

Environmental Surveillance

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Environmental 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 the radiological surveillance program, routine surveillance of all radiation exposure pathways is performed on all environmental media that could lead to a measurable annual dose 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 and the Savannah River National Laboratory (SRNL) perform surveillance activities for SRS. The Savannah River also is monitored by other groups, including the South Carolina Department of Health and Environmental Control (SCDHEC), the Georgia Department of Natural Resources, and the Academy of Natural Sciences (ANS).

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 materials 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 2006 than in 2005; however, they are consistent with historical results, which demonstrate long-term variability.

Only one sample contained detectable manmade gamma-emitting radionuclides (Cs-137) in 2006. This is consistent with historical results, which indicate only a small number of air samples with detectable activity.

During 2006, detectable levels of uranium-234 were observed in all air samples; uranium-238 was observed in most of these samples, and uranium-235 was observed in one sample, from Savannah, Georgia. These results are similar to those observed in 2005. Concentrations of the uranium isotopes were slightly lower than, but similar to, those observed in 2005. Aside from uranium, alpha-emitting radionuclide activity was observed in six samples from five locations. Americium-241 was detected at four locations on the site perimeter and one 25-mile location, while plutonium-238 was detected at one site perimeter location. Generally, these concentrations were consistent with historical results. All isotopes at the remaining locations were below detection levels. As observed in previous years, none of the samples showed strontium-89,90 above their minimum detectable concentration (MDC).

A self-assessment—conducted during the summer of 2006—revealed an error in the calculation of tritium-in-air results, with the potential for under-reporting actual concentrations. This error was corrected in the software and the results were recalculated. However, the expected increase in tritium concentration was not observed, except at the Burial Ground North (BGN) location. In large part, this is the result of decreased atmospheric releases (see chapter 4, “Effluent Monitoring”).

With the exception of the BGN location, tritium-in-air results for 2006 were similar to—but generally lower than—those observed in 2005. Tritium was detected at every sampling location, although not every sample from a particular location had detectable tritium. As in previous years, the BGN location showed average and maximum concentrations significantly higher than those observed at other locations. This was expected because of its proximity to SRS’s tritium facilities, which are near the center of the site. Consistent with the SRS source term, tritium concentrations generally decrease with increasing distance from the tritium facilities. (Graphic)

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)

Gamma-Emitting Radionuclides No detectable manmade gamma-emitting radionuclides were observed in rainwater samples in 2006.

Gross alpha and gross beta results from 2006 were consistent with those of 2005. In 2006, both the gross alpha and gross beta results generally were slightly lower than those of 2005. However, no long-term increasing or decreasing trend was evident, which implies that the observed values are natural background and does not indicate any contribution directly attributable to SRS.

Detectable levels of uranium-234 and uranium-238 were present in most samples. Elevated results were observed at the D-Area and BGN locations. D&D activities in the immediate vicinity of these sampling sites resulted in the movement of large amounts of soil and the subsequent formation of increased airborne particulates (dust). It is believed that this phenomenon is responsible for the observed increase. All locations showed detectable americium-241 (overall, 46 percent of the samples) and plutonium-238 (overall, 19 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 2006.

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. Tritium was detected at every sampling location, although not every sample from a particular location had detectable tritium. 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 57 and 111 mrem per year.

In general, the 2006 ambient gamma radiation monitoring results indicated gamma exposure rates slightly lower than those observed at the same locations in 2005 (Graphic). 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.

E-Area Stormwater Basins

Description of Surveillance Program

Stormwater accumulating in the E-Area stormwater basins is monitored because of potential contamination.

Surveillance Results Summary (Table)

There are no active discharges to the E-Area stormwater basins. The primary contributor to the E-Area basins is rainwater runoff from the low-level-waste burial ground. Rain events did not supply enough water to the E-06 basin for sampling purposes in 2006. The highest E-Area basin mean tritium concentration was observed at E-05, and was approximately four times lower than in 2005; this decrease is the result of decreased influence from the southwest plume phytoremediation project. No detectable fission products were observed at any of the basins; likewise, most actinides were below detection. 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.

Site 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.

Surveillance Results Summary (Table)

Demolition and construction activities continued to impact site stream surveillance locations in 2006. Sampling point U3R-F3, which was removed from service in 2005 because of construction activities at the MOX Fuel Fabrication Facility (MFFF), will be reestablished in 2007. In the interim, U3R sampling equipment located downstream of U3R-F3 tracked any releases that may have originated in the U3R-F3 drainage area. Releases to U3R-F3 were highly unlikely because the primary source to the outfall was deactivated in 2005 and, with exception of a remaining concrete pad, was demolished in early 2006.

Tritium, the predominant radionuclide detected above background levels in SRS streams, was observed at all stream locations in 2006 except the Upper Three Runs control point and site X-008 near T-Area. Tritium concentrations in all site streams generally declined in 2006 except at Steel Creek, which remained stable.

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, and were consistent with, but generally lower than, 2005 concentrations. Other nuclides were observed at locations throughout the site, consistent with the source of the material. Fission products generally were observed in Four Mile Creek; uranium generally was observed in the vicinity of T-Area; and uranium and other actinides generally were observed at the Central Sanitary Waste Treatment Facility. Some degree of year-to-year variation typically

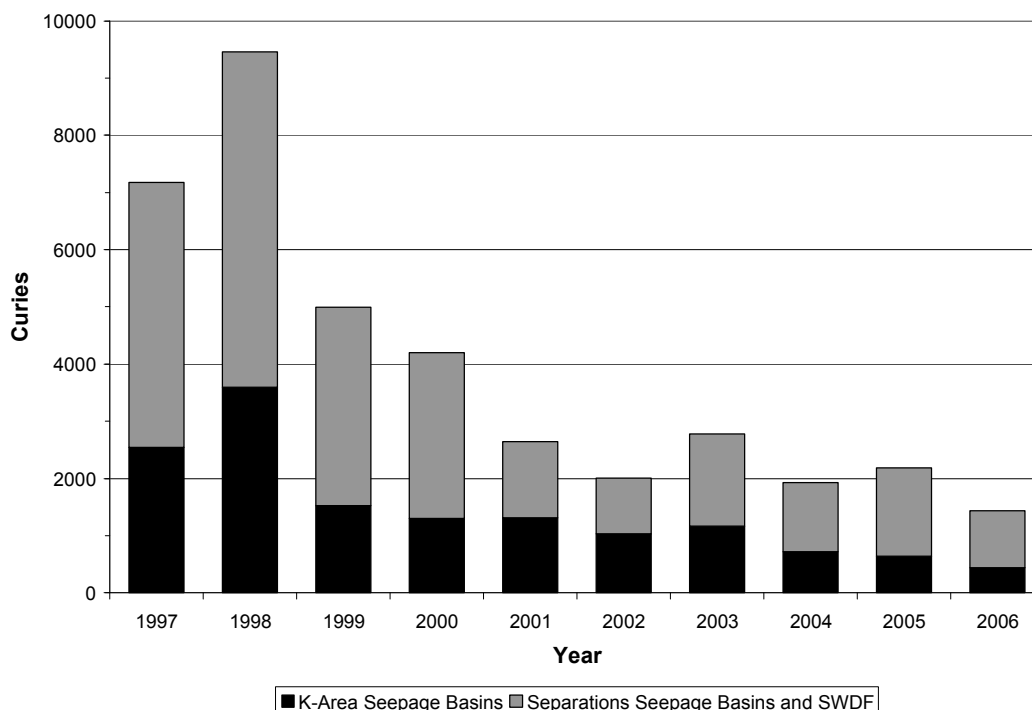


Figure 5–1 Tritium from SRS Seepage Basins and SWDF to Site Streams, 1997–2006

is observed in environmental media; however, no significant differences were observed between the 2005 and 2006 results.

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 continued to monitor and quantify the migration of radioactivity from site seepage basins and the Solid Waste Disposal Facility (SWDF) in 2006 as part of its stream surveillance program. Tritium, strontium-89,90, technetium-99, iodine-129, and cesium-137 were detected in migration releases.

Figure 5–1 is a graphical representation of releases of tritium via migration to site streams for the years 1997–2006. During 2006, the total quantity of tritium migrating from site seepage basins and SWDF was 1,644 Ci, compared to 2,180 Ci in 2005. This 25-percent decrease is attributed mainly to the completion in April 2006 of repair work on the Mixed Waste Management Facility Groundwater Retention Dam, which prevents contaminated shallow groundwater from reaching Four Mile Creek.

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. Measured migration of tritium into Four Mile Creek in 2006 occurred as follows:

- from F-Area seepage basins, 69.3 Ci—an 89-percent decrease from the 2005 total of 630 Ci
- from H-Area seepage basin 4 and SWDF, 657 Ci—an 11-percent increase from the 2005 total of 592 Ci
- from H-Area seepage basins 1, 2, and 3, 173 Ci—a 28-percent decrease from the 2005 total of 242 Ci

The measured migration from the north side of SWDF and the General Separations Area (GSA) into Upper Three Runs in 2006 was 94 Ci, a 25-percent increase from the 2005 total of 75 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, and 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 2006 was estimated to be 33.1 mCi. Migration releases of strontium-89,90 vary from year to year but have remained below 100 mCi the past 5 years.

In addition, a total of 41.3 mCi of cesium-137 was estimated to have migrated from the GSA seepage basins and SWDF in 2006. This 57-percent decrease from the 2005 total of 96.4 mCi is attributed primarily to the previously discussed completion of repair work on the Mixed Waste Management Facility Groundwater Retention Dam.

In 2006, 6.38 mCi of technetium-99 and 8.31 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 2006 migration total of 439 Ci represents a 32-percent decrease from the 641 Ci recorded in 2005.

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

Because of their historically low levels, the actinides uranium, plutonium, americium, and curium no longer are quantified in SRS streams. 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 2006 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)

Tritium is the predominant radionuclide detected above background levels in the Savannah River. The annual mean tritium concentration at RM-118.8 in 2006 was about 3 percent of the drinking water standard.

Detectable gross beta activity was observed at all river sampling locations, and was consistent with long-term gross beta levels in the river.

Detectable manmade radionuclides in Savannah River water were tritium, as indicated above, and uranium-234 (three samples), uranium-235 (two samples), and americium-241 (one sample).

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)

The combined tritium releases in 2006 (direct discharges and migration from seepage basins and SWDF) totaled 1,644 Ci, compared to 2,506 Ci in 2005.

The total tritium transport in SRS streams decreased from 2,378 Ci in 2005 to 1,391 Ci in 2006.

The total tritium transport in the Savannah River for 2006 was 3,328 Ci, compared with the previous year's 4,480 Ci. Both VEGP and SRS contributed to these release values. Accounting for VEGP's contribution, SRS's calculated releases of tritium to the river in 2006 totaled 1,248 Ci.

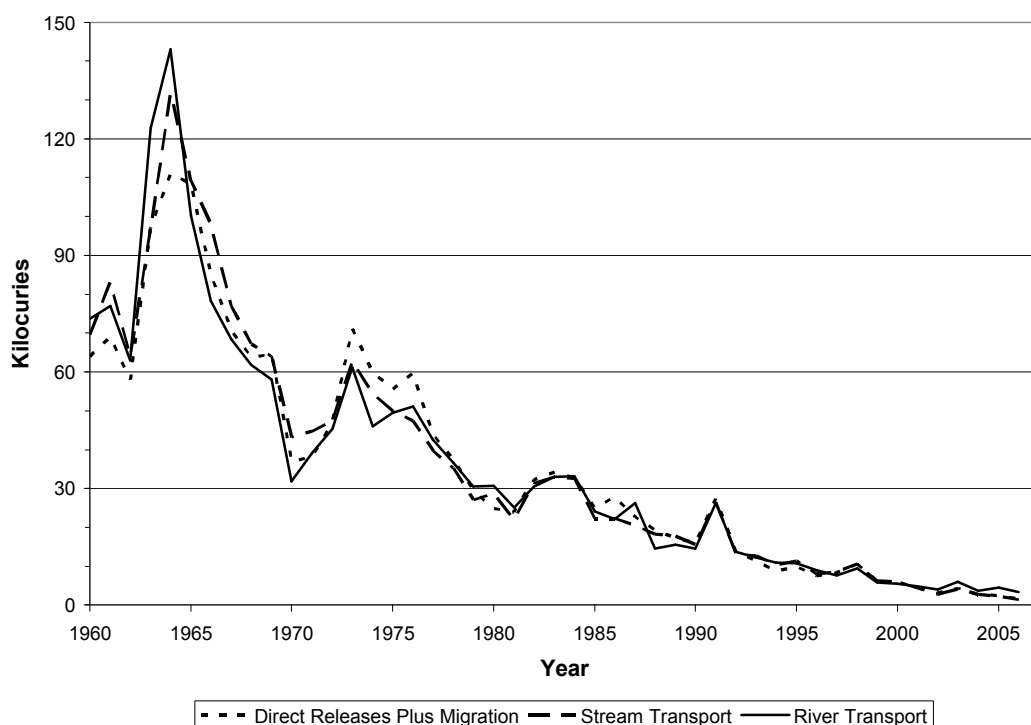


Figure 5–2 SRS Tritium Transport Summary, 1960–2006

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 was 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.

SRS tritium transport data (Table) for 1960–2006 are depicted in figure 5–2, which shows the history of direct releases, stream transport, and river transport, as determined by EPM.

EPM continued to assess the tritium flux in the Lower Three Runs system in 2006, as initially described in the *SRS Environmental Report for 2004*. As in the previous several years, a small but measurable amount of tritium from earlier EnergySolutions LLC (formerly Chem-Nuclear Systems) operations entered the stream system. The amount of the tritium 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 and Drinking Water (Table)



Description of Surveillance Program

EPM collected domestic and drinking water samples in 2006 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

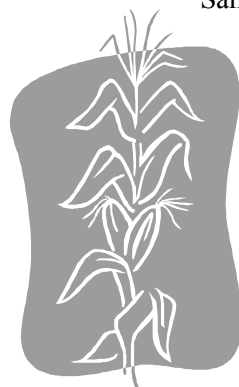
All domestic and drinking water samples collected by EPM were screened for gross alpha and gross beta concentrations to determine if activity levels warrant further analysis. No domestic water used for drinking purposes exceeded EPA's $1.50\text{E}+01$ -pCi/L alpha activity limit or $5.00\text{E}+01$ -pCi/L beta activity limit. Also, no onsite or offsite domestic or drinking water samples exceeded the $2.00\text{E}+04$ -pCi/L EPA tritium limit, and no domestic or drinking water samples exceeded the strontium 89,90 MDC.

No cobalt-60, cesium-137, uranium-235, plutonium-238, plutonium-239, or curium-244 was detected in any domestic or drinking water samples. Americium-241 was detected at nine locations, uranium-234 at 10 locations, and uranium-238 at five locations.

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 food products include 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 verify 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. The food product surveillance program was expanded in 2005 to include secondary crops on a rotating schedule. Corn and soybeans were sampled in 2006 as part of this program.

Food samples 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.

Surveillance Results Summary (Tables A, B)

The only gamma-emitting radionuclide detected in food products in 2006 was cesium-137, which was found in collards, corn, and soybeans at one location. Strontium-89,90 was detected in collards at all locations, in soybeans at three locations, and in corn at one location. Tritium was detected in collards at one location. Uranium-234 and uranium-238 were detected in soybeans and corn at one location and in beef at all locations. Americium-241 was detected in corn at all locations, in soybeans at one location, and in the CY2005 pecans at the 25-mile-location (results not available for inclusion in the 2005 environmental report). Gross alpha/beta analyses were conducted on all food samples except milk. Gross beta was detected in all food products. Not enough moisture was obtainable from the soybeans to run tritium analyses at any location. The 2006 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 one food sample. This is similar to results of previous years.

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. In 2006, analyses for technetium-99; iodine-129; and the actinide series (uranium-234, 235, and 238, plutonium 238 and 239, americium-241, and curium-244) were added to all samples.

Surveillance Results Summary (Tables A, B)

Cesium-137, iodine-129, and technetium-99 were the only manmade gamma-emitting radionuclides found in Savannah River edible fish composites. Strontium-89,90 and tritium were detected at most of the freshwater river locations. Plutonium-238 was found slightly above the MDC in composites from eight freshwater locations. Strontium-89,90, uranium-234, uranium-235, uranium-238, and plutonium-238 were detected in both saltwater fish and shellfish. Cesium-137 and strontium-89/90 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.

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

Surveillance Results Summary

A total of 324 deer and 92 feral hogs were taken during the 2006 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 19 pCi/g, while lab measurements ranged from 1 pCi/g to 17.2 pCi/g. The average field cesium-137 concentration was 2.65 pCi/g in deer (with a maximum of 9 pCi/g) and 3.19 pCi/g in hogs (with a maximum of 19 pCi/g).

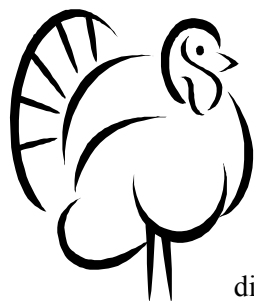


Strontium levels are determined in some of the animals analyzed for cesium-137. Typically, muscle and bone samples are collected for analysis from the same animals checked for cesium-137, and the samples are analyzed for strontium-89,90. As in previous years, strontium-89,90 was not quantified in muscle samples in 2006. Lab measurements of strontium-89,90 in bone ranged from a high of 5.62 pCi/g to a low of 0.87 pCi/g in deer and from a high of 3.54 pCi/g to a low of 1.32 pCi/g 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.



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, and the 18 beavers harvested were monitored by EPM to ensure safe and appropriate disposal. None of the harvested animals were near the site's radiological limit for disposal in the Solid Waste Disposal Facility.

During April 2006, a special hunt for the mobility impaired was held that resulted in the harvest of 23 turkeys. The average cesium-137 concentration measured in the field was 1 pCi/g.

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. Because of this program's design, a direct comparison of data from year to year is not appropriate. However, these results may be evaluated over a period of years to determine long-term trends.

Surveillance Results Summary (Table)

In 2006, radionuclides were detected in soil samples from 19 locations, as follows:

- cesium-137 at 17 locations (three onsite, all 10 perimeter, and four offsite)
- uranium-234 at all 19 locations
- uranium-235 at all locations except for one perimeter location
- uranium-238 at all locations except for one perimeter location
- plutonium-238 at 13 locations (three onsite, eight perimeter, and two offsite)
- plutonium-239 at 16 locations (four onsite, nine perimeter, and three offsite)
- americium-241 at 15 locations (three onsite, nine perimeter, and three offsite)
- curium-244 at three locations (one onsite and two offsite)

These results are similar to those of previous years.

Settleable Solids

Description of Surveillance Program

Settleable-solids monitoring in effluent water is required to ensure—in conjunction with routine sediment monitoring—that a long-term buildup of radioactive materials does not occur 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 Westinghouse Savannah River Company (WSRC) 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 co-located 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 2006, two TSS samples exceeded 30 ppm. One sample from Outfall D-1D had a result of 40 ppm because of a facility wash-down, while a sample from Outfall D-06 had a result of 38 ppm because of construction activities. Overall, the 2006 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 2006.

Surveillance Results Summary (Table)

Cesium-137 and cobalt-60 were the only manmade gamma-emitting radionuclides observed in river and stream sediments. The highest cesium-137 concentration in streams, $4.97\text{E}+02$ pCi/g, was detected in sediment from R-Canal; the lowest levels were below detection at several locations. The highest level found on the river, $4.86\text{E}-01$ pCi/g, was at River Mile 129; the lowest levels were below detection at several locations. 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.

Cobalt-60 was detected in stream sediment at a concentration of $4.41\text{E}-01$ pCi/g at the R-Canal location—the only location where cobalt-60 was detected.

Strontium-89,90 was above the MDC in sediment at six stream locations. The maximum detected value was $3.71\text{E}-01$ pCi/g, at the Four Mile Creek at the Road A-7 location. Plutonium-238 was detected in sediment during 2006 at all stream locations and at four river locations. The results ranged from a maximum of $1.39\text{E}-01$ pCi/g at FM-A7 to below detection at several locations. Plutonium-239 was detected in sediment at most stream and

four river locations. The maximum value was 1.82E-01 pCi/g—also at FM-A7. Uranium-234, 235, and 238 were detected at most locations.

The distribution and concentration of radionuclides in river sediment during 2006 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 confirm 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 2006 were detected as follows:

- tritium at two perimeter and one onsite location
- cesium-137 at eight perimeter locations
- strontium-89,90 at all 15 locations sampled
- uranium-234 at 11 locations (all the vegetation sampling sites except three perimeter locations and one offsite location)
- uranium-238 at 11 locations (all the vegetation sampling sites except three perimeter locations and one 25-mile location)
- plutonium-238 at one perimeter, one 25-mile, and at the 100-mile location
- americium-241 at six locations (four perimeter locations, one 25-mile location, and the Savannah location)

These results are similar to those of previous 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-two monitoring locations were designated on the trails to allow for continued monitoring at a consistent set of locations.

The 2005 survey was designated as a comprehensive survey (requiring extensive media sampling and analysis—as well as exposure rate measurements). Because of high water levels and the absence of suitable vegetation during the 2005, the comprehensive survey was rescheduled for 2006.

Analytical Results Summary

Because of high water levels and access difficulties, the 2006 survey could not be completed as planned. The full comprehensive survey now is scheduled to be conducted in 2007.

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,” provides some of the specific guidelines used in water quality surveillance, but because some of these guidelines are not quantifiable, they are not tracked.

Surveillance Results Summary (Table)

At every site, most water quality parameters and metals were detected in at least one sample. Only three samples had detectable pesticides/herbicides in 2006. These results continue to indicate that SRS discharges are not significantly affecting the water quality of the 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 2006 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.

Surveillance Results Summary (Table)

In 2006, 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 2006 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. 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 (Table)

In 2006, mercury analyses were performed on 159 fish from the Savannah River and 10 from the Edisto River at West Bank Landing. Concentrations of mercury generally were slightly lower than those observed in 2005, but similar to those of previous years. The highest concentrations were found in the Savannah River—in bass at Stokes Bluff Landing (2.14 µg/g), in catfish at Stokes Bluff Landing (9.76 µg/g), and in bream at Highway 17–A (1.00 µg/g).

River Water Quality Surveys

Description of Surveys

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

EPM conducted macroinvertebrate and diatom sampling during the spring and fall of 2006. The diatom slides were sent to ANS for archiving and processing of the 2006 spring collection. No adverse biological impacts were identified in the Savannah River diatom communities.

The number of macroinvertebrates collected from river traps during 2005 was similar to that documented in previous surveys: No adverse biological impacts were observed in the macroinvertebrate communities. Collections from 2006 will be sorted and archived during 2007.