CHAPTER 12.2

RADIONUCLIDES IN SOIL

ABSTRACT

During the period of greatest atmospheric releases at the Savannah River Site (SRS), from 1955 through the late 1960s, soil sampling and analysis were not routinely performed. A few special surveys performed between 1958 and 1970 are reported in this section, but methods for soil sampling and analysis were not standardized throughout the weapons complex until the early 1970s. *Radiological Assessments Corporation (RAC)* concludes that detailed analysis of soil radionuclide concentrations is not warranted because

(a) Data are not available for the early years
(b) It is not feasible to distinguish, using soil concentration data from the early years between radionuclides released from the Site and atmospheric weapons test fallout.
(c) The uncertainties involved in the use of soil concentration data to reconstruct doses to individuals living offsite are too large to allow useful dose reconstruction.

This section of the Phase II report summarizes the evidence indicating that soils data were not regularly collected during the years before 1970 and presents the limited special soil survey data *RAC* discovered for that period. We present summaries of documents found during the document search and extract and tabulate data of value. The summaries are organized by publication or memo date, beginning with the earliest reports found.

SUMMARIES OF DOCUMENTS RELATED TO SRS SOIL SAMPLING AND RADIONUCLIDE ANALYSIS

An internal SRS paper, Evans and Fenimore (1960), is one of the earliest *RAC*-discovered papers noting soil contamination. The contamination reported was entirely onsite and is not of value for dose reconstruction. Evans and Fenimore (1960) note that in November 1957, an experimental fuel element failed during calorimeter tests; as a result, an estimated 15,000 to 20,000 Ci of fission products was released to the emergency basin in Building 105-R. To minimize the release of activity to the Lower Three Runs Creek-Savannah River System, seepage basins were excavated in an abandoned construction area north of the reactor building, and the emergency basin water was pumped into these basins. About 2 years later, in December 1959, radioactive vegetation was discovered growing in the seepage basin area. The routine survey program, initiated by the Health Physics Section in January 1958, was expanded to determine the extent of spread of radioactivity around the basin system and to establish the cause of migration of radioactivity from the basins into surrounding soil strata and groundwater.

Analysis of vegetation from the seepage basin area indicated that deep-rooted plants had assimilated radioactivity from the soil. Highly radioactive vegetation was confined to the immediate vicinity of backfilled Basin 1 and an abandoned construction sewer line. Lower levels of radioactivity in vegetation were detected over a wider area south of Basin 1. The major soil contamination was confined to the Basin 1 and sewer line area. The movement of radioactivity in groundwater was more rapid in the sandy soils surrounding Basins 1 and 3 than in the clay strata

enveloping the remainder of the basins. Animal specimens collected near the basin system and in R-Area showed an uptake of radioactivity (Evans and Fenimore 1960).

Subsurface surveys were conducted by hand auguring 49 test wells. Soil samples were collected for laboratory analysis at 1-ft intervals during the drilling, and the radiation levels in the wells were determined with a gamma scintillometer. Samples less than 150 counts per minute, as surveyed with a Thyac, were discarded (laboratory analysis capability was limited at the time). The maximum concentration detected in soil from the 26 wells and samples laboratory-analyzed was 1100×10^{-9} Ci g^{-1} nonvolatile beta, dry weight analysis. The range was from 0.05 to 1100×10^{-9} Ci g^{-1}. The results indicate (per the SRS investigators) that the migration of gross quantities of radioactivity from the seepage basin system was limited. The areas of maximum contamination were confined to the soil immediately adjacent to Basin 1 and to the soil surrounding the abandoned construction sewer line (Evans and Fenimore 1960).

For the purposes of dose reconstruction based on soil contamination, these data are not of value because there is no indication in this report of soil concentrations offsite potentially exposing the public. The measurements presented are all associated with soil (and other) contamination well inside the SRS boundary, near the R-Reactor area.

H.A. McClearen (1974b) notes that the program to measure plutonium in soils was "intensified" at the Savannah River Plant (SRP) in 1972. It indicated Site perimeter and offsite soil plutonium levels of approximately 2 mCi km^{-2}. This value is the result of a 1973 soil monitoring survey. McClearen states that this average is "well within the range of deposition noted in the southeastern United States…," from atmospheric weapons testing. Health and Safety Laboratory measurements elsewhere in the country are cited to support this conclusion. The paper notes that "Measurement of releases at the emission point shows that 0.6 Ci of ^{238}Pu and 2.9 Ci of ^{239}Pu have been released since startup in 1955."

The study reported by McClearen (1974a) involved an initial onsite/offsite survey of seven, 10-core samples driven to 30-cm depth and analyzed in increments to determine depth and locations to sample in later studies. Most plutonium was found in the top 15 cm of the soil column. These results are listed in Table 12.2-1.

Table 12.2-1. Results of Initial 1973 Onsite and Offsite Soil Analyses for Plutonium[a]

Sample location	Plutonium deposition (mCi km^{-2})	
	^{239}Pu	^{238}Pu
Plant perimeter:		
NW quadrant	1.61	0.21
NE quadrant	1.37	0.08
SE quadrant	1.09	0.07
SW quadrant	1.28	0.07
Distant locations:		
Clinton, SC	1.81	0.08
Athens, GA	1.72	0.21
Savannah, GA	1.70	0.05

[a] Source: McClearen (1974a).

The study's second phase involved additional samples, all taken onsite, and located to characterize soils contaminated during two known plutonium release periods. The first of these

periods involved ^{239}Pu releases during reprocessing facility startup in 1955; the second involved ^{238}Pu releases in April 1969, after failure of the sand filter in H-Area. Wind data for those time periods were used to select sampling locations.

The 1973 results showed the influence of F-Area (10 samples) and H-Area (8 samples) on ^{239}Pu levels close to the facilities (F-Area data range: 3.2–26.2 mCi km^{-2} to 15-cm depth; H-Area range: 1.99–46.4 mCi km^{-2}). Close-in influence of the reprocessing areas was also evident for ^{238}Pu (F-Area range: 0.23–22.2 mCi km^{-2}; H-Area range: 0.59–91 mCi km^{-2}) (McClearen 1974a). For 26 other onsite samples taken more distant from the reprocessing facilities but inside the plant perimeter, results ranged from 1.26–2.99 mCi km^{-2} for ^{239}Pu and from <0.09–0.09 mCi km^{-2} for ^{238}Pu. These values approach those seen at the perimeter and offsite in the initial study and as reported by the Health and Safety Laboratory. McClearen (1974a) indicated minimal Site influence on offsite soil plutonium concentrations; however, releases from the two reprocessing facilities were clearly evident near the two facilities onsite.

Marter (1970) states, "Early in 1970, probably as a result of the fire at Rocky Flats, the AEC requested that soil samples from the environs of the Savannah River Plant be analyzed for plutonium. Soil analysis is not normally part of the routine environmental monitoring program at SRP, because the sampling and analysis of soils is considered to be an unreliable technique for determining deposited radioactivity." The Atomic Energy Commission (AEC) request prompted the development of sampling and analysis techniques and a series of SRS soil analyses. Marter (1970) summarized the results as follows: "No plutonium of SRP origin was detectable in soil samples from the plant perimeter and beyond. The measured plutonium activity in these samples, i.e., 0.07 d/m/g at plant perimeter, 0.05 d/m/g at 49 km, and 0.13 d/m/g at 60 km, is well below the range of 0.20 to 0.42 d/m/g predicted from global fallout. Dispersion calculations of deposition from SRP stacks at the plant perimeter (0.01 d/m/g) and at 30 km (0.001 dpm/g) confirm that the plant deposition off-site will be obscured and indistinguishable from global fallout because of the variability of global fallout and uncontrolled variables in obtaining representative soil samples."

Marter (1970) notes that deposition pans were installed in 1962 and were located at all onplant and offplant air monitoring stations as far as 25 mi away. Marter (1970) states that, "Deposition data are not available for the period from startup through 1962, a period during which 2.8 Ci of the total of 3.5 Ci (of plutonium) was released." Table 12.2-2 presents a summary of deposition pan data for the period 1963–1969, extracted from Marter (1970). Isotopic analyses were insufficient to make conclusions concerning plutonium versus other alpha emitter concentrations or perimeter versus offsite comparisons.

Table 12.2-2. Alpha Activity Deposited on 2 × 2-ft Pans Located at All SRS Air Monitoring Stations[a] Total alpha deposited, 1963–1969

Location	pCi m^{-2}	d/m/g of soil
F-Area	2310	0.40
H-Area	675	0.12
Plant perimeter stations	475	0.08
25-mi radius stations	390	0.07

[a] Source: Marter (1970).

During January 1970, soil was sampled from 12 onsite and two offsite locations. Results of the analyses are presented in Table 12.2-3, extracted from (Marter 1970).

Table 12.2-3. January 1970 Soil Analysis Results, SRS Onsite and Offsite[a]

Sample location	Plutonium in top centimeter of soil (d/m/g)
F-Area	
North	0.06 +/- 0.009
East	0.13 +/- 0.004
South	0.64 +/- 0.18
West	0.53 +/- 0.18
H-Area	
North	2.64 +/- 0.40
East	0.32 +/- 0.10
South	0.06 +/- 0.004
West	0.47 +/- 0.018
P-Area	
North	0.06 +/- 0.005
East	0.09 +/- 0.007
South	0.10 +/- 0.007
West	0.05 +/- 0.002
Fort Gordon, Georgia	0.05 +/-0.002
Bamberg, South Carolina	0.13 +/- 0.003

[a] Source: Marter (1970).

Marter concludes that SRS-released plutonium was indistinguishable offsite, obscured by fallout-deposited plutonium. The same SRS Phase II Database document also contains draft and handwritten versions of the reports noted above, including handwritten memos, data sheets, and data analysis sheets supporting the summaries in the previous tables. A handwritten note, probably from Ben Rusche to C. Patterson (Rusche 1973), mentions that "The variation of $^{238}Pu/^{239}Pu$ with distance suggest(s) that some of the Pu originated form SRP operations." Rusche suggests further analysis of samples to examine this question.

Another memo was written by J. E. Johnson (Johnson 1973). It confirms that "Soil sampling and analyses have not been a part of the routine SRP environmental monitoring program." Johnson presents the results of a few special soil surveys at SRS from 1958 through 1972. Some of these data are already reported previously in this section. The first survey noted by Johnson analyzed soil for ^{90}Sr in a number of onsite and offsite locations. Johnson (1973) states that "No evidence was found of plant [SRS] contribution." Table 12.2-4 presents those results.

Johnson also describes a 1967 study in which soils were collected along six traverses from the separations areas out to about 50 mi and analyzed for natural radioactivity, ^{90}Sr, and gamma-emitting radionuclides. He notes that "A possible slight contribution of cerium-144 was noted near the Separations Areas." Table 12.2-5 presents the results of that study.

Table 12.2-4. Comparison of ^{90}Sr in Top 20 cm of Soil (1958 versus 1967)[a]

Location	× 10^{-6} μCi g^{-1} 1958	1967
F-Area	0.124	0.215
H-Area	-	0.230
Plant inner	0.105	0.268
Plant outer	0.150	0.268
25-mi radius	0.171	0.310

[a] Source: Johnson (1973).

Table 12.2-5. Soil Radioactivity Levels per 1967 SRP Study; Transects Out to 50 Miles[a]

Element	Month	Depth (cm)	Radioactivity in soil (× 10^{-6} μCi g^{-1}) F-Area	H-Area	Plant inner	Plant outer	25-mi radius	50-mi radius
^{90}Sr	January	0–5	0.300	0.350	0.300	0.410		
		5–10	0.130	0.110	0.130	0.110		
	September	0–5				0.390	0.450	0.720
		5–10				0.160	0.170	0.250
^{137}Cs	January	0–5	1.000	0.820	1.030	0.800		
		5–10	0.230	0.090	0.280	0.220		
	September	0–5				1.070	1.120	1.610
		5–10				0.170	0.150	0.220
^{144}Ce	January	0–5	0.820	0.630	0.580	0.540		
		5–10	0.370	0.370	0.370	0.310		
	September	0–5				0.500	0.560	0.510
		5–10				0.240	0.220	0.190
Thorium	January	0–5	0.480	0.590	0.480	0.380		
		5–10	0.460	0.570	0.460	0.390		
	September	0–5				0.380	0.320	0.310
		5–10				0.360	0.300	0.270
Uranium	January	0–5	1.530	1.800	1.560	1.400		
		5–10	1.410	1.850	1.450	1.400		
	September	0–5				1.040	1.320	1.660
		5–10				1.120	1.190	1.500

[a] Source: Johnson (1973).

Johnson notes that, as of 1973, a laboratory had been dedicated to soils analysis, and the necessary field and laboratory equipment had been purchased or fabricated. He states that "Adequate cores will be collected on-plant and off-plant to determine the distribution of plutonium with soil depth and to inventory the ^{238}Pu and ^{239}Pu in the SRP environment… This work will be continued until we have a satisfactory inventory of plutonium in the plant and environs. Following this or toward the end of routine soil assays we will inaugurate a fallout collection program to assess and audit plutonium additions to the environs."

Johnson (1973) also reports a more detailed version of the 1970 plutonium-in-soil results presented earlier, shown in Table 12.2-6.

Table 12.2-6. Onsite and Offsite Soil Survey of Plutonium in Top 1 cm of Soil (1970)[a]

Location	Total plutonium ($\times 10^{-6}$ μCi g^{-1})	^{239,240}Pu ($\times 10^{-6}$ μCi g^{-1})	^{238}Pu ($\times 10^{-6}$μCi g^{-1})	Alpha % ^{239,240}Pu	Alpha % ^{238}Pu
Fort Gordon	0.0214	0.0197	0.0017	92.09	7.91
Bamberg	0.0603	0.0571	0.0032	94.64	5.36
F-Area					
North	0.0245	0.0163	0.0082	69.57	30.43
East	0.0581	0.0448	0.0131	77.36	22.64
South	0.2888	0,2600	0.0287	90.04	9.96
West	0.2392	0.1588	0.0804	66.60	33.40
H-Area					
North	1.1882	0.8193	0.3689	68.97	31.03
East	0.1454	0.0622	0.0833	42.78	57.22
South	0.0262	0.0136	0.0127	51.92	48.08
West	0.2107	0.0734	0.1374	34.78	65.22
P-Area					
North	0.0260	0.0195	0.0065	76.71	23.29
East	0.0394	0.0364	0.0031	92.49	7.51
South	0.0450	0.0407	0.0040	90.82	9.18
West	0.0203	0.0174	0.0033	84.71	15.29

[a] Source: Johnson (1973).

Johnson (1973) presents the results of a 1972 survey of ^{238}Pu, ^{239}Pu, ^{137}Cs, and ^{40}K in soil, at the plant perimeter, 25-mi radius, and 50-mi radius. Table 12.2-7 summarizes the maximum, minimum, and average values for the seven sets of soil samples analyzed at seven locations around the Site perimeter and each of the two circles at 25 and 50 mi. An attached note from H. McLendon (1973) states that five cores were extracted and composited at each location then dried and analyzed in the SRS laboratory.

Table 12.2-7. SRS Radionuclide Survey at the Perimeter and Two Radii Offsite (1972)[a]

	Radioactivity in soil at 9-cm depth ($\times 10^{-6}$ μCi g^{-1} [dry weight])								
	Plant perimeter			25-mile radius			50-mile radius		
Nuclide	Max	Min	Average	Max	Min	Average	Max	Min	Average
^{238}Pu	0.046	ND[b]	0.0068	0.0090	0.0004	0.0018	0.0036	0.0001	0.0009
^{239}Pu	0.035	0.002	0.0131	0.0189	0.0054	0.0120	0.0490	0.0027	0.0155
^{137}Cs	3.50	<0.05	0.79	3.01	<0.03	0.07	1.66	<0.03	0.54
^{40}K	6.5	<0.5	1.8	0.8	<0.6	<0.6	<0.7	<0.5	<0.6

[a] Source: Johnson (1973).
[b] ND = not detectable.

A memo written by S. L. Hoeffner evaluates the effect of water and soil quality variables on the sorption of ^{60}Co on SRP soils (Hoeffner 1984). The pH was a major factor influencing cobalt sorption, as indicated by the ^{60}Co distribution coefficient, Kd. The Kd ranged from 2 to more than 10,000 mL g^{-1} over a pH range of 2 to 9. Decreases in cobalt sorption that occur with elevated levels of Mg^{2+}, Ca^{2+}, or K^{+} are the result of accompanying small decreases in pH. The ions Na^{+}, Cl^{-}, and NO_3^{-} had no effect on cobalt sorption. Changes in cobalt sorption with soil clay content also were caused by changes in pH.

Hoeffner (1984) notes that ^{60}Co is a major radionuclide in the SRP burial ground. As of 1982, about 540,000 Ci of ^{60}Co were buried in the trenches. Hoeffner (1984) notes that low concentrations of ^{60}Co have been detected in groundwater monitoring wells and that laboratory studies that give a basic understanding of the factors influencing cobalt migration in the SRP burial ground have not been available before this work. The paper notes that ^{60}Co was found in 1 of 20 groundwater wells, at 13 pCi L^{-1}, and that most ^{60}Co remains at the bottom of the burial trenches.

An SRS internal paper (Arnett 1993) summarizes radioactivity in soil data collected by SRS. Table 12.2-8 summarizes these data.

A large set (6 ft^3) of environmental monitoring database printouts was found during the *RAC* Phase II dose reconstruction record search (Du Pont XX). We also found a computer data tape possibly containing the same information found on the printouts. SRS staff were unable to decode the data tape over several months of intermittent effort by various groups. The information from the printed monthly report tables has been used by *RAC* to provide SRS environmental monitoring and release data for a number of locations and years. Only a small quantity of soil concentration data is available on the printouts, however, and only a fraction of that information pertains to offsite monitoring. Onsite soil concentration data were often presented for F-Area, H-Area, and other onsite areas, but the onsite soil data are not of value for offsite dose reconstruction. Table 12.2-9 summarizes the offsite data from the printouts.

Carlton et al. (1992) collects and summarizes available data related to plutonium in the SRS environment onsite and offsite. While the sections related to releases and environmental monitoring are generally large and varied, only one-half a page of information is provided concerning plutonium soil sampling. Carlton et al. (1992) states that "The amount of ^{238}Pu and ^{239}Pu in the top 8 cm of soil has been measured at the same sampling sites since 1974…. Since the great majority of ^{239}Pu was released in a single year, 1955, and the majority of ^{238}Pu was released in 1969, the soil deposition actually is almost entirely a measure of deposition during the years of the greatest releases…. Therefore, the measurements do not show the steady accumulation of plutonium isotopes in the soil that would be expected if a steady accumulation had taken place over the period of measurement." Three figures summarize the influence of the SRS reprocessing canyons on plutonium in the environment and clearly show decreasing concentration in soil with distance from the canyons. Carlton et al. (1992) presents no data on offsite concentrations of plutonium.

Table 12.2-8. Radioactivity in Soil pCi g^{-1} (± 1 sigma) Dry Weight (0–8 cm depth)[a]

Location	^{90}Sr	^{137}Cs	^{238}Pu	^{239}Pu
F-Area				
2000 ft east	(1.21 ± 1.84)E-02	(5.54±0.37)E-01	(2.70 ± 0.10)E-01	(3.27±0.11)E-01
2000 ft west	(1.54 ± 1.75)E-02	(7.19±0.40)E-01	(4.03 ± 0.14)E-01	(2.92±0.11)E-01
2000 ft north	(1.99 ± 1.82)E-02	(1.05±0.05)E+00	(3.55 ± 0.29)E-02	(5.31±0.14)E-01
2000 ft south	(2.16 ± 1.82)E-02	(2.4±20.42)E-01	(6.45 ± 0.82)E-03	(8.11±0.92)E-03
H-Area				
2000 ft east	(0.09 ±1.63)E-02	(8.22 ±0.42)E-01	(1.42 ± 0.04)E-02	(5.54 ± 0.23)E-02
2000 ft west	(1.87 ±1.67)E-02	(2.31 ± 0.27)E-01	(5.33 ± 1.30)E-03	(1.65 ± 0.22)E-02
2000 ft north	(0.72 ±1.63)E-02	(7.72 ± 2.42)E-02	(1.97 ± 0.50)E-03	(4.85 ± 0.75)E-03
2000 ft south	(2.89 ±1.83)E-02	(1.32 ±0.05)E+00	(2.13 ± 0.16)E-02	(4.09 ± 0.21)E-02
S-Area				
#1	(0.02±1.77)E-02	(7.60 ± 0.42)E-01	(1.54 ± 0.18)E-02	(7.32 ± 0.41)E-02
#2	(0.25±1.14)E-02		(1.33 ± 0.44)E-03	(3.53 ± 0.63)E-03
#3	(1.27±1.87)E-02	(2.58 ± 0.27)E-01	(3.84 ± 0.19)E-02	(3.44 ± 0.18)E-02
#4	(2.21±1.81)E-02	(1.35 ± 0.28)E-01	(5.17 ± 2.07)E-04	(1.37 ± 0.29)E-03
Z-Area				
#1	(0.89±1.44)E-02	(6.15 ±1.95)E-02	(1.14 ± 0.51)E-03	(3.84 ± 1.04)E-03
#3	(0.78±1.45)E-02	(3.24 ± 0.36)E-01	(2.66 ± 0.45)E-03	(1.56 ± 0.11)E-02
#5	(2.44±1.63)E-02	(6.65 ± 0.44)E-01	(8.81 ± 0.88)E-03	(5.36 ± 0.24)E-02
#7	(1.01±1.65)E-02	(4.76 ± 0.36)E-01	(8.77 ± 1.42)E-03	(8.49 ± 0.47)E-02
Site perimeter				
NE quadrant	(2.88 ± 2.00)E-02	(4.31 ± 0.36)E-01	(4.75±3.39)E-04	(1.36 ± 0.12)E-02
NW quadrant	(1.52 ± 1.90)E-02	(4.84 ± 0.38)E-01	(6.08±3.48)E-04	(4.46 ± 0.85)E-03
SE quadrant	(0.34 ± 1.89)E-02	(3.01 ± 0.24)E-01	(1.61±0.70)E-03	(9.30 ± 1.44)E-03
SW quadrant	(1.50 ± 1.89)E-02	(4.65 ± 0.38)E-01	(2.19±1.01)E-03	(1.78 ± 0.25)E-02
100-mi radius				
Clinton, SC	(1.46 ± 1.79)E-02	0/1[b]	(2.34±1.64)E-04	(4.74 ± 0.56)E-03
Savannah, GA	(1.19 ± 1.65)E-02	0/1	(1.12±7.25)E-04	(1.93 ± 0.23)E-02

[a] Source: Arnett (1983).

[b] The gamma analysis package currently used by Environmental Monitoring does not force an activity determination if a threshold setting is not met. For these reported radionuclides, "No. of Samples" is displayed as "number with activities quantified/number of samples counted". Only the numbers quantified are used in the max, min, and mean generation.

Table 12.2-9. Soil Sample Analysis Results from Environmental Data Printouts

Date collected	Location[a]	Radionuclide	pCi g^{-1} Avg.	Reference
3/1/85	Savannah	^{90}Sr	0.06	KRM1997101325
5/18/87	PP NE	^{238}Pu	0	KRM1997101329
5/18/87	PP NW	^{238}Pu	0	“
5/18/87	PP SE	^{238}Pu	0	“
5/18/87	PP SW	^{238}Pu	0.02	“
5/8/87	Clinton	^{238}Pu	0	“
5/8/87	Savannah	^{238}Pu	0	“
5/18/87	PP NE	^{239}Pu	0.01	“
5/18/87	PP NW	^{239}Pu	0.01	“
5/18/87	PP SE	^{239}Pu	0.02	“
5/18/87	PP SW	^{239}Pu	0.01	“
5/8/87	Clinton	^{239}Pu	0.02	“
5/8/87	Savannah	^{239}Pu	0.01	“
5/8/87	Clinton	^{40}K	3.18	“
5/8/87	Savannah	^{40}K	0	“
5/8/87	Clinton	^{137}Cs	54	“
5/8/87	Savannah	^{137}Cs	33	“
5/5/88	PP NE	^{238}Pu	0	KRM1997101331
5/5/88	PP NW	^{238}Pu	0.01	“
5/5/88	PP SW	^{238}Pu	0	“
5/5/88	PP NE	^{239}Pu	0.01	“
5/5/88	PP NW	^{239}Pu	0.02	“
5/5/88	PP SW	^{239}Pu	0.02	“
5/5/88	PP NE	^{90}Sr	0.01	“
5/5/88	PP NW	^{90}Sr	0.02	“
5/5/88	PP SE	^{90}Sr	0.02	“
5/5/88	PP SW	^{90}Sr	0.02	“
5/5/88	Clinton	^{90}Sr	0.05	“
5/5/88	Savannah	^{90}Sr	0	“
5/18/89	PP NE	^{238}Pu	0.01	HRM199607108
5/18/89	PP NW	^{238}Pu	0.01	“
5/18/89	PP SE	^{238}Pu	0.01	“
5/18/89	PP SW	^{238}Pu	0.01	“
5/18/89	Clinton	^{238}Pu	0.01	“
5/12/89	Savannah	^{238}Pu	0.01	“
5/18/89	PP NE	^{239}Pu	0.01	“
5/18/89	PP NW	^{239}Pu	0.01	“
5/18/89	PP SE	^{239}Pu	0.01	“
5/18/89	PP SW	^{239}Pu	0.01	“
5/18/89	Clinton	^{239}Pu	0	“
5/12/89	Savannah	^{239}Pu	0	“
5/18/89	PP NE	^{90}Sr	0.01	“
5/18/89	PP NW	^{90}Sr	0.01	“

Date collected	Location[a]	Radionuclide	pCi g^{-1} Avg.	Reference
5/18/89	PP SE	^{90}Sr	0.02	"
5/18/89	PP SW	^{90}Sr	0.02	"
5/18/89	Clinton	^{90}Sr	0.10	"
5/25/90	PP NW	^{238}Pu	0.01	HRM199607106
5/25/90	PP SE	^{238}Pu	0	"
5/25/90	PP SE	^{239}Pu	0.01	"
5/25/90	PP NE	^{90}Sr	0.6	"
5/25/90	PP NW	^{90}Sr	0.41	"
5/25/90	PP SE	^{90}Sr	0.54	"
5/25/90	PP SW	^{90}Sr	0.9	"
5/25/90	Clinton	^{90}Sr	0.31	"

[a] PP = plant perimeter.

USEFULNESS AND LIMITATIONS OF THE SOIL MONITORING DATA FOR DOSE RECONSTRUCTION

We do not anticipate that the soil monitoring data collected at the SRS will be useful for later stages of dose reconstruction. Data we were able to locate generally included summaries of studies done previously and not original data. Soil data were not collected routinely before the 1970s, but rather as a part of special studies and then only very sporadically. Offsite soil data for these special studies were very limited. Most soil data were collected onsite, close to release points, where soil levels of some nuclides were elevated. In studies where samples at the Site perimeter and at offsite locations were collected, similar concentrations at the two sets of locations were evident. This indicates that Site contributions and fallout contributions are not discernible from one another.

Background concentrations are likely represented by samples collected at remote locations at Clinton, South Carolina; Savannah, Georgia; Fort Gordon, Georgia; and Bamberg, South Carolina. In some cases, 25-mile radius data were also collected. For all nuclides of plutonium, ^{90}Sr, and ^{137}Cs, concentrations at these background locations are similar to Site perimeter concentrations. These data show little evidence of Site contribution to offsite soil contamination.

Because of limited spatial and temporal resolution and the close agreement between Site perimeter and background concentrations, soil monitoring data will not be useful for reconstructing releases from the SRS. Even with the use of environmental transport models to simulate releases from the Site and deposition, validation of the deposition pattern with soil data will not be possible because of the difficulty of distinguishing between Site and fallout contributions.

SUMMARY

Offsite soils environmental monitoring data were not collected routinely at the SRS before the 1970s, and the intermittent information available is insufficient to construct a useful picture of offsite soil concentrations of radionuclides. Available information is summarized here, and it indicates little evidence of offsite soil contamination associated with SRS releases in the early years.

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