
Environmental Surveillance



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*E*nvironmental Surveillance at the Savannah River Site (SRS) is designed to survey and quantify any effects that routine and nonroutine operations could have on the site and on the surrounding area and population. Site surveillance activities are divided into radiological and nonradiological programs.

As part of SRS’s radiological surveillance program, routine surveillance of all radiation exposure pathways is performed on all environmental media (air, rain, ambient gamma radiation, surface water, soil, sediment, vegetation, drinking water, food products, and wildlife) that could lead to a measurable annual dose above background at and beyond the site boundary.

Nonradioactive environmental surveillance at SRS involves the sampling and analysis of surface water, drinking water, sediment, groundwater, and fish. Results from the analyses of surface water, drinking water, sediment, and fish are discussed in this chapter. A description of the groundwater monitoring program analysis results can be found in chapter 7, “Groundwater.”

The Environmental Services Section’s Environmental Permitting and Monitoring (EPM) group performs surveillance activities for SRS. The Savannah River also is monitored by other groups, including the South Carolina Department of Health and Environmental Control (SCDHEC) and the Georgia Department of Natural Resources.

A complete description of the EPM surveillance program, including sample collection and analytical procedures, can be found in section 1105 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures, WSRC-3Q1-2 (SRS EM Program)*. Brief summaries of analytical results are presented in this chapter; complete data sets can be found in tables on the CD accompanying this report.

Radiological Surveillance

Air

Description of Surveillance Program

EPM maintains a network of 15 sampling stations in and around SRS to monitor the concentration of tritium and radioactive particulate matter in the air.

Surveillance Results Summary ([Table](#))

Except for tritium, specific radionuclides were not routinely detectable at the site perimeter. Both onsite and offsite activity concentrations were similar to levels observed in previous years.

Average gross alpha and gross beta results were slightly higher in 2007 than in 2006; however, they are consistent with historical results, which demonstrate [long-term variability](#).

Only two samples contained detectable manmade gamma-emitting radionuclides (Cs-137) in 2007. This is consistent with historical results, which indicate only a small number of air samples with detectable activity.

During 2007, detectable levels of uranium-234 were observed in six air samples and uranium-238 was observed in one sample. These results are similar to those observed in 2006. Where detected, concentrations of the uranium isotopes were slightly

higher than, but similar to, those observed in 2006. Uranium is naturally occurring in soil, and therefore expected to be present in low concentrations on some particulate filters. Aside from uranium, the only alpha-emitting radionuclide activity was Pu-238, observed in one sample. This result is higher than historical levels; however, it is believed to be a lab error because (1) no corresponding increase in Pu-239 or gross alpha/beta activity was observed, (2) the cycles immediately before and after the result in question were consistent with long-term levels, (3) the two nearest neighbor sites before, during, and after the result in question were consistent with long-term levels. All alpha-emitting isotopes at the remaining locations were below detection levels. Two samples showed strontium-89,90 above the minimum detectable concentration (MDC). A change in analytical protocol was implemented in 2007, resulting in both an observed greater variability of results as well as an increase in number of detectable samples.

With the exception of the Burial Ground North (BGN) location, tritium-in-air results for 2007 were similar to—but generally lower than—those observed in 2006. As in previous years, the BGN location showed average and maximum concentrations significantly higher than those observed at other locations. BGN results are expected to be both higher and more variable because of the location's proximity to both the tritium facilities and the phytoremediation project near the center of the site, and are influenced by operations at these facilities. Tritium was detected at every sampling location, although not every sample from a particular location had detectable tritium. Consistent with the SRS source term, tritium concentrations generally decrease with increasing [distance from the tritium facilities](#).

Rainwater

Description of Surveillance Program

SRS maintains a network of 15 rainwater sampling sites as part of the air surveillance program. These stations are used to measure deposition of radioactive materials.

Surveillance Results Summary ([Tables A, B](#))

No detectable manmade gamma-emitting radionuclides were observed in rainwater samples in 2007.

Gross alpha and gross beta results from 2007 were consistent with those of 2006. In 2007, the average

gross alpha results generally were slightly higher (five of seven locations showed an increase) than those of 2006, while average gross beta results generally were slightly lower (four of seven locations showed a decrease). A slight decreasing trend is observed in annual average beta concentrations; however, annual average gross alpha and gross beta concentrations, as well as individual sample results, are consistent with historical results, which demonstrate [long-term variability](#).

Detectable levels of uranium-234 and uranium-238 were present in most samples. Uranium is naturally occurring in soil, and therefore expected to be present at low concentrations in some deposition samples. Elevated uranium-238 results again were observed at the D-Area and BGN locations. Increased airborne particulate matter (dust) is present at these locations as a result of one or both of the following: (1) D&D activities in the immediate vicinity, resulting in the movement of large amounts of soil, and (2) increased vehicle traffic on nearby dirt roads or fields. It is believed that this phenomenon is responsible for the observed increase. All locations showed detectable americium-241 (overall, 30 percent of the samples). All other actinides, as well as strontium-89,90, either were below detection levels or were present in only a small number of samples in 2007.

As in previous years, tritium-in-rain values were highest near the center of the site. This is consistent with the H-Area effluent release points that routinely release tritium. All samples from the center of the site contained detectable tritium. However, tritium was detected in only eight samples representing three locations beyond the center of the site; all these locations were on the site perimeter. As with tritium in air, concentrations generally decreased as [distance from the effluent release point](#) increased.

Gamma Radiation

Description of Surveillance Program

Ambient gamma exposure rates in and around SRS are monitored by a system of thermoluminescent dosimeters (TLDs).

Surveillance Results Summary ([Table](#))

Exposures at all TLD monitoring locations show some variation based on normal site-to-site and year-to-year differences in the components of natural ambient gamma exposure levels. Exposure rates varied between 54 and 110 mrem per year.

In general, the 2007 ambient gamma radiation monitoring results indicated gamma exposure rates slightly lower than those observed at the same locations in 2007. The average exposure was 76 mrem in 2007 compared to 77 mrem in 2006; 25 locations showed lower exposure in 2007, 21 showed higher, and six were the same. However, these results generally are consistent with previously published [historical results](#), and indicate that no significant difference in average exposure rates is observed between monitoring networks—except in the case of population centers. Exposure rates in population centers are slightly elevated compared to the other monitoring networks—as expected—because of factors such as buildings and roadways, which emit small amounts of radiation.

Stormwater Basins

Description of Surveillance Program

Stormwater accumulating in site stormwater basins is monitored because of potential contamination. In 2007, monitoring was initiated at two new basins—Z-Area Basin and Pond 400—in addition to six E-Area basins.

Surveillance Results Summary ([Table](#))

There are no active discharges to site stormwater basins. The primary contributor is rainwater runoff. Rain events did not supply enough water to the E-06 basin for sampling purposes in 2007. The highest E-Area basin mean tritium concentration was at the E-05 basin, and was consistent with—although slightly lower than—the highest E-Area basin concentration in 2006. No detectable fission products were observed at any of the E-Area basins; likewise, most actinides were below detection limits. However, uranium-234, uranium-238, and americium-241 were detected at some of the basins. Gross alpha and gross beta were detected at all basins in concentrations generally consistent with those of previous years, although gross beta results were slightly elevated at most locations.

In 2007, tritium, technetium-99, uranium-234, uranium-238, plutonium-238, and gross alpha/beta were observed at the Z-Area basin. Uranium-234, uranium-238, plutonium-238, and strontium-89,90 were observed at Pond 400.

Streams

Description of Surveillance Program

Continuous surveillance monitoring occurs downstream of several process areas to detect and quantify levels of radioactivity in effluents transported to the Savannah River.

Sampling point U3R-F3 was temporarily removed from service in 2005 because of construction activities at the MOX Fuel Fabrication Facility (MFFF). It was decided in 2007 to permanently discontinue this point. Also, because of changes in operations at several F-Area facilities, two locations (F-001 and U3R-2) were moved from the effluent program to the surveillance program.

Surveillance Results Summary ([Table](#))

Detectable concentrations of tritium, the predominant radionuclide detected above background levels in SRS streams, were observed at least once at all stream locations in 2007. Tritium discharges to site streams generally declined in 2007 except at Steel Creek, which increased slightly from the previous few years.

No detectable concentrations of cobalt-60 were observed in any of the five major SRS streams. As expected, gross alpha and gross beta were observed in all streams. Steel Creek and Upper Three Runs concentrations were slightly higher than, but consistent with, previous levels, while the remainder were similar to previous levels. Other nuclides were observed at locations throughout the site, consistent with the source of the material, and exhibited variations similar to those of previous years. Uranium was observed in all major streams; fission products primarily in Four Mile Creek; and uranium and other actinides primarily from the Central Sanitary Waste Treatment Facility.

No significant trends or differences in results were observed between 2007 and previous years.

Seepage Basin and Solid Waste Disposal Facility Radionuclide Migration ([Table](#))

To incorporate the migration of radioactivity to site streams into total radioactive release quantities, EPM

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continued to monitor and quantify the migration of radioactivity from site seepage basins and the Solid Waste Disposal Facility (SWDF) in 2007 as part of its stream surveillance program. Tritium, strontium-89,90, technetium-99, and iodine-129 were detected in migration releases.

Figure 5-1 is a graphical representation of releases of tritium via migration to site streams for the years 1998-2007. During 2007, the total quantity of tritium migrating from site seepage basins and SWDF was 1,317 Ci, compared to 1,644 Ci in 2006.

Radioactivity previously deposited in the F-Area and H-Area seepage basins and SWDF continues to migrate through the groundwater and to outcrop into Four Mile Creek and Upper Three Runs. Because of their proximity, migration from the SWDF cannot be distinguished from migration from H-Area Basin 4. Measured migration of tritium into Four Mile Creek in 2007 occurred as follows:

- from F-Area seepage basins, 154 Ci—a 121-percent increase from the 2006 total of 70 Ci

- from H-Area seepage basin 4 and SWDF, 333 Ci—a 49-percent decrease from the 2006 total of 657 Ci
- from H-Area seepage basins 1, 2, and 3, 94 Ci—a 45-percent decrease from the 2006 total of 171 Ci

The measured migration from the north side of SWDF and the General Separations Area (GSA) into Upper Three Runs in 2007 was 54 Ci, a 43-percent decrease from the 2006 total of 94 Ci. (The GSA is in the central part of SRS and contains all waste disposal facilities, chemical separations facilities, and associated high-level waste storage facilities, along with numerous other sources of radioactive material.)

The total amount of strontium-89,90 entering Four Mile Creek from the GSA seepage basins and SWDF during 2007 was estimated to be 22.2 mCi. Migration releases of strontium-89,90 vary from year to year but have remained below 100 mCi the past 6 years. There was no quantified migration of Cs-137 from the GSA seepage basins and SWDF in 2007.

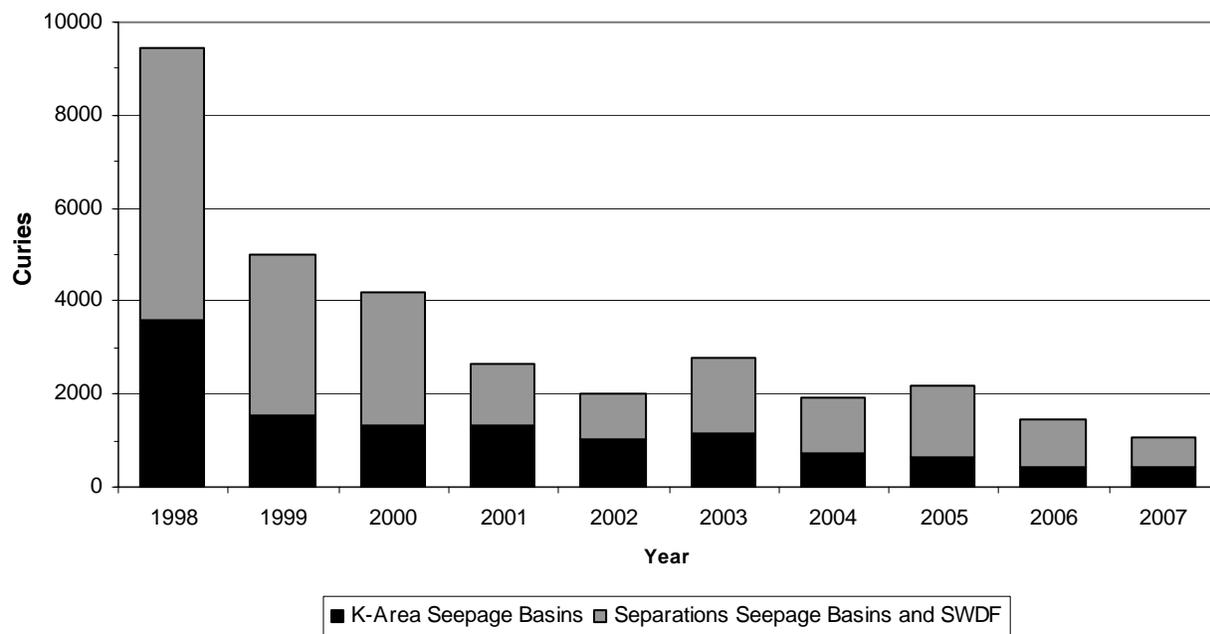


Figure 5-1 Tritium from SRS Seepage Basins and SWDF to Site Streams, 1998-2007

In 2007, 2.3 mCi of technetium-99 and 9.22 mCi of iodine-129 were estimated to have migrated into Four Mile Creek.

K-Area Drain Field and Seepage Basin Liquid purges from the K-Area disassembly basin were released to the K-Area seepage basin in 1959 and 1960. From 1960 until 1992, purges from the K-Area disassembly basin were discharged to a percolation field below the K-Area retention basin. Tritium migration from the seepage basin and the percolation field is measured in Pen Branch. The 2007 migration total of 431 Ci represents a slight decrease from the 439 Ci recorded in 2006.

C-Area, L-Area, and P-Area Seepage Basins Liquid purges from the C-Area, L-Area, and P-Area disassembly basins were released periodically to their respective seepage basins from the 1950s until 1970.

Migration releases from these basins no longer are quantified; however, they are accounted for in the stream transport totals.

Transport of Actinides in Streams

Transport (flux) in site streams of the actinides uranium, plutonium, americium, and curium no longer is quantified because of the actinides' historically low levels. However, the streams are sampled and analyzed annually for the presence of these actinides. The resulting concentrations are compared to those of previous years to identify any trends. Values for 2007 were consistent with historical data.

Savannah River

Description of Surveillance Program

Continuous surveillance is performed along the Savannah River at points above and below SRS, and includes the point at which liquid discharges from Georgia Power Company's Vogtle Electric Generating Plant (VEGP) enter the river.

Surveillance Results Summary (Table)

Based on curies released, tritium is the predominant radionuclide detected above background levels in the [Savannah River](#). The annual mean tritium concentration at RM-118.8 declined slightly in 2007 but remained approximately 2 percent of the drinking

water standard.

Detectable gross alpha and gross beta activity was observed at all [river sampling locations](#), and was consistent with long-term gross alpha and gross beta levels in the river.

Tritium was the only manmade radionuclide detected in Savannah River water, as indicated above. Uranium-234 and uranium-238 also were quantified in all annual samples, which are analyzed for a more comprehensive suite of radionuclides.

Tritium Transport in Streams (Table)

Tritium is introduced into SRS streams and the Savannah River from former production areas on site. Because of the mobility of tritium in water and the quantity of the radionuclide released during the years of SRS operations, a tritium balance has been performed annually since 1960. The balance is evaluated among the following alternative methods of calculation:

- tritium releases from effluent release points and calculated seepage basin and SWDF migration (direct releases)
- tritium transport in SRS streams and the last sampling point before entry into the Savannah River (stream transport)
- tritium transport in the Savannah River downriver of SRS after subtraction of any measured contribution above the site (river transport)

Combined tritium releases in 2007 (direct discharges and migration from seepage basins and SWDF) totaled 1,317 Ci, compared to 1,644 Ci in 2006.

The total tritium transported to the Savannah River from SRS streams decreased from 1,391 Ci in 2006 to 1,025 Ci in 2007.

The total tritium released to the Savannah River in 2007 was 1,938 Ci, compared with the previous year's 3,328 Ci. Both VEGP and SRS contributed to these release values. SRS's calculated releases of tritium to the river in 2007 totaled 855 Ci.

SRS [tritium transport data](#) for 1960–2007 are depicted in figure 5–2, which shows the history of direct releases, stream transport, and river transport, as determined by EPM.

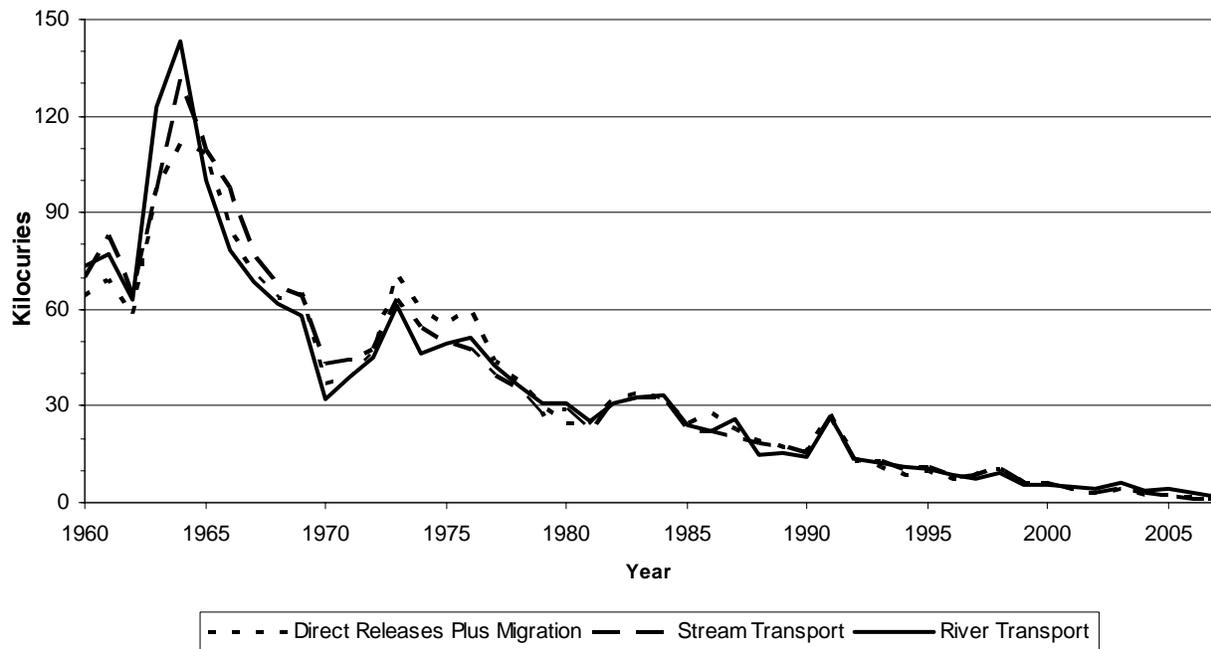


Figure 5-2 SRS Tritium Transport Summary, 1960-2007

SRS has maintained a tritium balance of direct releases plus migration, stream transport, and river transport since 1960 in an effort to account for and trend tritium releases in liquid effluents from the site. The general trend over time is attributable to (1) variations in tritium production at the site (production discontinued in the late 1980s); (2) the implementation of effluent controls, such as seepage basins, beginning in the early 1960s; and (3) the continuing depletion and decay of the site's tritium inventory.

EPM continued to assess the tritium flux in the Lower Three Runs system in 2007. A more extensive tritium flux assessment initially was conducted in 2004—and described in the *SRS Environmental Report for 2004*. As it has during the past several years, a small but measurable amount of tritium from earlier EnergySolutions LLC (formerly Chem-Nuclear Systems) operations entered the stream system in 2007. The amount of the tritium entering the system is expected to continue a gradual decline. EPM and EnergySolutions will maintain a monitoring program for Lower Three Runs to evaluate this tritium migration.

Domestic Water

Description of Surveillance Program

EPM collected domestic water samples in 2007 from locations at SRS and at water treatment facilities that use Savannah River water. Potable water was analyzed at offsite treatment facilities to ensure that SRS operations did not adversely affect the water supply

and to provide voluntary assurance that drinking water did not exceed EPA drinking water standards for radionuclides.

Onsite domestic water sampling consisted of quarterly grab samples at large treatment plants in A-Area, D-Area, and K-Area and annual grab samples at wells and small systems. Composite samples were collected monthly off site from

- the Beaufort-Jasper Water and Sewer Authority's Chelsea and Purrysburg Water Treatment Plants
- the City of Savannah Industrial and Domestic Water Supply Plant
- the North Augusta (South Carolina) Water Treatment Plant

Surveillance Results Summary (Table)

All domestic water samples collected by EPM were screened for gross alpha and gross beta concentrations to determine if activity levels warrant further analysis.

No domestic water exceeded EPA's $1.50E+01$ -pCi/L alpha activity limit or $5.00E+01$ -pCi/L beta activity limit. Also, no onsite or offsite domestic water samples exceeded the $2.00E+04$ -pCi/L EPA tritium limit, and no domestic water samples exceeded the strontium-89,90 MDC.

No cobalt-60, cesium-137, uranium-235, plutonium-239, or curium-244 was detected in any domestic water samples. On site, americium-241 was detected at two locations, uranium-234 at 10, uranium-238 at eight, and plutonium-238 at one.

Terrestrial Food Products

Description of Surveillance Program

The terrestrial food products surveillance program consists of radiological analyses of food product samples typically found in the Central Savannah River Area (CSRA). These foods include milk, meat (beef), fruit, and green vegetables (collards). Data from the food product surveillance program are not used to show direct compliance with any dose standard; however, the data can be used as required to validate dose models and determine environmental trends.

Samples of food—including meat (beef), fruit (melons or peaches), and a green vegetable (collards)—are collected from one location within each of four quadrants and from a control location within an extended (to 25 miles beyond the perimeter) southeast quadrant. All food samples are collected annually except milk, which is collected quarterly from dairies within a 25-mile radius of the site. One of the four dairies used for milk collection closed during the first quarter of 2007, and no replacement location could be found during the year. The food product surveillance program was expanded in 2005 to include secondary crops on a rotating schedule. Cabbage and wheat were sampled in 2007 as part of this program.

Food samples typically are analyzed for the presence of gamma-emitting radionuclides, tritium, strontium-89,90, uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239, americium-241, curium-244, gross alpha, and gross beta. Gross alpha and gross beta analyses were not performed on cabbage, collards, or watermelon in 2007 because of laboratory error.

Surveillance Results Summary (Tables A, B)

The only gamma-emitting radionuclide detected in

food products in 2007 was cesium-137, which was found in cabbage at three locations and wheat at one location. Strontium-89,90 was detected in collards and cabbage at all locations and in beef at one location. Tritium was detected in collards at one location. Uranium-234 was detected in two fruit samples and all beef samples, while uranium-238 was detected in four beef samples. Plutonium-238 was detected at four beef samples and in one cabbage sample, and plutonium-239 was detected in one beef sample and one cabbage sample. Americium-241 was detected in one wheat sample. Gross beta was detected in all food products. The 2007 results appeared to be randomly distributed among the monitoring locations, and no underlying spatial distribution was observed.

Tritium in food products is attributed primarily to releases from SRS; however, tritium was detected in only collards (three samples) and milk (three samples) during 2007.

Tritium was in collards at three locations. Concentrations ranged from $4.92E-02$ pCi/g (non-detectable) to $9.35E-02$ pCi/g (detectable). These concentrations were similar to those of previous years.

Tritium was detected in milk at three of the four sampling locations. The concentration at Denmark was $6.03E+02$ pCi/L. Girard was $5.46E+02$ pCi/L, and Waynesboro was $5.22E+02$ pCi/L. It was nondetectable at Miller Dairy ($1.22E+02$ pCi/L). These results are similar to those of previous years.

Due to laboratory error, gross alpha/beta analyses were only conducted on two food products (beef and wheat) during 2007. Gross beta concentrations were detectable in beef and ranged from $1.11E+00$ pCi/g to $2.41E+00$ pCi/g; these levels are similar to those of previous years' data.

Beginning in 2005 several food products are collected on a three year cycle. Wheat was in the cycle to be collected in 2007. Gross beta was detected in all samples and ranged from $1.24E-01$ pCi/g to $1.94E-01$ pCi/g. There is not enough data available at this time for trending of this food product.

Aquatic Food Products

Description of Surveillance Program

The aquatic food product surveillance program includes fish (freshwater and saltwater) and shellfish. To determine the potential dose and risk to the public

from consumption, both types are sampled.

Nine surveillance points for the collection of freshwater fish are located on the Savannah River—from above SRS at Augusta, Georgia, to the coast at Savannah, Georgia. Composite samples—comprised of three to five fish of a given species—are prepared for each species from each location. Analyses for technetium-99; iodine-129; and the actinide series (uranium-234, uranium-235, and uranium-238, plutonium-238 and plutonium-239, americium-241, and curium-244) were added to all samples in 2006.

Surveillance Results Summary

Cesium-137 and iodine-129 were the only manmade gamma-emitting radionuclides found in Savannah River edible fish composites during 2007. Strontium-89,90, uranium-234, uranium-238, plutonium-238, and tritium were detected at most of the [freshwater river locations](#). Plutonium-239 was found slightly above the MDC in one composite from each of three freshwater locations—Beaver Dam Creek mouth and Stokes Bluff Landing (on the Savannah River) and West Bank Landing (on the Edisto River).

The laboratory strontium-89,90 analysis for one sample—an edible bass composite from the Hwy 17A bridge area (3.00E+00 pCi/g)—is questionable because it is well above historical levels and because the nonedible composite concentration is much lower (5.70E-02 pCi/g). If the strontium-90 concentration in edible bass were truly elevated, the corresponding nonedible composite would also be elevated because this isotope tends to accumulate in the skeletal system. Cesium-137 and strontium-89,90 concentrations were similar to those of previous years at all other locations.

Tritium, uranium-234, uranium-235, uranium-238, and plutonium-238 were detected in [saltwater fish](#); uranium-234, uranium-235, uranium-238, and strontium 89,90 were detected in [shellfish](#). Concentrations were similar to those of previous years.

Deer and Hogs

Description of Surveillance Program

Annual hunts, open to members of the general public, are conducted at SRS to control the site's deer and feral hog populations and to reduce animal-vehicle accidents. Before any animal is released to a hunter, EPM personnel use portable sodium iodide detectors to perform field analyses for cesium-137. Media samples (muscle and/or bone) are collected

periodically for laboratory analysis based on a set frequency, on cesium-137 levels, and/or on exposure limit considerations.

SRS created an administrative dose limit of 30 mrem for the consumption of game animals in 2006. This limit, which ensures that no single pathway contributes more than 30 percent to the all-pathway dose limit of 100 mrem, is consistent with DOE guidance.

Surveillance Results Summary

A total of 388 deer and 84 feral hogs were taken during the 2007 site hunts. As observed during previous hunts, cesium-137 was the only manmade gamma-emitting radionuclide detected during laboratory analysis. Generally, the cesium-137 concentrations measured by the field and lab methods were comparable. Field measurements from all animals ranged from 1 pCi/g to 8.7 pCi/g, while lab measurements ranged from 1 pCi/g to 5.7 pCi/g. The average field cesium-137 concentration was 1.46 pCi/g in deer (with a maximum of 8.7 pCi/g) and 1.58 pCi/g in hogs (with a maximum of 6.89 pCi/g). This range of concentrations is normal for the site's deer and hog populations.

The muscle and bone samples from a subset of the animals returned to the lab for cesium-137 analysis also are analyzed for strontium-89,90. Typically, muscle and bone samples are collected for analysis from the same animals checked for cesium-137, and the samples are analyzed for strontium-89,90. Strontium was detected in three muscle samples—two deer (5.22E-03 and 5.08E-03 pCi/g) and one hog (7.32E-03 pCi/g). Lab measurements of strontium-89,90 in bone ranged from a high of 5.16 pCi/g to below detection in deer and from a high of 3.19 pCi/g to below detection in hogs. These results are similar to those of previous years.

Turkeys/Beavers

Description of Surveillance Programs

Prior to 2003, wild turkeys were trapped on site by the South Carolina Department of Natural Resources and used to repopulate game areas in South Carolina and other states. Since that time, the program has remained inactive because of reduced needs.

During April 2007, a special hunt for the mobility impaired was held that resulted in the harvest of five turkeys. The average cesium-137 concentration measured in the field was 1.3 pCi/g.

The U.S. Department of Agriculture Forest Service–Savannah River harvests beavers in selected areas within the SRS perimeter to reduce the population and thereby minimize dam-building activities that can result in flood damage to timber stands, to primary and secondary roads, and to railroad beds. This activity resumed during 2006. Although population control activities continued in 2007, no beavers were removed from their habitat for disposal.

Soil

Description of Surveillance Program

The SRS soil monitoring program provides

- data for long-term trending of radioactivity deposited from the atmosphere (both wet and dry deposition)
- information on the concentrations of radioactive materials in the environment

The concentrations of radionuclides in soil vary greatly among locations because of differences in rainfall patterns and in the mechanics of retention and transport in different types of soils. Two locations (West Jackson and Windsor Road) were added to the program in 2007. Because of this program's design, a direct comparison of data from year to year is not appropriate. However, the data may be evaluated over a period of years to determine long-term trends.

Surveillance Results Summary (Table)

In 2007, radionuclides were detected in soil samples from all 21 locations, as follows:

- cesium-137 at 13 locations (two onsite, seven perimeter, and four offsite)
- uranium-234 at all locations
- uranium-235 at all locations
- uranium-238 at all locations
- plutonium-238 at 14 locations (four onsite, six perimeter, and four offsite)
- plutonium-239 at 16 locations (five onsite, seven perimeter, and four offsite)

- americium-241 at 14 locations (four onsite, seven perimeter, and three offsite)
- curium-244 at two perimeter locations

Uranium is naturally occurring in soil and therefore expected to be present in most soil samples. These results are similar to those of previous years.

Settleable Solids

Description of Surveillance Program

Settleable-solids monitoring in effluent water is required to determine—in conjunction with routine sediment monitoring—whether a long-term buildup of radioactive materials occurs in stream systems.

DOE limits on radioactivity levels in settleable solids are 5 pCi/g above background for alpha-emitting radionuclides and 50 pCi/g above background for beta/gamma-emitting radionuclides.

Low total suspended solids (TSS) levels result in a small amount of settleable solids, so an accurate measurement of radioactivity levels in settleable solids is impossible. Based on this, an interpretation of the radioactivity-levels-in-settleable-solids requirement was provided to SRS by DOE in 1995. The interpretation indicated that TSS levels below 40 parts per million (ppm) were considered to be in de-facto compliance with the DOE limits.

To determine compliance with these limits, EPM uses TSS results—gathered as part of the routine National Pollutant Discharge Elimination System (NPDES) monitoring program—from outfalls collocated at or near radiological effluent points. If an outfall shows that TSS levels regularly are greater than 30 ppm, a radioactivity-levels-in-settleable-solids program and an increase in sediment monitoring will be implemented.

Surveillance Results Summary

In 2007, one TSS sample exceeded 30 ppm. This sample, collected from Outfall K–18 in March, had a result of 51 ppm, which was caused by heavy construction activities near K-Area. Overall, the 2007 NPDES TSS results indicate that SRS remains in compliance with the DOE radioactivity-levels-in-settleable-solids requirement.

Sediment

Description of Surveillance Program

Sediment sample analysis measures the movement, deposition, and accumulation of long-lived radionuclides in stream beds and in the Savannah River bed. Significant year-to-year differences may be evident because of the continuous deposition and remobilization occurring in the stream and river beds—or because of slight variation in sampling locations—but the data obtained can be used to observe long-term environmental trends.

Sediment samples were collected at eight Savannah River and 13 site stream locations in 2007.

Surveillance Results Summary (Table)

Cesium-137 was the only manmade gamma-emitting radionuclide observed in river and stream sediments in 2007. The highest cesium-137 concentration in streams, $2.68E+01$ pCi/g, was detected in sediment from R-Canal; the lowest levels were below detection at two locations. The highest level found on the river, $8.76E-01$ pCi/g, was at River Mile 129; the lowest level was below detection at one location. Generally, cesium-137 concentrations were higher in stream sediments than in river sediments. This is to be expected because the streams receive radionuclide-containing liquid effluents from the site. Most radionuclides settle out and deposit on the stream beds or at the streams' entrances to the swamp areas along the river.

Strontium-89,90 was above the MDC in sediment at three stream locations in 2007. The maximum detected value was $6.49E-01$ pCi/g, at the Four Mile Creek at Road A-7A location.

Plutonium-238 was detected in sediment during 2007 at eight stream locations and five river locations. The results ranged from a maximum of $2.95E-01$ pCi/g at FM-A7A to below detection at several locations. Plutonium-239 was detected in sediment at most stream and river locations. The maximum value was $1.27E-01$ pCi/g—also at FM-A7A. Uranium-234, uranium-235, and uranium-238 were detected at most locations.

The distribution and concentration of radionuclides in river sediment during 2007 were similar to those of previous years.

Concentrations of all isotopes generally were higher in streams than in the river. As indicated in the earlier discussion of cesium-137, this is to be expected. Differences observed when these data are compared to those of previous years probably are attributable to the effects of resuspension and deposition, which occur constantly in sediment media.

Grassy Vegetation

Description of Surveillance Program

The radiological program for grassy vegetation is designed to collect and analyze samples from onsite and offsite locations to determine radionuclide concentrations. Vegetation samples are obtained to complement the soil and sediment samples in order to determine the environmental accumulation of radionuclides and to help validate the dose models used by SRS. Bermuda grass is preferred because of its importance as a pasture grass for dairy herds.

Vegetation samples are obtained from

- locations containing soil radionuclide concentrations that are expected to be higher than normal background levels
- locations receiving water that may have been contaminated
- all air sampling locations

Surveillance Results Summary (Table)

Radionuclides in the grassy vegetation samples collected in 2007 were detected as follows:

- tritium at four perimeter and one onsite location
- cesium-137 at six perimeter locations
- strontium-89,90 at all nine locations (one onsite, six perimeter, and two 25-mile radius)
- uranium-234 at nine locations (one onsite, seven perimeter, and one 25-mile radius)
- uranium-238 at nine locations (one onsite, seven perimeter, and one 25-mile radius)

Overall results show a slight decline in radionuclide concentrations during the past several years.

Savannah River Swamp Surveys

Introduction

The Creek Plantation, a privately owned land area located along the Savannah River, borders part of the southern boundary of SRS. In the 1960s, an area of the Savannah River Swamp on Creek Plantation—specifically, the area between Steel Creek Landing and Little Hell Landing—was contaminated by SRS operations. During high river levels, water from Steel Creek flowed along the lowlands comprising the swamp, resulting in the deposition of radioactive material. SRS studies estimated that a total of approximately 25 Ci of cesium-137 and 1 Ci of cobalt-60 were deposited in the swamp.

Comprehensive and cursory surveys of the swamp have been conducted periodically since 1974. These surveys measure radioactivity levels to determine changes in the amount and/or distribution of radioactivity in the swamp. A series of 10 sampling trails—ranging from 240 to 3,200 feet in length—was established through the swamp. Fifty-four monitoring locations were designated on the trails to allow for continued monitoring at a consistent set of locations. [Fledderman, 2007]

The 2007 survey was designated as a comprehensive survey (requiring extensive media sampling and analysis). Because of access difficulties caused by high water levels, 15 of the 84 soil samples and four of the 54 vegetation samples could not be collected.

Analytical Results Summary (Table)

As anticipated, based on source term information and historical survey results, Cs-137 was the primary manmade radionuclide detected. Cs-137 was detected in all soil samples while Co-60 was detected in two samples. Cs-137 concentrations varied from a low of 0.0004 pCi/g to a high of 67 pCi/g. These levels are comparable with results of previous surveys. Examination of the seven shallow core samples showed that in general, higher concentrations of Cs-137 were observed in the shallow depths. Increased activity was observed as far away as trail 10, while higher concentrations were present on trails 1 and 4.

Cs-137 was detected in 30 of the 50 vegetation samples, while no Co-60 was detected in any sample. Concentrations varied from below detection to a maximum of 19.7 pCi/g. These levels are comparable with results of previous surveys. Higher

concentrations were generally observed on trails 1, 5, and 6. No relationship was observed between soil and vegetation samples; however, the samples were collected at different times of the year.

Nonradiological Surveillance

Air

SRS does not conduct onsite surveillance for nonradiological ambient air quality. However, to ensure compliance with SCDHEC air quality regulations and standards, SRNL most recently conducted air dispersion modeling for all site sources of criteria pollutants and toxic air pollutants in 2001. This modeling indicated that all SRS sources were in compliance with air quality regulations and standards. Since that time, additional modeling conducted for new sources of criteria pollutants and toxic air pollutants has demonstrated continued compliance by the site with current applicable regulations and standards. The states of South Carolina and Georgia continue to monitor ambient air quality near the site as part of a network associated with the federal Clean Air Act.

Surface Water

SRS streams and the Savannah River are classified by SCDHEC as “Freshwaters,” which are defined as surface water suitable for

- primary and secondary contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- fishing and survival and propagation of a balanced indigenous aquatic community of fauna and flora
- industrial and agricultural uses

Appendix A, “Applicable Guidelines, Standards, and Regulations,” of this report provides some of the specific guidelines used in water quality surveillance, but because some of these guidelines are not quantifiable, they are not tracked at SRS.

Surveillance Results Summary (Table)

Most water quality parameters and metals were detected in at least one sample at every location. Six samples, one from each of six locations (three from onsite streams and three from the Savannah River),

had detectable pesticides/herbicides in 2007. These results continue to indicate that SRS discharges are not significantly affecting the water quality of onsite streams or the river.

Drinking Water

Most of the drinking water at SRS is supplied by three systems that have treatment plants in A-Area, D-Area, and K-Area. The site also has 14 small drinking water facilities, each of which serves populations of fewer than 25 persons.

Surveillance Results Summary

All samples collected from SRS drinking water systems during 2007 were in compliance with SCDHEC and EPA water quality standards. Additional information is provided in the Safe Drinking Water Act section of chapter 3, “Environmental Compliance.”

Sediment

The nonradiological sediment surveillance program provides a method to determine the deposition, movement, and accumulation of nonradiological contaminants in stream systems. In 2007, sample preparation prior to analysis was changed from an extraction (toxicity characteristic leaching procedure, or TCLP) to a total sample digestion.

Surveillance Results Summary (Table)

In 2007, as in the previous 5 years, no pesticides or herbicides were found to be above the quantitation limits in sediment samples. Metals analyses results for 2007 also were comparable to those of the previous 5 years.

Fish

EPM personnel analyze the flesh of fish caught from the Savannah and Edisto Rivers to determine concentrations of mercury in the fish. In 2007, additional metals (arsenic, cadmium, manganese, and antimony) were added to the analytical suite. The fish analyzed represent the most common edible species of fish in the CSRA (freshwater) and at the mouth of the Savannah River (saltwater).

Surveillance Results Summary

In 2007, mercury analyses were performed on 174 fish from the Savannah River and eight from the Edisto

River at West Bank Landing. Concentrations of mercury generally were slightly higher than those observed in 2006. This increase could be the result of conditions related to the drought of 2007. The highest concentrations were found in the Savannah River—in bass at the mouth of Lower Three Runs (1.66 µg/g), in catfish at the mouth of Four Mile Creek (1.07 µg/g), and in bream at Highway 17–A (2.13 µg/g).

Arsenic was detected in six samples, with the highest concentration in bass (1.15 mg/g) at Augusta Lock and Dam. Cadmium was detected in 17 samples, with the highest concentration in bream (1.58 mg/g) at Augusta Lock and Dam. Manganese was detected at all locations, with the highest concentration in bream (2.74 mg/g) at Hwy. 301. Antimony was detected in 27 samples, with the highest concentration in bream (.59 mg/g) at Upper Three Runs Creek mouth.

River Water Quality Surveys

Description of Surveys

Academy of Natural Sciences (ANS) personnel conducted biological and water quality surveys of the Savannah River from 1951 through 2003, when EPM assumed this responsibility. The surveys were designed to assess potential effects of SRS contaminants and warm-water discharges on the general health of the river and its tributaries. This is accomplished by looking for

- patterns of biological disturbance geographically associated with the site
- patterns of change over seasons or years that indicate improving or deteriorating conditions

EPM conducted macroinvertebrate sampling during the spring and fall of 2007 and diatom sampling on a monthly basis. The diatom slides were sent to ANS for archiving and processing of the 2007 spring collection. No adverse biological impacts were identified in the Savannah River diatom communities.

Macroinvertebrates collected from river traps during 2006 were similar in species diversity to those documented in surveys during the 1990s. An overall decrease in total populations was observed that likely is associated with low flow in the river and incipient drought conditions. No evidence of adverse biological impacts was found in the observed macroinvertebrate communities. Collections from 2007 will be sorted and archived during 2008.