Chapter 4

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 may 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 6, "Groundwater."

The Environmental Monitoring and Analysis group (EMA, formerly the Environmental Monitoring Section) of the Environmental Services Section (formerly the Environmental Protection Department) and the Savannah River Technology Center (SRTC) perform surveillance activities. 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 of Philadelphia (ANSP).

A complete description of the EMA 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, Volume 1 (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

EMS maintains a network of 17 sampling stations in and around SRS to monitor the concentration of tritium and radioactive particulate materials in the air.

Surveillance Results

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 beta results were slightly lower in 2002 than in 2001. However, they are consistent with historical results, which demonstrate a long-term variability.

No manmade gamma-emitting radionuclides were observed in 2002. These results are consistent with historical results, which indicate only a small number of samples with detectable activity.

Detectable alpha activity, primarily uranium isotopes, was observed at three offsite locations; 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 the lower limit of detection (LLD).

Tritium-in-air results for 2002 were similar to those observed in 2001. As in previous years, the Burial Ground North 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.

Rainwater

Description of Surveillance Program

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

Surveillance Results

Gamma Emitting Radionuclides Except at the Burial Ground North location, no detectable manmade gamma-emitting radionuclides were observed in rainwater samples in 2002.

Detectable cesium-137 was observed at Burial Ground North from May through November, with a maximum concentration of 1,180 pCi/m^2; this location showed a spike in May and June, then showed a fairly regular decrease to long-term historical levels. An Environmental Monitoring Section investigation showed a similar increase in both gross alpha and gross beta activity in rainwater; however, air particulate filter samples collected during this time indicated no unusual concentrations. The field station and the sampling equipment were checked for contamination, with negative results. Based on the investigation's inconclusive results, the reason for the observed increase in concentrations is unknown.

Except for the previously discussed Burial Ground North results, the gross alpha and gross beta results were consistent with those of 2001. Although the 2002 results generally were slightly lower than those of 2001, no long-term increasing or decreasing trend was evident. This implies that the observed values are natural background and does not indicate any contribution directly attributable to SRS.

The analysis of rain ion columns was expanded in 1999 to include uranium isotopes (uranium-234, uranium-235, uranium-238), americium-241, and curium-244—in addition to plutonium isotopes (plutonium-238 and plutonium-239). Except for U-234 and U-238 at several locations, all isotopes were below detection levels in 2002; generally, these concentrations were consistent with historical results.

As in 2001, no detectable levels of strontium-89,90 were observed in rainwater samples during 2002.

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. 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 network of thermoluminescent dosimeters (TLDs).

Surveillance Results

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.

In general, the 2002 ambient gamma radiation monitoring results indicated gamma exposure rates slightly lower than those observed at the same locations in 2001. However, these results generally are consistent with previously published historical results, and indicate that—except in the case of population centers—no significant difference in average exposure rates is observed between monitoring networks.

E-Area Stormwater Basins

Description of Surveillance Program

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

Surveillance Results

Because of dry conditions, no samples were obtained from the E–03 and E–06 locations in 2002. Because there are no active discharges to the E-Area stormwater basins, the primary contributor to seepage basin water is rainwater runoff. In 2002, the highest mean tritium concentration, 2.85E+05 pCi/L, was detected in E–05. This is the result of two tritium spikes caused by equipment failure that resulted in drainage from the nearby Four Mile Creek phytoremediation project. This concentration is similar to last year's high mean tritium concentration for the same location. Mean cobalt-60, cesium-137, and gross alpha concentrations all were below the minimum detectable concentrations (MDCs).

Site Streams

Description of Surveillance Program

Continuous surveillance is used on several SRS streams that monitor below process areas and that

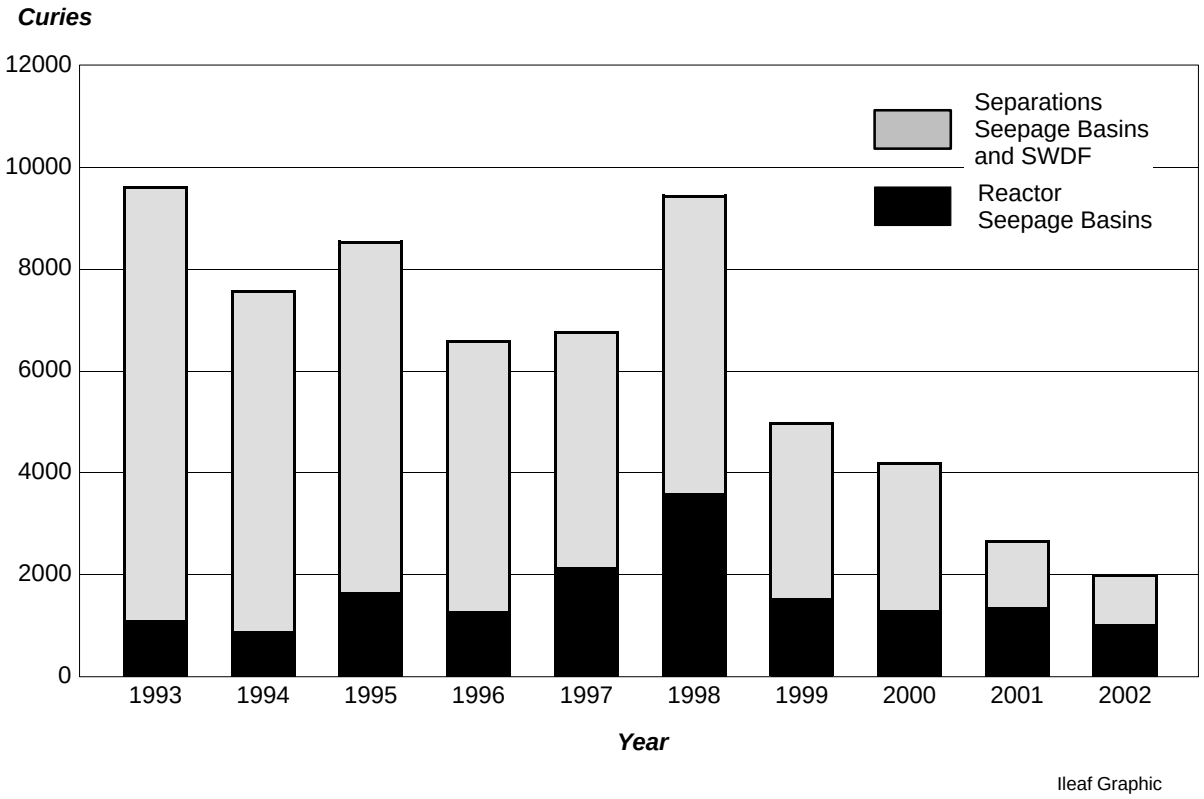

Figure 4–1 Tritium Migration from SRS Seepage Basins and SWDF to Site Streams, 1993–2002

serve to detect and quantify levels of radioactivity in liquid effluents being transported to the Savannah River.

Surveillance Results

The tritium, gross alpha, and gross beta mean concentrations increased at the U3R–1A control location in late 2001, and investigations were begun in an effort to determine the reason for the elevated concentrations. It was discovered that there had been an error in the analysis of tritium in 2001; as a result, the 2002 sample values were able to be reported correctly. The mean tritium concentration for 2002 was below the MDC.

The investigation into the gross alpha and gross beta results has proven inconclusive. No offsite activities that would affect sample results were identified, but additional water and sediment samples have been collected, and the investigation is continuing.

Mean 2002 gross alpha and gross beta concentrations at surveillance locations other than U3R–1A generally were consistent with historical data.

A technetium-99 measurement program begun in 2001 is still in the development stages in terms of establishing historical technetium-99 levels. During 2002, as in 2001, technetium-99 was detected at FM–2, FM–2B, and FM–A7.

Mean tritium concentrations at downstream locations were consistent with historical values.

Seepage Basin and Solid Waste Disposal Facility Radionuclide Migration

To incorporate the migration of radioactivity to site streams into total radioactive release quantities, EMS monitored and quantified the migration of radioactivity from site seepage basins and the Solid Waste Disposal Facility (SWDF) in 2002 as part of its stream surveillance program. During 2002, tritium, strontium-89,90, technetium-99, and cesium-137 were detected in migration releases. Measured iodine-129 results were not available from EMS and the value measured in 1996 was used for dose calculation.

Figure 4–1 is a graphical representation of releases of tritium via migration to site streams for the years 1993–2002. During 2002, the total quantity of tritium migrating from the seepage basins and SWDF was about 2,007 Ci, compared to 2,675 Ci in 2001. The decline is attributed to the continuing depletion and decay of the tritium inventory in the seepage basins.

F-Area and H-Area Seepage Basins and SWDF Radioactivity previously deposited in the F-Area and H-Area seepage basins and SWDF continues to migrate via the groundwater and to outcrop into Four Mile Creek and into Upper Three Runs.

Measured migration of tritium into Four Mile Creek in 2002 occurred as follows:

- from F-Area seepage basins, 226 Ci—a 20-percent decrease from the 2001 total of 284 Ci
- from H-Area seepage basin 4 and SWDF, 381 Ci—a seven-percent decrease from the 2001 total of 411 Ci
- from H-Area seepage basins 1, 2, and 3, 95 Ci—a 41-percent decrease from the 2001 total of 161 Ci

The measured migration from the north side of SWDF and the General Separations Area (GSA) into Upper Three Runs in 2002 was 275 Ci, a 42-percent decrease from the 2001 total of 470 Ci. (The GSA is in the central part of SRS and contains all waste disposal facilities, chemical separations facilities, 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 2002 was estimated to be 32.8 mCi—a 65-percent increase from the 2001 level of 20 mCi. Migration releases of strontium-89,90 vary from year to year but have remained below 75 mCi the past four years (see data table on CD accompanying this report).

In addition, a total of 20.7 mCi of cesium-137 was estimated to have migrated from the GSA seepage basins and SWDF in 2002. This was a decrease of 45 percent from the 2001 total of 37.5 mCi.

As discussed previously, iodine-129 was not measured in Four Mile Creek water samples during 2002. It was assumed that 78.2 mCi migrated from the GSA seepage basins in 2002. This was the amount last measured (during 1996).

A total of 29.4 mCi of technetium-99 was estimated to have migrated from the F-Area and H-Area seepage basins. This was a decrease of 36 percent from the 2001 total of 45.6 mCi.

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 2002 migration total of 853 Ci represents a 16-percent decrease from the 1,010 Ci recorded in 2001.

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.

No radionuclide migration was attributed to the C-Area and L-Area seepage basins in 2002. A total of 177 Ci of tritium migrated from the P-Area seepage basin during 2002, 43 percent less than the 309 Ci of tritium in 2001.

Transport of Actinides in Streams

Uranium, plutonium, americium, and curium are analyzed on an annual basis from each stream location. Values for 2002 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 below the point at which liquid discharges from Georgia Power Company's Vogtle Electric Generating Plant enter the river.

Surveillance Results

Tritium is the predominant radionuclide detected above background levels in the Savannah River. The annual mean tritium concentration at RM–118.8 in 2002 was about 5 percent of the drinking water standard.

The average gross alpha concentration at each river location was below the representative MDC in 2002.

Gross beta activities at all locations were slightly above the representative MDC for the analysis in 2002. Mean and maximum concentrations were similar at all locations, indicating that there was no significant release of beta-emitting nuclides attributable to SRS discharges.

The mean concentrations for cesium-137 and cobalt-60 were below their representative MDCs for analysis in 2002 at all Savannah River locations. The maximum concentration of cesium-137 at RM–118.8 was slightly above the representative MDC; cobalt was below the MDC. Activity levels for strontium-89,90 and for all actinides—including

isotopes of uranium and plutonium—fluctuated around their respective representative MDCs.

Tritium Transport in Streams and River

Tritium is introduced into SRS streams and the Savannah River from 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 total combined tritium releases in 2002 (direct discharges and migration from seepage basins and SWDF) were 3,096 Ci, compared to 4,423 Ci in 2001.

During 2002, the total tritium transport in SRS streams decreased by approximately 34 percent (from 4,320 Ci in 2001 to 2,857 Ci in 2002).

The 2002 measured tritium transport in the Savannah River (4,051 Ci) was more than the stream transport total. Most of this difference is attributed to Plant Vogtle's 2002 tritium releases, which totaled 1,700 Ci.

SRS tritium transport data for 1960–2002 are depicted in figure 4–2, which shows summaries of the past 43 years of direct releases, stream transport, and river transport determined by EMS.

General agreement between the three calculational methods of annual tritium transport—measurements at the source, stream transport, and river transport—serves to validate SRS sampling schemes and counting results. Differences between the various methods can be attributed to uncertainties arising in the collection and analytical processes, including the determination of water flow rates and of varying transport times.

Drinking Water

Description of Surveillance Program

EMS collected drinking water samples in 2002 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 drinking 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. Collected monthly off site were composite samples from

- two water treatment plants downriver of SRS that supply treated Savannah River water to Beaufort and Jasper counties in South Carolina and to Port Wentworth, Georgia
- the North Augusta (South Carolina) Water Treatment Plant

Surveillance Results

All drinking water samples collected by EMS were screened for gross alpha and gross beta concentrations to determine if activity levels warrant further analysis. No samples collected in 2002 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 drinking water samples collected and analyzed by EMS in 2002 exceeded the 2.00E+04-pCi/L EPA tritium limit, and no drinking water samples collected and analyzed by EMS for strontium 89,90 in 2002 exceeded the 1.40E+00-pCi/L representative MDC.

No cobalt-60, cesium-137, or plutonium-239 were detected in any drinking water samples collected during 2002. Samples from some locations showed detectable levels of uranium isotopes, plutonium-238, and/or americium-241.

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.

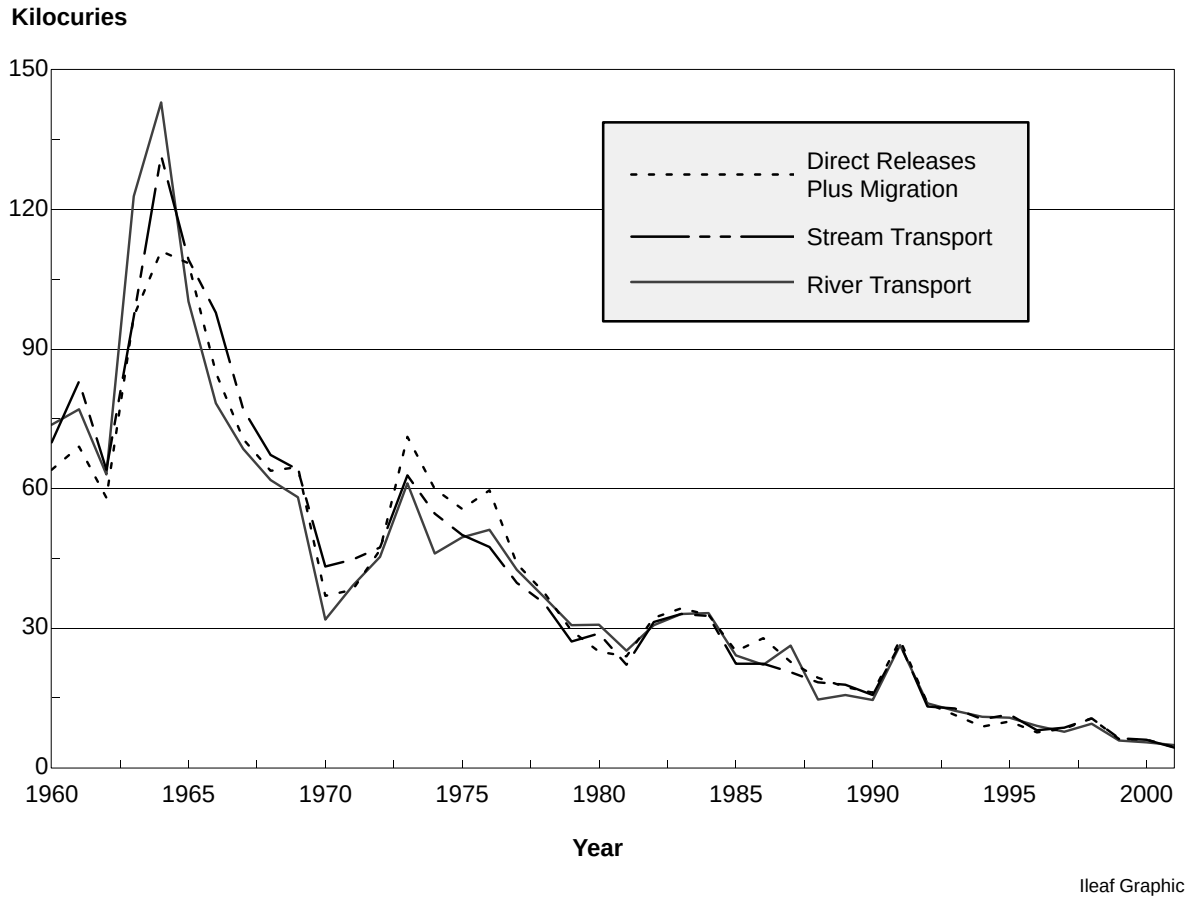

Figure 4–2 SRS Tritium Transport Summary, 1960–2002

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 stopped 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.

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.

Food samples are analyzed for the presence of gamma-emitting radionuclides, tritium, strontium-89,90, plutonium-238, and plutonium 239.

Surveillance Results

The only manmade gamma-emitting radionuclide detected in food products other than milk in 2002 was cesium-137, which was found in collards from three sampling locations. Strontium-89,90 was detected in collards from one location, while tritium was detected in fruit and milk at all locations. No other radionuclides were detected in food products.

Tritium in milk and other samples is attributed primarily to releases from SRS. Tritium concentrations in fruit and milk were similar to those of previous years. No tritium was detected in any other food sample.

These results are similar to those 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 and

nine are located on site. Because of drought conditions, samples were able to be collected at only four of the onsite locations.

Surveillance Results

Cesium-137 was the only manmade gamma-emitting radionuclide found in Savannah River edible composites. Strontium-89,90 and tritium were detected at most of the river locations. No manmade radionuclides above the MDC were found in saltwater fish or shellfish. These results 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, EMA uses portable sodium iodide detectors to perform field analysis 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.

Surveillance Results

A total of 1,316 deer and 168 feral hogs were taken during the 2002 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 approximately 1 pCi/g to 28 pCi/g, while lab measurements ranged from approximately 1 pCi/g to 26 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. Lab measurements of strontium-89,90 ranged from a high of 10.6 pCi/g to a low of 3.96 pCi/g—both in bone samples.

Turkeys/Beavers

Description of Surveillance Programs

Wild turkeys have been trapped on site by the South Carolina Wildlife and Marine Resources Department and used to repopulate game areas in South Carolina and other states. The U.S. Department of Agriculture Forest Service–Savannah River harvests beavers in selected areas within the SRS perimeter to reduce the beaver 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. However, both programs were inactive in 2002 because of reduced needs.

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.

Soil samples are collected from four onsite locations, four site perimeter locations and two offsite locations.

Surveillance Results

Radionuclides in soil samples from 2002 were detected as follows:

- Cesium-137 at eight locations (on site/perimeter/off site)
- Uranium-234, 235, and 238 at all locations
- Plutonium-238 at three onsite locations
- Plutonium-239 at eight locations (on site/perimeter/off site)
- Americium-241 at one onsite location and off site in Savannah
- Curium-244 only in Savannah

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, EMS uses TSS results—gathered as part of the routine National Pollutant Discharge Elimination System monitoring program—from outfalls co-located at or near radiological effluent points. If an outfall shows that TSS levels regularly are greater than 40 ppm, a radioactivity-levels-in-settleable-solids program and an increase in sediment monitoring would be implemented.

Surveillance Results

During 2002, only one TSS sample exceeded 40 ppm. The sample—collected from outfall H–02 (effluent sample point HP–15)—showed 103 ppm.

An investigation into the cause of this H–02 concentration determined that a construction accident had damaged a domestic water line, causing the elevated reading. A TSS sample had been collected the previous week with a result of 1 ppm. Four samples were collected the week after the 103–ppm reading—each with a TSS result of less than 2 ppm. An examination of the H–02 results for 2002 indicated that

- the annual mean—including the 103-ppm value—was 6 ppm, considerably lower than the 40-ppm compliance limit
- no other TSS results were greater than 2 ppm

Based on these findings, it was determined that the monitoring of radioactivity levels in settleable solids was not required at H–02.

Overall, the TSS results indicate that SRS is 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 locations and 13 site stream locations in 2002.

Surveillance Results

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, 4.37E+02 pCi/g, was detected in sediment from R-Canal. The highest level found on the river, 2.27E+00 pCi/g, was at the mouth of Lower Three Runs; the lowest levels were below the MDC 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 above the MDC in sediment from the following locations:

- Four Mile Creek Swamp Discharge
- Four Mile A–7A
- R-Canal

The highest Cobalt-60 concentration, 6.47E–01 pCi/g, was measured at R-Canal; concentrations at the other sediment sampling locations were below the MDC.

Concentrations of strontium-89,90 in sediment ranged from a high of 3.73 E+00 pCi/g at the FM–A7 location to lows below the MDC at most of the other locations.

Concentrations of plutonium-238 in sediment during 2002 ranged from a high of 8.22E–01 pCi/g at the Four Mile A–7A location to lows below the MDC at several locations. Concentrations of plutonium-239 ranged from a high of 3.53E–01 pCi/g at the Four Mile 2 location to lows below the MDC at several locations. Uranium-234,238 was detected at all locations, and uranium-235 at all except one location.

Concentrations of radionuclides in river sediment during 2002 were similar to those of previous years. As expected, concentrations of all isotopes in streams generally were higher than concentrations in the river. 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 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

Surveillance Results

Radionuclides in the grassy vegetation samples collected from 2002 were detected as follows:

- Tritium at three onsite locations and offsite at Savannah
- Cesium-137 (the only manmade gamma-emitting radionuclide detected) at two onsite locations
- Strontium-90 at all locations except for one offsite location
- Uranium-234 at the Burial Ground and uranium-238 at several locations
- Plutonium-239 at the 25-mile radius 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 the southeast portion 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.

Details – 2002 Survey

A cursory survey was conducted May through August 2002. Cursory surveys provide assurance that conditions observed during the more detailed comprehensive surveys have not changed significantly. During cursory surveys, soil and vegetation samples are collected from one location per trail—typically at or near the area of highest observed activity.

Analytical Results

All 2002 survey samples were analyzed for gamma-emitting radionuclides and total strontium. As anticipated, based on source term information and historical survey results, cesium-137 was the primary radionuclide detected in all the soil and vegetation samples. Also, total strontium was present at low concentrations in four vegetation samples.

These concentrations are consistent with historical results, although the range of concentrations was not as great. In general, higher levels of cesium-137 in soil were observed in the trails closest to the SRS boundary. As observed in previous surveys, the vertical distribution profile in soil—that is, the variation of contaminant concentration with depth in a soil column—is not as pronounced in the swamp, where significant scouring and/or deposition is possible, as it is in areas of undisturbed soil.

Thermoluminescent dosimeter (TLD) sets were placed at 53 of 54 monitoring sites to determine ambient gamma exposure rates. Fifty-two of the 53 sets were retrieved from the swamp; the exposure time varied from 51 to 83 days. The gamma exposure rate ranged from 0.16 to 0.58 mrem/day, which is consistent with the range observed in the 2001 survey.

The highest exposure rates were measured on trails 1, 4, and 5. This follows the trends observed in previous surveys. Because of the limited scope of soil sampling, correlations between gamma exposure rate and cesium-137 concentrations in soil could not be examined.

Conclusion

Results of the 2002 survey of the Savannah River Swamp generally were consistent with those observed in previous surveys. Over time, some changes in the spatial distribution of activity

throughout the swamp have been observed, which means that some localized movement of activity may be occurring.

Nonradiological Surveillance

Air

SRS currently does not conduct onsite surveillance for nonradiological ambient air quality. However, to ensure compliance with SCDHEC air quality regulations and standards, SRTC conducted air dispersion modeling for all site sources of criteria pollutants and toxic air pollutants in 1993. 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 as "Freshwaters" by SCDHEC. Freshwaters 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

Analyses of the surface water data 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 15 small drinking water facilities that serve populations of fewer than 25 persons.

Surveillance Results

All samples collected from SRS drinking water systems during 2002 were in compliance with SCDHEC and EPA water quality limits (maximum contaminant levels).

Sediment

EMA's nonradiological sediment surveillance program provides a method of determining the deposition, movement, and accumulation of nonradiological contaminants in stream systems.

Surveillance Results

In 2002, as in the previous 6 years, no pesticides or herbicides were found to be above the quantitation limits in sediment samples. Because of an administrative error, no metals analyses were conducted during 2002.

Fish

EMA analyzes the flesh of fish caught from onsite streams and ponds and from the Savannah River to determine concentrations of mercury in the fish. The fish analyzed represent the most common edible species of fish in the Central Savannah River Area (freshwater) and at the mouth of the Savannah River (saltwater).

Surveillance Results

In 2002, 175 fish were caught from SRS streams and ponds and the Savannah River and analyzed for mercury. Because of low water, no fish were caught from the Pen Branch–3, Four Mile Creek–6, Steel Creek–4, Upper Three Runs–4, Lower Three Runs, and Beaver Dam Creek locations.

Concentrations of mercury contained in fish samples from 2002 were similar to those of previous years.

Academy of Natural Sciences of Philadelphia River Quality Surveys

Description of Surveys

ANSP has conducted biological and water quality surveys of the Savannah River since 1951. The surveys are 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

Samples were collected for the 2001 survey and are scheduled to be analyzed by ANSP in 2003. No surveys were conducted by ANSP in 2002 because no contract was in place; SRS personnel, however, collected and archived diatoms (monthly) and macroinvertebrates (twice during the year), as has been customary. These (2002) samples will be archived but will be analyzed only if the 2001 analysis results are statistically different from those of previous years. ANSP is expected to conduct limited river studies during 2003.