department of Energy (DOE) complex, was constructed during the early 1950s to produce materials (primarily plutonium-239 and tritium) used in nuclear weapons. The site covers approximately 310 square miles in South Carolina and borders the Savannah River. Savannah River Nuclear Solutions (SRNS) assumed responsibility from Washington Savannah River Company (WSRC) for SRS Maintenance and Operations activities in August 2008. Savannah River Remediation (SRR) subsequently took over the site's Liquid Waste Operations functions from WSRC in July 2009.

Mission

SRS's mission is to fulfill its responsibilities safely and securely in the stewardship of the nation's nuclear weapons stockpile, nuclear materials, and the environment. These stewardship areas reflect current and future missions to

- meet the needs of the U.S. nuclear weapons stockpile
- store, treat, and dispose of excess nuclear materials safely and securely
- treat and dispose of legacy radioactive liquid waste from the Cold War
- clean up radioactive and chemical environmental contamination from previous site operations

SRS continued in 2009 to improve environmental quality, clean up its legacy waste sites, manage any waste produced from current operations, and plan for future operations. This included working with the South Carolina Department of Health and Environmental Control (SCDHEC), the Environmental Protection Agency (EPA), and the Nuclear Regulatory Commission to find mutually acceptable solutions for waste disposition. As part of its ongoing mission, the site will continue to address the highest-risk waste management issues by safely disposing of liquid waste and surplus nuclear materials at offsite locations, and by safely stabilizing any waste tank residue remaining on site.

Site Location, Demographics, and Environment

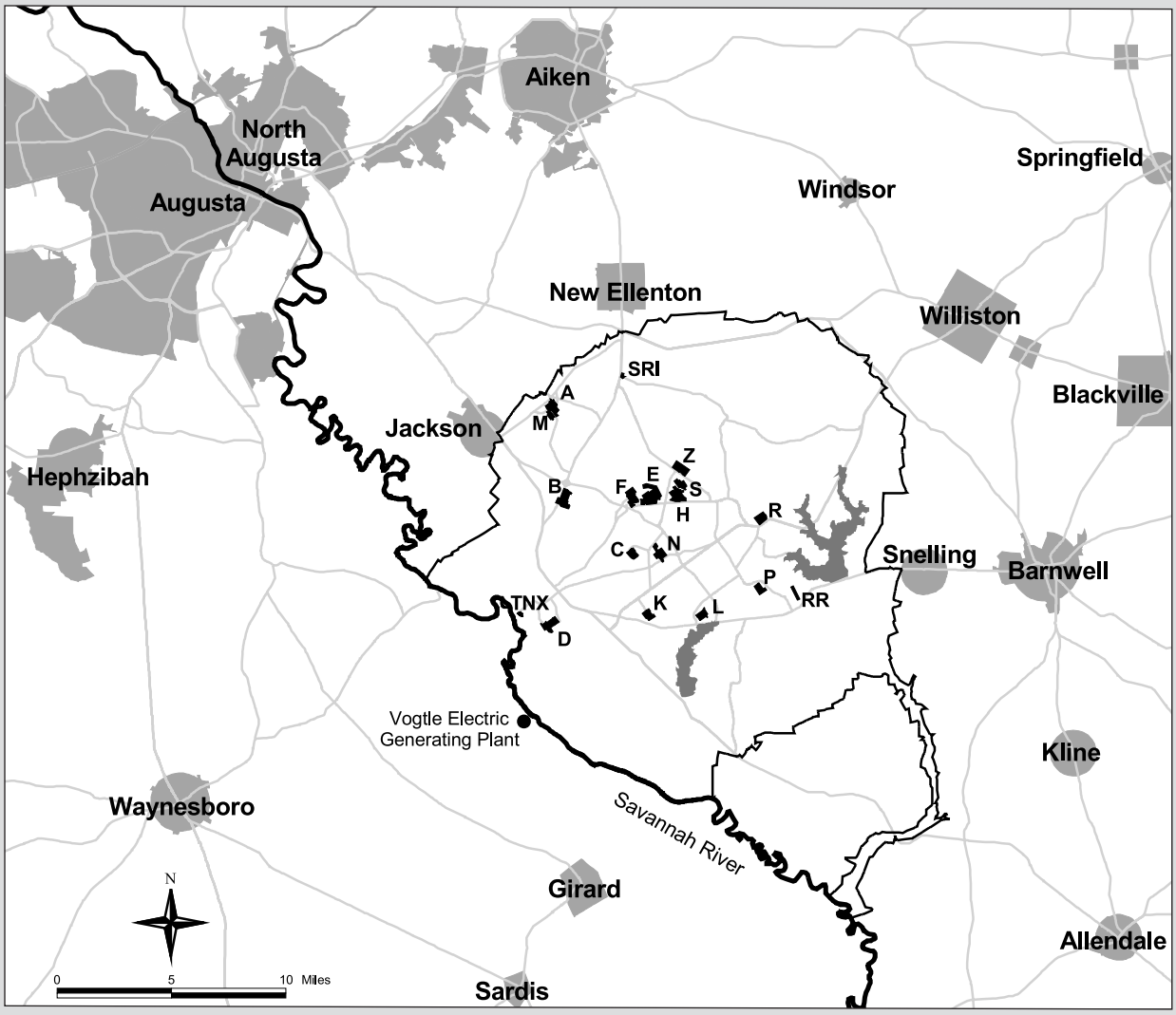
SRS covers 198,344 acres in Aiken, Allendale, and Barnwell counties of South Carolina. The site is approximately 12 miles south of Aiken, South Carolina, and 15 miles southeast of Augusta, Georgia (figure 1–1).

The average population density in the counties surrounding SRS is about 91 people per square mile, with the largest concentration in the Augusta metropolitan area. Based on 2000 U.S. Census Bureau data, the population within a 50-mile radius of the center of SRS is approximately 712,780. This translates to an average population density of about 91 people per square mile, with the largest concentration in the Augusta metropolitan area.

Water Resources

SRS is bounded on its southwestern border by the Savannah River for about 35 river miles and is approximately 160 river miles from the Atlantic Ocean.

The Savannah River is used as a drinking water supply source for some residents upstream of SRS. The nearest downriver municipal drinking water



SRNL Map

Figure 1–1 The Savannah River Site

SRS is located in South Carolina, about 12 miles south of Aiken, South Carolina, and about 15 miles southeast of Augusta, Georgia. The Savannah River flows along a portion of the site's southwestern border. The capital letters within the SRS borders identify operations areas referenced throughout this report.

source (Beaufort-Jasper Water and Sewer Authority's Purrysburg Water Treatment Plant) is located approximately 90 river miles from the site. The river also is used for commercial and sport fishing, boating, and other recreational activities. There are no known large-scale uses of the river for irrigation by farming operations downriver of the site. The groundwater flow system at SRS consists of four major aquifers. Groundwater generally migrates downward as well as laterally in recharge areas—eventually either discharging into the Savannah River and its tributaries or migrating into the deeper regional flow system. SRS groundwater is used both for processes and for drinking water.

Geology

SRS is located on the southeastern Atlantic Coastal Plain, which is part of the larger Atlantic Plain that extends south from New Jersey to Florida. The center of SRS is approximately 25 miles southeast of the geological Fall Line that separates the Coastal Plain from the Piedmont. Characterization of regional earthquake activity is dominated by the catastrophic Charleston, South Carolina, earthquake of August 31, 1886 (est. magnitude of 7.0 on the Richter

scale). With nearly three centuries of available historic and contemporary seismic data, the Charleston/Summerville area remains the most seismically active region of South Carolina—and the most significant seismogenic region affecting SRS. Ongoing studies by University of South Carolina seismologists suggest a recurrence interval of 500–600 years for magnitude 7.0 or greater earthquakes (similar to the 1886 event) near Charleston. Earthquake activity occurring within the upper Coastal Plain of South Carolina, where the majority of SRS is located, is best characterized by occasional small shallow events associated with strain release near small-scale faults and intrusives. Levels of seismic activity within this region are very low, with magnitudes or sizes generally less than or equal to 3.0

Land and Forest Resources

About 90 percent of SRS land area consists of natural forests and managed pine plantations, which are planted, maintained, and harvested by the U.S. Department of Agriculture Forest Service–Savannah River. The site contains portions of three forest types: Oak-Hickory-Pine, Southern Mixed, and Southern Floodplain. More than 370 Carolina bays exist on SRS. These unique wetlands provide important habitat and refuge for many plants and animals.

Animal and Plant Life

The majority of SRS is undeveloped; only about 10 percent of the total land area is developed or used for industrial facilities. The remainder is maintained in healthy, diverse ecosystems. About 260 species of birds, 60 species of reptiles, 40 species of amphibians, 85 species of freshwater fish, and 50 species of mammals have been identified at SRS. The site also is home to an estimated 950 species of plants.

Primary Site Activities

Liquid Waste Operations

SRS continued to manage its Liquid Waste Operations facilities in support of the integrated high-activity waste removal program in 2009. This work included operation of the Defense Waste Processing Facility, the Saltstone Production and Disposal Facilities, the F-Area and H-Area tank farms, and the Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit salt processing facility. A detailed description of the site's 2009 Liquid Waste Operations activities can be found on the CD accompanying this report.

Separations

In the past, the SRS separations facilities processed special nuclear materials and spent fuel from site reactors to produce materials for nuclear weapons and isotopes for medical and National Aeronautics and Space Administration applications. The end of the Cold War in 1991 brought a shift in the mission of these facilities to stabilization of nuclear materials from onsite and offsite sources for safe storage or disposition. F Canyon, one of the site's two primary separations facilities, was deactivated in 2006. The other facility, H Canyon, continues to operate, and an important part of its mission is the conversion of weapons-usable, highly enriched uranium to low-enriched uranium for use in the manufacture of commercial reactor fuel, a key function of the nation's nuclear nonproliferation program.

Spent Nuclear Fuel Storage

SRS's spent nuclear fuel facilities store fuel elements from a variety of foreign and domestic reactors. The mission of the spent nuclear fuel program is to cost-effectively eliminate the hazards associated with legacy spent nuclear fuel—from research reactors around the world—by receiving, stabilizing, and dispositioning the fuels in a safe and environmentally sound manner.

Tritium Processing

SRS tritium facilities are designed and operated to supply and process tritium, a radioactive form of hydrogen gas that is a vital component of nuclear weapons. These facilities are part of the National Nuclear Security Administration's Defense Programs operations at SRS.

Waste Management

SRS manages

- the large volumes of radiological and nonradiological waste created by previous operations of the nuclear reactors and their support facilities
- newly generated waste created by ongoing site operations

Although the primary focus is on safely managing the radioactive liquid waste, the site also must handle, store, treat, dispose of, and minimize solid waste resulting from past, ongoing, and future operations. Solid waste includes hazardous, low-level, mixed, sanitary, and transuranic wastes. More information about radioactive liquid and solid wastes is included on the CD housed inside the back cover of this report.

Area Completion Projects

Past operations at SRS have released hazardous constituents and substances to soil and groundwater at numerous waste sites, with contamination levels exceeding regulatory thresholds.

The mission of Area Completion Projects (ACP) personnel is to protect human health and the environment by meeting all applicable regulatory requirements while safely deactivating and decommissioning contaminated facilities and remediating soils and groundwater. Completing the cleanup of legacy waste at contaminated waste sites and removing obsolete facilities helps consolidate ongoing site operations and free up SRS areas for future missions. The use of streamlined cleanup strategies enables ACP to accelerate work and reduce overall lifecycle costs.

The approach for soil and groundwater cleanup is to mitigate the source of the contamination and to monitor and, if needed, remediate contamination that already has migrated from the source. The approach for facility deactivation is to bring facilities to a safe and stable condition, in part by de-energizing facility systems. Following deactivation, the excess administrative, radiological, and nuclear facilities are decommissioned—by demolition or by placement into an in situ end state in which part of the facility remains.

Cleanup decisions are reached through implementation of a core team process with EPA Region 4 and SCDHEC. In reaching such decisions, input from the public and stakeholders (such as the Citizens Advisory Board) is solicited and considered.

Numerous technologies have been pioneered to increase the effectiveness of ACP's remediation efforts and to reduce hazardous risk across the site. ACP utilizes a Green Remediation approach to reduce greenhouse gas emissions and other negative environmental impacts that might occur during characterization or remediation of hazardous waste sites.

Green Remediation is the practice of (1) considering all the environmental effects of remedy implementation and (2) incorporating options to minimize the environmental footprints of cleanup actions. Natural remedies used at SRS include phytoremediation (augmented natural vegetative processes), bioremediation (augmented naturally occurring microbial processes), and natural remediation (natural processes to address contamination). These technologies are proving to be a cost-efficient means of reducing risk to human health and the environment, and have been successful in expediting cleanups.

More information about ACP's 2009 operations is included on the CD accompanying this report.

Effluent Monitoring and Environmental Surveilance

SRS sampling locations, sample media, sampling frequency, and types of analysis are selected based on environmental regulations, exposure pathways, public concerns, and measurement capabilities. The selections also reflect the site's commitment to (1) safety; (2) protecting human health; (3) reducing the risks associated with past, present, and future operations; (4) improving cost effectiveness, and (5) meeting regulatory requirements.

Releases

Releases to the environment of radioactive and nonradioactive materials come from legacy contamination as well as from ongoing site operations. For instance, shallow contaminated groundwater—a legacy—flows slowly toward onsite streams and swamps and into the Savannah River. In ongoing site operations, releases occur during the processing of nuclear materials.

Meeting certain regulations, such as the Safe Drinking Water Act and the Clean Air Act, requires that releases of radioactive materials from site facilities be limited to very small fractions of the amount handled. The site follows an optimization philosophy that emissions will be kept as low as reasonably achievable (ALARA).

Pathways

The routes that contaminants can follow to enter the environment and then reach people are known as exposure pathways. A person potentially can be

exposed when he or she breathes the air, consumes locally produced foods and milk, drinks water from the Savannah River, eats fish caught from the river, or uses the river for recreational activities such as boating, swimming, etc.

One way to determine if contaminants from the site have reached the environment is through environmental monitoring. The site gathers thousands of air, water, soil, sediment, food, vegetation, and animal samples each year. The samples are analyzed for potential contaminants released from site operations, and the potential radiation exposure to the public is assessed. Samples are taken at the points where materials are released from (1) the facilities (effluent monitoring) and (2) the environment itself (environmental surveillance). SCDHEC and the Georgia Department of Natural Resources also have programs in place to monitor the environment in and around SRS.

Research and Development

The Savannah River National Laboratory (SRNL)—the site's applied research and development laboratory—creates, tests, and implements solutions to SRS's technological challenges. Other environmental research is conducted at SRS by the following organizations:

- *Savannah River Ecology Laboratory (SREL)* – More information can be obtained by contacting SREL at 803–725–2472 or by viewing the laboratory's website at http://www.srel.edu/. Also, SREL's technical progress report for 2009 is included on the CD accompanying this document.

- *U.S. Department of Agriculture Forest Service–Savannah River (USFS–SR)* – More information can be obtained by contacting USFS–SR at 803–725–0006 or 803–725–0237 or by viewing the USFS–SR website at http://www.srs.gov/general/srfs/srfs.htm. Also, USFS–SR's 2009 report is included on the CD accompanying this document.

- *Savannah River Archaeological Research Program (SRARP)* – More information can be obtained by contacting SRARP at 803–725–3724, or by viewing the SRARP website at http://www.srarp.org.