HEALTH PHYSICS REGIONAL MONITORING

Semiannual Report, January through June 1958

WORKS TECHNICAL DEPARTMENT

du Pont de Nemours and Company
Explosives Department - Atomic Energy Division
Savannah River Plant

DPSP 58-25-38

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January 9, 1959

E. I. du Pont de Nemours and Company
Explosives Department - Atomic Energy Division
Savannah River Plant

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Abstract

Radioactivity from bomb fallout and Plant operations was detected in environmental samples collected during January 1958 through June 1958. Radioactivity deposited on the Plant site in fallout from weapons tests was estimated to be approximately one-third as much as during the previous 6-month period.

Except for tritium released from Buildings 232-F, 232-H, and 234-H stacks, Plant contributions to environmental radioactivity decreased.

Introduction

Under a program established by the Du Pont Company in June 1951, the Savannah River Plant site and surrounding region are systematically monitored for radioactivity. The regional monitoring program accumulates information that is useful both as a measure of the effectiveness of Plant controls and as an authoritative record of environmental conditions. This report, covering the period from January through June 1958, is one of a series of reports concerning the regional monitoring program.

Data Reporting

Survey data were averaged for the six-month period and compared with the previous six-month averages (H. G. Mealing, Jr., R. S. Harvey and J. H. Horton, "Health Physics Regional Monitoring Semiannual Report," DPSP 58-25-17, July 15, 1958).

In reporting data, "average" or "total" refers to the average or total for the six-month report period, and "previous average" or "previous total" to the average or total for the preceding six-month period. "Maximum" refers to the highest individual sample collected during the six-month period.

Samples containing no detectable radioactivity were averaged as containing the minimum detectable amount.

Sensitivity and Standard Deviation of Laboratory Analyses

The sensitivity of laboratory analyses refers to the minimum amount of radioactivity that can be detected by the procedure. It is based on statistical counting errors (90% confidence level) and is influenced by the sample size, counter efficiency, and counter background. No self-absorption corrections have been applied.

The standard deviations, calculated from spike recovery values, are applicable to the 6-month averages of data in the report.

Analysis	Sample	Sensitivity	Standard Deviation, %	Spike Value
Alpha	Water	$0.33 \pm 0.11 \times 10^{-3}$ d/m/ml	10	100×10^{-3} d/m/ml
	Mud	0.33 ± 0.11 d/m/g	-	-
	Vegetation	0.17 ± 0.06 d/m/g	-	-
	Air	$0.026 \pm 0.009 \times 10^{-14}$ μc/cc	-	-
Beta	Water	$6.9 \pm 0.4 \times 10^{-15}$ c/ml	-	-
	Mud	$6.9 \pm 0.4 \times 10^{-12}$ c/g	-	-
	Vegetation	$3.5 \pm 0.2 \times 10^{-12}$ c/g	-	-
	Air	$1.2 \pm 0.07 \times 10^{-14}$ μc/cc	-	-
Uranium or Plutonium	Water	$0.39 \pm 0.13 \times 10^{-3}$ d/m/ml	24	100×10^{-3} d/m/ml
	Mud	0.40 ± 0.13 d/m/g	20	100 d/m/g
	Vegetation	0.041 ± 0.014 d/m/g	17	10 d/m/g
Radioiodine	Water	$6.9 \pm 0.4 \times 10^{-15}$ c/ml	12	300×10^{-15} c/ml
	OP Vegetation	$0.55 \pm 0.03 \times 10^{-12}$ c/g	24	20×10^{-12} c/g
	H Area Vegetation	$1.64 \pm 0.10 \times 10^{-12}$ c/g	21	60×10^{-12} c/g
	Air	$2.3 \pm 0.09 \times 10^{-14}$ μc/cc	-	-
	Milk	$92 \pm 5.3 \times 10^{-15}$ c/ml	18	3000×10^{-15} c/ml
Tritium	Water	1 μc/ℓ	5	7 to 70 μc/ℓ

Summary

WASTE RELEASED BY PLANT OPERATIONS. Radioactivity released to the environment by stacks and effluent streams was approximately 0.3 curie alpha, 335 curies nonvolatile beta, 6 curies radioiodine and 1,200,000 curies tritium. Approximately 0.7 curie alpha, 550 curies nonvolatile beta, 11 curies radioiodine and 3400 curies tritium were released to seepage basins.

BOMB FALLOUT. During the report period, an estimated 130 curies of nonvolatile beta and 15 curies of radioiodine were deposited on the Plant site in rain. At least 99% of the nonvolatile beta and over 90% of the radioiodine consisted of debris from weapons tests.

VEGETATION. Concentrations of alpha on vegetation increased slightly but the maximum plutonium concentration observed was only 0.27 d/m/g in a sample collected near H Area. Nonvolatile beta concentrations decreased, but accumulation of bomb fallout on dormant vegetation during January, February, and March and increased fallout during April caused concentrations to remain fairly high during the first four months of the report period. The average radioiodine concentration on vegetation collected near H Area was the lowest observed since radioiodine analysis of H-Area vegetation was begun during the July - December 1955 report period.

ATMOSPHERE. Concentrations of alpha in the atmosphere remained low and the highest weekly concentration observed was 0.5×10^{-14} μc/cc in a sample collected from Waynesboro. Concentrations of nonvolatile beta at all locations decreased because of decreased bomb fallout. Radioiodine concentrations were the lowest observed in several years, and the average concentrations near the Separations areas were no higher than those at off-Plant locations.

Particulate radioactivity suspended in air and deposited on the ground decreased because of decreased weapons test debris.

Twelve of 352 atmospheric water vapor samples contained detectable tritium (greater than 1 μc/ℓ of water) and the maximum concentration was 5 μc/ℓ in a sample collected at F Area.

Radiation dosage decreased at all locations and the highest average dose rate observed was 1.25 mrad/24 hours at H and L Areas.

RAINWATER. Concentrations of alpha increased slightly at some locations, while concentrations of nonvolatile beta and radioiodine decreased at all locations. Tritium was detected in 8 samples, and the maximum concentration observed was 7 μc/ℓ in a sample collected at F Area.

STREAMS. Concentrations of alpha and nonvolatile beta in water samples collected from the A-Area effluent decreased, while increased concentrations were observed at the M-Area effluent. Nonvolatile beta concentrations in water collected from the F and H-Area segregated water decreased, while alpha concentrations in the F-Area effluent increased. Concentrations of nonvolatile beta increased in all reactor effluent streams except the effluent from L Area, and nonvolatile beta discharged to Pen Branch and Steel Creek and to Lower Three Runs was detectable in the Savannah River.

GROUND WATER. Samples collected from drilled, cased wells near the Separations areas and the burial ground showed no evidence of contamination by Plant operations, but wells near the seepage basins were influenced by radioactivity in the basins (see Seepage Basins).

PLANT DRINKING WATER. Slightly increased alpha and nonvolatile beta concentrations were observed at some locations, but there was no indication of influence by Plant operations.

PUBLIC WATER SUPPLIES. Concentrations of alpha in public water samples showed no significant changes. Concentrations of nonvolatile beta generally decreased, although indications of influence by bomb fallout were observed at several locations.

SEEPAGE BASINS. Concentrations of alpha in the 700 Area and TNX seepage basins, and the concentration of nonvolatile beta in the TNX seepage basin increased. The average concentration of nonvolatile beta in the 700-Area seepage basin remained approximately the same.

The concentration of alpha in the F-Area seepage basin No. 1 increased, while the concentration of nonvolatile beta in the basin decreased. Concentrations of alpha, nonvolatile beta and radioiodine in all H-Area seepage basins decreased.

Concentrations of nonvolatile beta in the R-Area and P-Area seepage basins decreased, while the nonvolatile beta concentration in the L-Area basin increased. The average concentration in the C-Area basin remained approximately the same.

BIOLOGICAL SPECIMENS. Algae samples collected from Lower Three Runs, Steel Creek and the Savannah River contained higher concentrations of radioactivity than other aquatic specimens even though algae concentrations of radioactivity were substantially lower than those observed during the previous report period.

Concentrations of nonvolatile beta in all organs of Lower Three Runs fish increased. Radiostrontium and radiocesium were the primary contributors of radioactivity in the bones and flesh, respectively. Steel Creek fish contained significant but greatly reduced concentrations of radioactivity in the bony structures and in the intestinal tract and radiostrontium was the main contributor of radioactivity in the bone. The fleshy tissues of Steel Creek fish did not contain significant concentrations of radioactivity. With the exception of fish collected near the mouth of Lower Three Runs and Steel Creek, Savannah River fish did not contain significant concentrations of radioactivity.

Survey Results

Radioactivity Released by Plant Operations

100 AREAS

The major sources of liquid waste from the 100 Areas were, (1) the thermal shield water, purged at rates of 1 to 6 gallons per minute, except in R Area, where no significant purging was done, and (2) the disassembly basin water, purged at rates of 700 to 1800 gallons per minute.

Alpha activity discharged in the 100-Area effluents was estimated as 270 mc due almost entirely to naturally occurring radioactivity in river water.

Nonvolatile beta discharged in thermal shield water increased, while fewer fuel element failures resulted in reduced nonvolatile beta discharged in disassembly basin water. The release from the R-Area disassembly basin continued to be influenced by the November 1957 experimental fuel element failure (for details of the incident see DPSP 58-25-17). The nonvolatile beta releases from the 100 Areas are tabulated below.

	Nonvolatile Beta Released in Thermal Shield Water, curies					
Area →	R	P	L	K	C	Total for All Areas
Total	-	23	35	3	4	65
Previous Total	23	11	10	2	2	48

	Nonvolatile Beta Released in Disassembly Basin Water, curies					
Area →	R	P	L	K	C	Total for All Areas
Total	169	40	25	14	22	270
Previous Total	208	88	74	6	10	386

More thorough sampling of purged disassembly basin water during charge and discharge periods permitted accurate evaluation of the tritium released to the 100-Area effluent streams for the first time, and the 6-month total release was approximately 11,000 curies.

Tritium released from the 100-Area stacks totaled 49,000 curies, with a maximum monthly release of 6700 curies from L Area in January.

200 AREAS

Stack releases of alpha, nonvolatile beta and radioiodine from the plutonium separations stacks continued to decrease, while the tritium release from Buildings 232-F, 232-H, and 234-H increased. Liquid releases to Four Mile Creek were negligible.

A summary of the 200-Area stack releases is given below.

	Stack-Released Radioactivity				
	Alpha, mc		Nonvolatile Beta, mc		Radio-iodine, c
Area →	F	H	F	H	H
Total	12	1	130	240	6
Previous Total	16	2	170	340	24

300 AREA

An estimated 55 pounds (17 mc) of natural uranium was discharged from the 300 Area to Tim's Branch, as compared to 16 pounds (4.9 mc) during the previous 6-month period.

Bomb Fallout

Radioactivity deposited on the Plant site, estimated from results of rainwater samples and rain gage readings, is listed in the following table.

	Nonvolatile Beta, c	Radioiodine, c
January	17	3
February	9	2
March	18	3
April	57	4
May	14	1
June	17	2
Total →	132	15
Previous Total →	335	125

At least 99% of the nonvolatile beta and over 90% of the radioiodine was debris from weapons tests.

Radioactivity on Vegetation

There were 802 vegetation samples analyzed for alpha and nonvolatile beta activity, and 662 were analyzed for radioiodine. The sample locations are shown in figures 1 and 2.

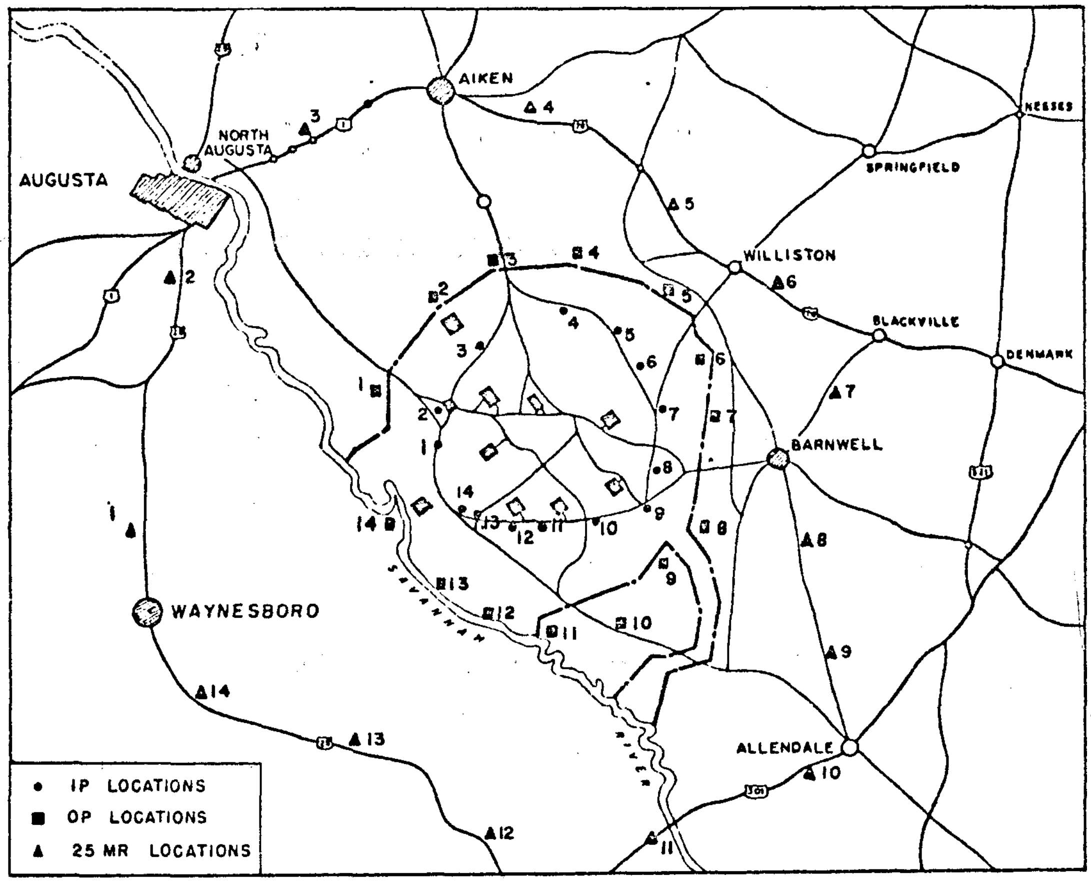

Figure 1. Vegetation Sample Locations

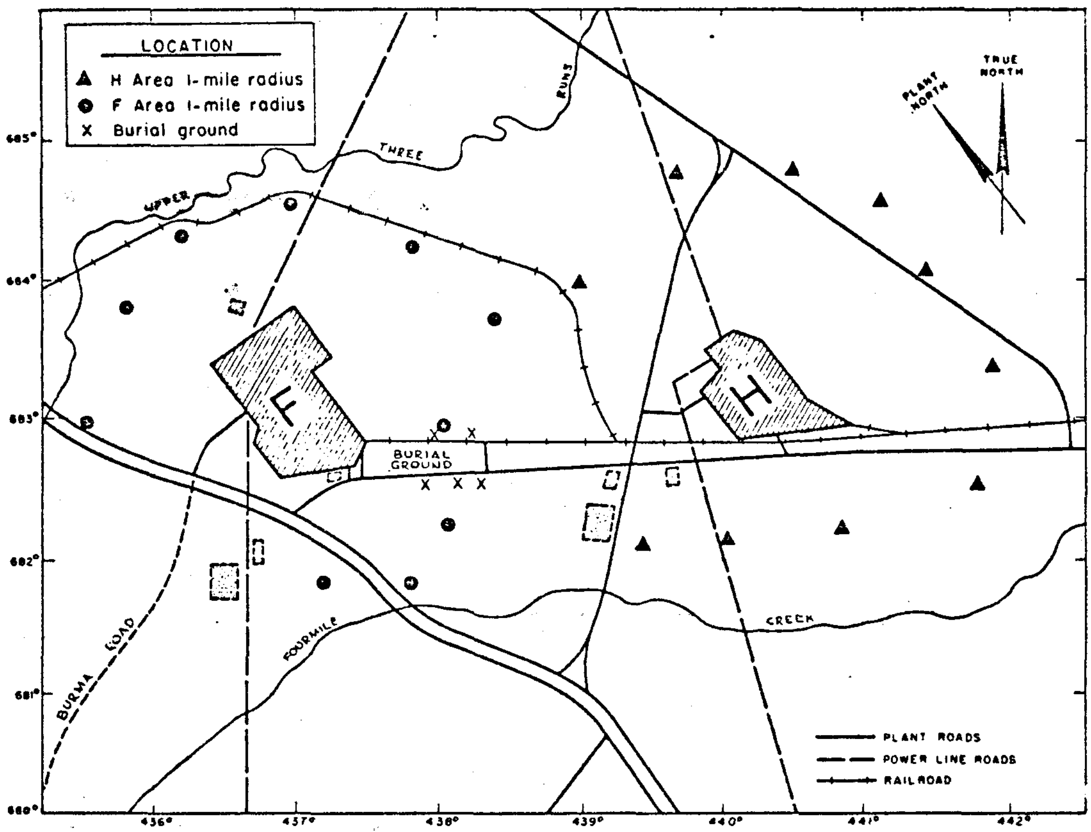

Figure 2. Vegetation Sample Locations in F and H Areas

Results of the alpha analyses are summarized below.

Location	Alpha, d/m/g Max	Avg	Prev Avg
F Area (at 1-mile radius)	2.7	0.6	0.4
H Area (at 1-mile radius)	3.3	.6	.4
Inner Perimeter	2.3	.5	.3
Outer Perimeter	2.1	.4	.3
25-Mile Radius	2.3	.4	.3
Burial Ground (at fence)	3.5	0.5	0.3

Two hundred and three samples, including all samples containing greater than 1 d/m/g total alpha, were analyzed for TBP extractable alpha. Of these samples, only 42 contained sufficient radioactivity for pulse-height analysis. Results of the analyses are summarized below.

Location	No. of Samples Analyzed by TBP Extraction	No. Pulse-Height Analyzed	No. Containing Detectable Pu	Max Pu Concentration, d/m/g	No. Containing Detectable U	Max U Concentration, d/m/g
F Area	34	7	1	0.11	6	0.36
H Area	48	18	10	.27	11	.49
Inner Perimeter	45	6	2	.07	3	.18
Outer Perimeter	34	2	1	0.14	1	.08
25-Mile Radius	37	6	0	-	2	.43
Burial Ground	5	3	0	-	1	0.41

A summary of nonvolatile beta concentrations on vegetation is shown below:

Location	Nonvolatile Beta, 1×10^{-12} c/g Max	Avg	Prev Avg
F Area (at 1-mile radius)	830	240	260
H Area (at 1-mile radius)	760	230	300
Inner Perimeter	860	230	390
Outer Perimeter	1000	140	260
25-Mile Radius	660	150	250
Burial Ground (at fence)	440	170	270

The higher average concentrations at F Area, H Area, and IP were probably because of the greater sampling of bermuda and crab grass at these locations. Past experience has shown that grasses accumulate more radioactivity from the air than most other plants.

The decreased concentrations at all locations were because of decreased bomb fallout; but, because of accumulation of fallout on dormant vegetation during January, February, and March, and increased fallout during April, large decreases in concentrations were not observed until May. Monthly concentrations of nonvolatile beta on vegetation are shown below.

	Nonvolatile Beta on Vegetation At All Sampled Locations, 1×10^{-12} c/g
January	200
February	240
March	280
April	310
May	72
June	76

The apparent half life of nonvolatile beta on vegetation was generally long (50 to greater than 100 days) and only during March and April was short half-lived radioactivity observed on vegetation. The shortest half life observed was 10 days for the nonvolatile beta in a sample collected at the 25-Mile Radius on April 2.

Twenty special vegetation samples collected from 10 off-Plant locations in Georgia, South Carolina, Alabama, and Ohio during May 24 to June 1 contained nonvolatile beta concentrations greater than those observed in routine samples collected on and near the Plant site during the same period. The average nonvolatile beta concentration in the special samples was 85×10^{-12} c/g, with a maximum of 170×10^{-12} c/g in a sample collected from Anderson, S. C., while samples collected from routine OP locations on May 26 contained an average of 50×10^{-12} c/g with a maximum of 110×10^{-12} c/g.

A summary of radioiodine concentrations on vegetation samples is given below.

	Radioiodine, 1×10^{-12} c/g		
Location	Max	Avg	Prev Avg
H Area (at 1-mile radius)	9.6	2.0	19
Outer Perimeter	7.8	1.2	11

The average concentration at H Area was the lowest observed since radioiodine analysis of H-Area vegetation was begun during July - December 1955.

Radioiodine in Milk

Of 55 milk samples collected from Talatha, Snelling, Aiken, and North Augusta, only four contained detectable radioiodine. The maximum concentration observed was 2.7×10^{-13} c/ml in a sample collected at Snelling on January 20, and the average concentration in the four positive samples was 1.9×10^{-13} c/ml.

Radioactivity in the Atmosphere

Radioactivity in the atmosphere was determined by counting 324 two-inch diameter air filters for alpha and beta activity and 338 two-inch diameter silver nitrate impregnated air filters for radioiodine, by determining by radioautograph the number of radioactive particles collected on 228 eight-inch by ten-inch air filters and 845 eight-inch by ten-inch adhesive papers, and by the analysis of 352 water vapor samples for tritium. Radiation dosage was determined by 1187 ionization chamber readings and 139 film badge readings. The air filters, film badges and tritium monitors were located at the air monitoring stations, while ionization chambers were located at the perimeters of each of the Plant areas and at the air monitoring stations. Adhesive papers were located at Inner Perimeter vegetation sampling locations, near F and H Areas and at Building 643-G burial ground fence. The locations of Plant areas and air monitoring stations are shown in figure 3.

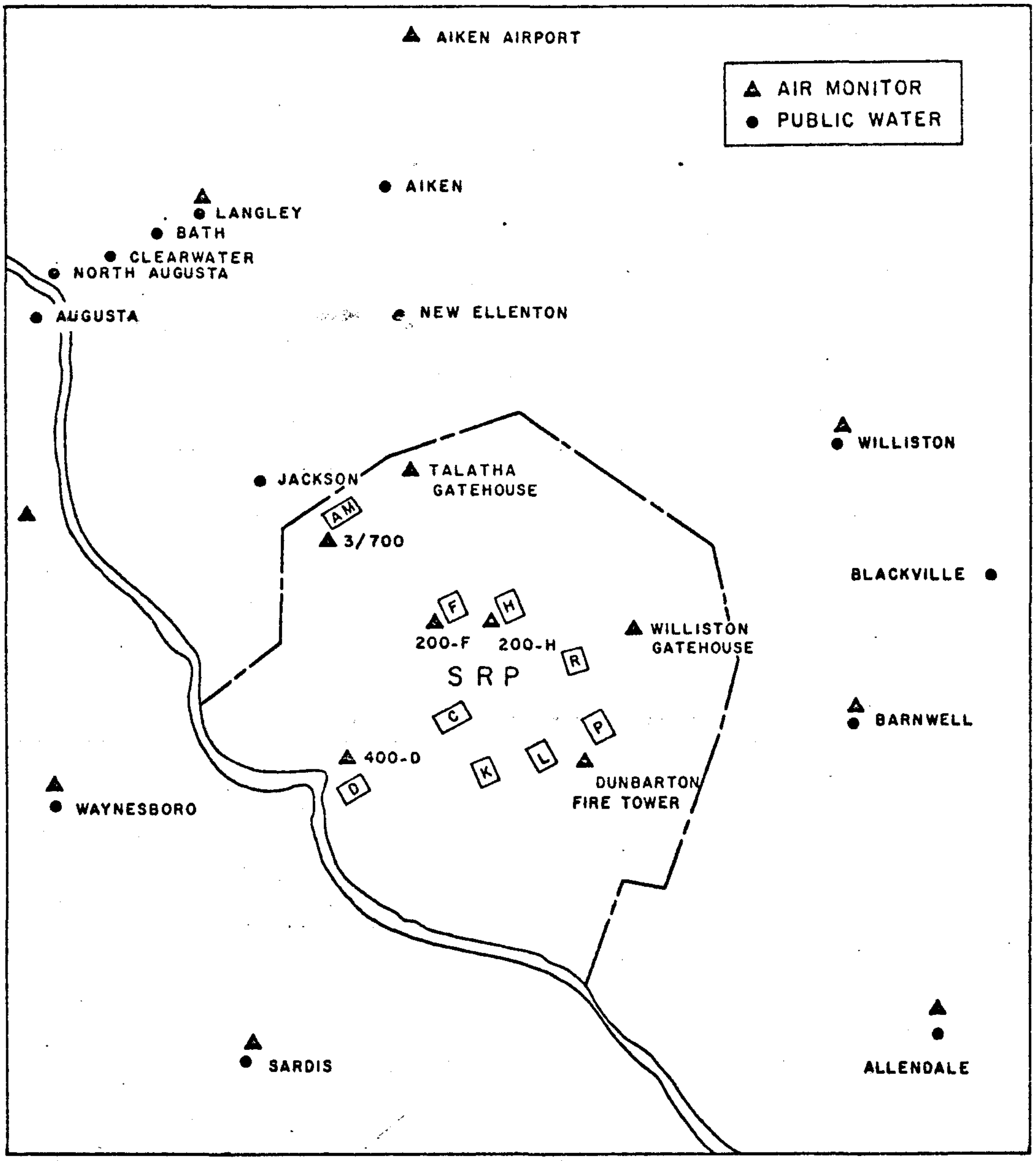

Figure 3. Constant Air Monitoring Stations and Public Water Sampling Locations

RADIOACTIVITY AS DETERMINED BY COUNTING AIR FILTERS

Three days were allowed for the decay of radon and thoron daughters before counting the filters for alpha and beta activity.

	Atmospheric Radioactivity, 1×10^{-14} μc/cc								
	Alpha			Filterable Beta			Radioiodine		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
F Area	0.2	0.1	0.1	610	270	510	23	6	94
H Area	.2	.1	.1	1000	370	380*	29	8	110
400 Area	.2	.1	.1	620	290	460	18	5	49
Talatha Gatehouse	.4	.2	.1	740	330	440	32	8	54
Williston Gatehouse	.2	.1	.1	1300	370	520	27	8	42
300/700 Area	.4	.2	.1	920	380	520	21	7	53
Dunbarton Fire Tower	.2	.1	.1	640	310	450	29	8	42
Waynesboro	.5	.2	.1	730	310	460	25	7	43
Aiken Airport	.2	.1	.1	1000	340	410	37	8	20*
Allendale	.2	.1	0.1	680	320	360*	27	8	28*
Bush Field	.2	.1	-	720	290	-	25	8	24*
Langley	.2	.1	-	720	260	-	23	6	27*
Barnwell	.2	.1	-	740	230	-	24	6	56
Williston	.1	.1	-	590	260	-	30	6	45
Sardis	0.2	0.1	-	470	220	-	15	6	35

* Results doubtful because of difficulties with sampling equipment.

Increases in the concentration of filterable beta in air were observed during the first of April and during the middle of May. The increase during April was due to Soviet nuclear weapons tests during March, and the May increase was probably due to United States tests at the Pacific proving grounds which began on April 28.

The average concentration of filterable beta in air at all locations during January, February, and March was 150×10^{-14} μc/cc, and the highest weekly average concentration during the three-month period was 250×10^{-14} μc/cc. During the last three months of the report period the average concentration for all locations was as high as 680×10^{-14} μc/cc during the week ending April 8 and 600×10^{-14} μc/cc during the week ending May 13.

The average apparent half life of filterable beta collected on air filters during January, February, and March was approximately 65 days, while weekly average half lives as short as 12 days were observed in April. The shortest weekly average half life observed in May was 50 days.

RADIATION DOSAGE

Location	Mrad/24 Hr Avg	Prev Avg
H Area	1.25	1.42
L Area	1.25	1.37
K Area	1.20	1.28
P Area	1.17	1.38
C Area	1.14	1.17
[illegible] Area	1.13	1.32
300/700 Area	1.10	1.32
F Area	1.06	1.18
400 Area	1.06	1.15
TC Area	1.05	1.21
Allendale	0.98	1.25
Williston Gatehouse	0.95	1.06
Aiken Airport	0.92	1.17
Dunbarton Fire Tower	0.90	1.25
Talatha Gatehouse	0.89	1.14
Waynesboro	0.89	1.08

PARTICULATE FALLOUT

Location	Particles/ft^2/wk Max	Avg	Prev Avg
Inner Perimeter	76	6	25
F Area	39	6	23
F Area (at 1-mile radius)	47	7	19
H Area	32	5	18
H Area (at 1-mile radius)	50	5	19
Burial Ground Fence*	13	1	5

* Papers placed in vertical positions to collect horizontally moving particles.

Throughout the report period, the larger individual particles were counted with GM counters, and where possible, recounts were made to determine the approximate half life of the radioactivity. Monthly deposition of particles at the Inner Perimeter locations and the results of GM counts of the particles are summarized in the following table.

	Deposition, particles/ft²/mo	No. Counted With GM Counters	Beta Activity, d/m Max	Beta Activity, d/m Avg	Avg Half Life, days
January	28	26	160	44	40
February	3	9	52	17	*
March	11	28	3600	350	25
April	80	60	2100	250	40
May	20	48	250	65	50
June	19	50	110	35	80

* Insufficient radioactivity for decay studies.

SUSPENDED PARTICLES

Location	Particles/1000 Cubic Meters of Air: Max	Avg	Prev Avg
F Area	210	75	170
H Area	190	64	130
Talatha Gatehouse	210	73	140
Williston Gatehouse	200	63	120
Dunbarton Fire Tower	190	70	150
400 Area	200	93	220
300/700 Area	210	77	140
Aiken Airport	160	77	120
Allendale	190	75	100
Waynesboro	160	76	110

The monthly average concentrations of suspended particles and results of GM counts of the larger individual particles are shown in the following table.

	Particles/1000 Cu Meters of Air	Particles Counted With GM Counters	Beta Activity, d/m Max	Beta Activity, d/m Avg
January	60	52	280	76
February	50	39	620	51
March	41	44	3100	320
April	120	57	1400	170
May	78	82	240	95
June	88	59	280	57

TRITIUM IN WATER VAPOR

Tritium in atmospheric water vapor was monitored by the analyses of weekly samples collected by pumping air through silica gel columns at the air monitoring stations. Of 352 samples collected by this method, 12 contained detectable tritium (greater than 1 μc/ℓ of water). Five of 50 samples collected at the F and H Areas contained from 1.3 μc/ℓ to 5.0 μc/ℓ, the maximum concentration occurring in a sample collected at F Area on March 18. Five of 123 samples collected at other on-Plant locations contained from 1.3 to 1.7 μc/ℓ, and 2 of 179 samples collected from off-Plant locations contained 1.3 μc/ℓ each.

Radioactivity in Rainwater

Location	No. of Samples	Alpha, 1×10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile β, 1×10^{-15} c/ml Max	Avg	Prev Avg	Radioiodine, 1×10^{-15} c/ml Max	Avg	Prev Avg
F Area	24	13.2	3.3	1.7	1000	370	530	100	30	140
H Area	23	7.8	2.8	1.4	680	340	550	140	37	180
300/700 Area	23	6.9	3.0	2.1	1100	490	950	120	34	230
Talatha Gatehouse	23	4.0	1.6	1.0	530	350	650	110	31	280
Williston Gatehouse	22	4.0	2.4	1.7	420	210	450	120	33	230
Dunbarton Fire Tower	22	2.5	0.7	1.1	410	180	550	54	27	270
400-D	21	2.7	1.3	1.3	490	260	460	160	32	280
Aiken Airport	24	3.3	1.7	1.3	960	360	540	110	31	180
Allendale	23	4.1	1.7	1.0	680	200	360	96	28	220
Waynesboro	23	1.9	0.9	0.8	510	290	490	85	27	170
Langley*	9	3.9	1.4	-	1500	790	-	87	30	-
Sardis*	9	3.5	1.3	-	1400	490	-	49	23	-
Bush Field*	10	3.0	1.4	-	1200	660	-	95	48	-
Williston*	10	2.4	1.3	-	1200	530	-	67	29	-
Barnwell*	9	2.5	1.1	-	1100	550	-	104	46	-

* Data for last 10 weeks of report period only. Bomb fallout was at a maximum during this time, and consequently the average nonvolatile beta concentrations in this group of samples exceeded average concentrations at locations where complete data were available.

Detectable tritium concentrations were limited to eight samples, four of which were collected at F and H Areas. The maximum concentration observed was 7 μc/ℓ in a sample collected at the F Area on May 20, and the maximum concentration observed at locations other than near the separations areas was 1.5 μc/ℓ.

Radioactivity in Streams

Water samples were collected weekly from the locations shown in figure 4. Mud samples were collected monthly at the same locations except at the Savannah River location 10, where weekly samples were collected; and at the TNX effluent where mud was not sampled. Large variations in reactor effluent water levels during charge and discharge operations caused difficulties in operation of the continuous water samplers at locations downstream from the reactors. After March, daily w[illegible]ter samples were collected from the affected locations during c[illegible] and discharge periods, and weekly concentrations were comput[illegible] from results of analyses of the daily samples.

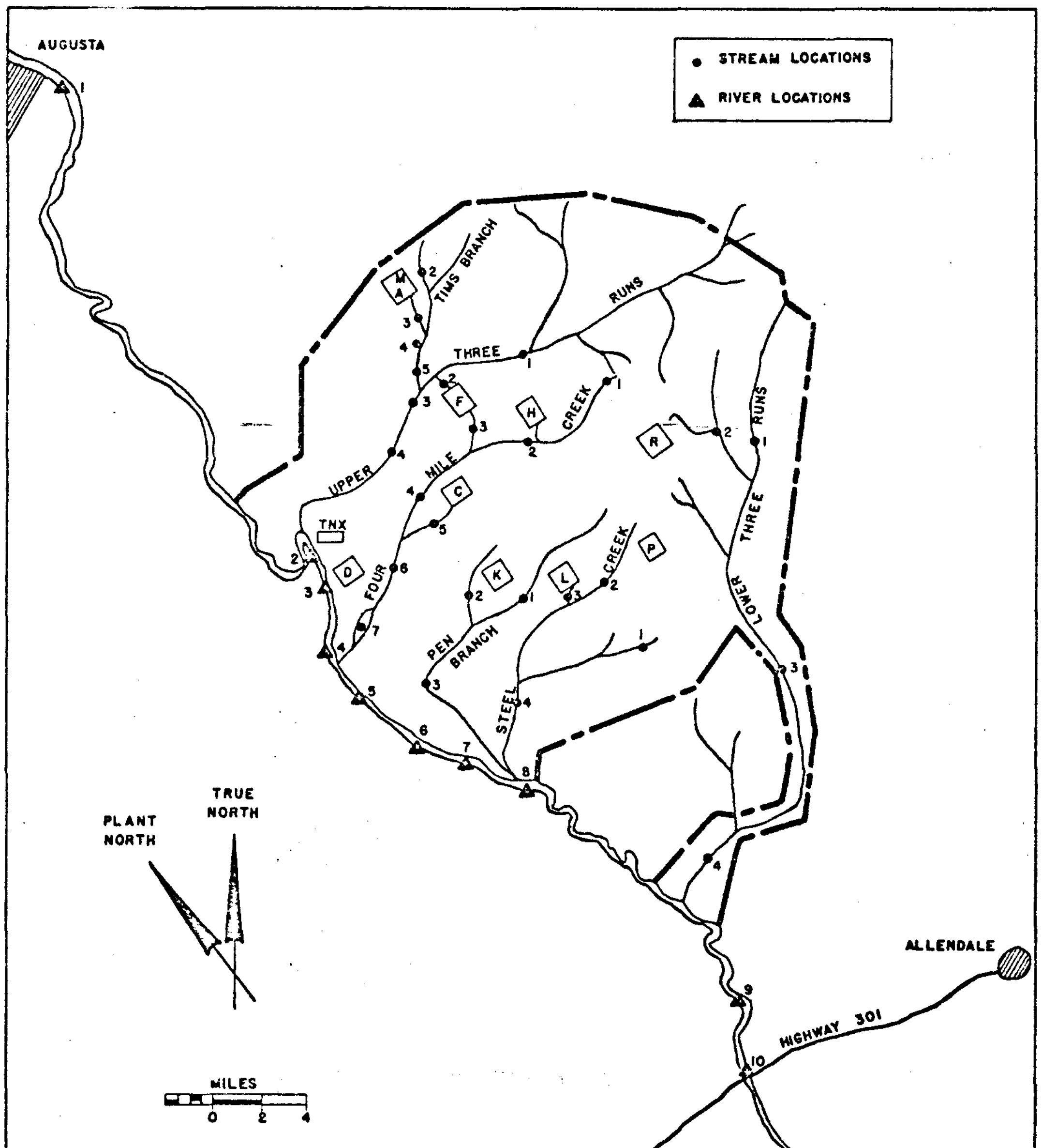

Figure 4. Stream and River Sample Locations

Results of alpha and nonvolatile beta analyses of 962 water samples and 236 mud samples, and U or Pu analyses of 104 water samples and 170 mud samples are summarized in the following tables.

TIMS BRANCH

Radioactivity in Water

Location	U or Pu, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	[illegible]	200	350	320	100	280
3	1500	250	74	1100	230	130
4	68	36	41	460	54	50
5	24	13	20	57	23	27

Radioactivity in Mud

Location	U or Pu, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
2	4700	1800	2300	470	190	290
3	1200	630	930	210	72	78
4	340	110	202	51	19	19
5	170	59	140	34	13	10

The maximum concentration of U or Pu in water at location 2 (700-Area effluent) occurred in a sample collected on February 20, while the maximum nonvolatile beta concentration occurred in a sample collected on June 26.

The maximum U or Pu concentration in water collected from location 3 (300-Area effluent) occurred in a sample collected on March 20, and the maximum nonvolatile beta concentration occurred in a sample collected on January 9.

Alpha pulse-height analyses of samples from locations 2 and 3 showed that the radioactivity was due to natural (unenriched) uranium.

UPPER THREE RUNS

Radioactivity in Water

Location	Alpha, 1×10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1×10^{-15} c/ml Max	Avg	Prev Avg
1	6	4	4	32	11	16
2	48	19	8	240	58	74
3	7	3	3	44	14	15
4	5	3	3	46	14	18

Radioactivity in Mud

Location	U or Pu, d/m/g Max	Avg	Prev Avg	Nonvolatile Beta, 1×10^{-12} c/g Max	Avg	Prev Avg
1	58	28	29	8	8	8
2	510	200	76	120	62	150
3	130	41	37	82	29	11
4	310	81	50	25	18	12

The maximum nonvolatile beta concentrations in water samples collected at location 1 (control), location 3 and location 4, occurred in samples collected on April 17 and were due to bomb fallout.

The maximum alpha and nonvolatile beta concentrations in water collected at location 2 (F-Area storm sewer) occurred in a sample collected on February 6. The flow of water at location 2 is insignificant as compared to the flow of Upper Three Runs, and therefore the concentrations at location 2 did not influence concentrations further downstream.

FOUR MILE CREEK

Radioactivity in Water

Location	Alpha, 1 x 10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-15} c/ml Max	Avg	Prev Avg
1	1	1	1	24	9	14
2	5	2	2	410	48	72
3	10	6	4	77	42	60
4	3	2	1	63	27	40
5	2	1	1	11,000	1300	89
6	2	1	2	10,000	740	45
7	3	[illegible]	1	8,800	640	40

Radioactivity in Mud

Location	U or Pu, d/m/g Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-12} c/g Max	Avg	Prev Avg
1	17	9	14	25	10	8
2	23	11	36	28	12	11
3	60	34	29	11	9	8
4	7	4	12	13	8	7
5	43	16	18	34	15	14
6	15	9	27	47	25	15
7	16	8	26	18	13	11

The maximum concentration of nonvolatile beta in water at location 2 occurred in a sample collected on May 1 and was due to the drainage of retention basin water to Four Mile Creek. The maximum concentration of alpha in water at location 2 occurred in a sample collected on May 8.

Alpha concentrations in water collected at location 3 (200-F segregated water effluent) exceeded 9 x 10^{-3} d/m/ml in samples collected on January 16, February 20, March 13, and June 19. The alpha activity was due to natural (unenriched) uranium.

Samples collected during charge-discharge operations in C Area accounted for 85% of the 6-month average nonvolatile beta concentration in water at location 5. Daily samples collected during charge and discharge shutdowns contained as much as 14,000 x 10^{-15} c/ml in a sample collected on June 12. The half life of the nonvolatile beta in the June 12 sample was approximately 18 days, while the half life of nonvolatile beta in samples collected at times other than during charge and discharge shutdowns ranged from 13 to 92 days, with a weighted average half life of 35 days.

PEN BRANCH

Radioactivity in Water

Location	Alpha, 1 x 10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-15} c/ml Max	Avg	Prev Avg
1	3	1	1	125	14	21
2	3	1	1	8400	800	750
3	2	1	1	1800	260	230

Radioactivity in Mud

Location	Alpha, d/m/g Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-12} c/g Max	Avg	Prev Avg
1	1.0	0.6	0.6	17	11	8
2	2.5	1.5	1.6	46	27	33
3	2.0	1.1	0.8	40	20	27

Water samples collected during charge and discharge operations in K Area accounted for 86% of the 6-month average nonvolatile beta concentration at location 2. The maximum weekly concentration occurred in a sample collected on February 13, but daily samples collected during charge and discharge operations contained as much as 45,000 x 10^{-15} c/ml in a sample collected on April 17. The half life of the nonvolatile beta in samples collected during charge and discharge operations was approximately 5 days, as compared to a weighted average half life of 34 days for samples collected during other periods.

STEEL CREEK

Radioactivity in Water

Location	Alpha, 1 x 10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-15} c/ml Max	Avg	Prev Avg
1	3	1	1	45	13	17
2	3	1	2	59,000	4600	1,400
3	2	1	1	23,000	1200	13,000
4	3	1	1	3,500	380	890

Radioactivity in Mud

Location	Alpha, d/m/g Max	Avg	Prev Avg	Nonvolatile Beta, 1×10^{-12} c/g Max	Avg	Prev Avg
1	0.8	0.4	0.9	10	8	8
2	7.0	2.9	1.7	5800	1200	91
3	2.4	1.2	1.4	18	12	43
4	3.6	2.2	1.0	260	83	26

Failure of a fuel element immediately previous to the shutdown and disassembly dewatering operations in February contributed to the relatively high nonvolatile beta concentrations observed in water samples collected at location 2, and the maximum concentration occurred in a sample collected on January 23. Monthly average concentrations during January, February and March were 22,000 $\times 10^{-15}$ c/ml, 3500 $\times 10^{-15}$ c/ml, and 400 $\times 10^{-15}$ c/ml, while the average concentration during the remainder of the report period was 450 $\times 10^{-15}$ c/ml. Radiostrontium accounted for 13% of the nonvolatile beta in January, 30% in February, 26% in March, and 10% during April, May, and June. The nonvolatile beta discharged during January, February, and March had an apparent half life of approximately 20 days. Resumption of thermal shield purge and short half-lived material discharged during charge and discharge operations during April, May, and June decreased the average half life of the nonvolatile beta to approximately 10 days.

Approximately 90% of the average nonvolatile beta concentration in water samples collected from location 3 was due to samples collected during charge and discharge operations in L Area, and the maximum concentration occurred in a sample collected on February 27. The half life of nonvolatile beta in samples collected during shutdowns was approximately 5 days, while the half life of samples collected during the remainder of the report period ranged from 1 to 170 days, with a weighted average of 30 days. The high previous average concentration at location 3 was due to a process improvement shutdown in L Area during the previous report period.

Radiostrontium accounted for approximately 17% of the nonvolatile beta in water samples collected from location 4.

LOWER THREE RUNS

	Radioactivity in Water					
	Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg
1	2	1	1	31	12	13
2	3	2	1	11,000	2700	2100
3	2	1	-	1,600	840	-
4	2	1	1	610	350	210

	Radioactivity in Mud					
	Alpha, d/m/g			Nonvolatile Beta, 1×10^{-12} c/g		
Location	Max	Avg	Prev Avg	Max	Avg	Prev Avg
1	1.1	0.6	0.7	13	9	8
2	2.5	1.3	1.1	1200	470	240
3	0.6	0.4	-	260	92	-
4	1.2	0.6	0.7	33	17	12

Radioactivity discharged to the R-Area disassembly basin during the November 1957 experimental fuel element failure (see DPSP 58-25-17) continued to influence nonvolatile beta concentrations in Lower Three Runs. Of the nonvolatile beta in water samples collected from location 2, radiostrontium accounted for 22% and radiocesium accounted for 33%. The maximum nonvolatile beta concentration occurred in a sample collected on May 1, during C&D operations, and was largely short half-lived material (approximately 7.5-day half life).

SAVANNAH RIVER

Radioactivity in Water

Location	Alpha, 1 x 10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-15} c/ml Max	Avg	Prev Avg
1	3	1	1	44	17	23
2	2	1	1	26	13	23
3	2	1	1	72	22	25
4	2	1	1	49	17	27
5	2	1	1	40	14	24
6	2	1	1	28	13	26
7	2	1	1	26	15	27
8	2	1	1	69	28	85
9	3	1	1	45	30	54
10	2	1	1	44	27	53
11*	1	1	-	18	14	-

* Data for last 6 weeks of period only.

Radioactivity in Mud

Location	U or Pu, d/m/g Max	Avg	Prev Avg	Nonvolatile Beta, 1 x 10^{-12} c/g Max	Avg	Prev Avg
1	13	9	10	29	22	27
2	18	8	9	36	25	25
3	12	8	8	27	21	25
4	17	11	8	40	27	24
5	11	6	6	36	25	31
6	23	10	10	27	18	28
7	15	11	6	33	22	21
8	9	6	7	33	25	38
9	18	11	9	28	15	8
10	17	9	11	40	21	17
11*	-	-	-	17	11	-

* Data for last 4 weeks of period only.

The maximum nonvolatile beta concentration in water at location 3 occurred in a sample collected on February 3 and was probably due to radioactivity discharged to the Savannah River through the TNX seepage basin.

The slightly higher average concentrations of nonvolatile beta at locations 8, 9, and 10 were due to radioactivity discharged through Steel Creek, Pen Branch and Lower Three Runs.

TRITIUM

Monthly water samples from the A, R, C, P, L, and K-Area effluents and weekly samples from the F and H-Area effluents, and from Savannah River location 10, were analyzed for tritium. After April 10, weekly samples from the Road A intersections (last location downstream) of all Plant effluent streams were analyzed for tritium. Of the 169 samples analyzed, only three contained detectable concentrations (>1 μc/ℓ).

Detectable tritium concentrations were: 4.5 μc/ℓ in a sample collected from Four Mile Creek location 6 on June 12, 2.0 μc/ℓ in a sample collected from Pen Branch location 3 on June 19, and 2.1 μc/ℓ in a sample collected from Lower Three Runs location 2 on June 5. The concentrations in Four Mile Creek and Pen Branch were due to charge and discharge operations in the C and K Areas, while the concentration in Lower Three Runs probably resulted from the discharge of water from a sump in R Area.

Radioactivity in Ground Water

Ground water was monitored by analyses of water samples collected from drilled, cased wells near F and H Areas (ZW Wells), and at the burial ground. Tritium was not detectable in samples collected from any of the wells. Results of alpha and nonvolatile beta analyses are shown in the following tables.

ZW WELLS

		Radioactivity in Water					
		Alpha, 1×10^{-3} d/m/ml			Nonvolatile Beta, 1×10^{-15} c/ml		
Location	No. of Samples	Max	Avg	Prev Avg	Max	Avg	Prev Avg
1	1	-	2	-	-	7	-
2	2	2	1	2	16	14	9
3	2	3	2	2	8	8	9
4	2	3	3	4	20	13	11
5	2	2	1	3	16	11	8
6	2	3	2	2	10	9	14
7	2	1	1	1	10	8	6
8	2	3	2	3	7	7	13
9	2	1	1	2	9	8	8
10	2	2	2	3	16	12	11

BURIAL GROUND WELLS

Location	Radioactivity in Water: Alpha, 1 × 10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1 × 10^{-15} c/ml Max	Avg	Prev Avg
1	1	1	1	13	8	11
2	2	1	1	15	9	9
3	2	1	1	8	7	9
4	2	1	2	14	8	13
5	2	1	1	18	10	12
6	1	1	1	8	7	10
7	2	1	1	15	9	10
8	6	3	2	29	12	14
9	2	1	2	16	9	8

Although the maximum alpha and nonvolatile beta concentrations were observed in a well situated in a location likely to be influenced by burial ground radioactivity, the concentrations were too small to be taken as evidence of ground water contamination.

Radioactivity in Plant Drinking Water

Samples of drinking water were collected monthly from operating areas and quarterly from other domestic water systems. Results of analyses of 84 samples are summarized in the following table.

Location	Alpha, 1 × 10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile β, 1 × 10^{-15} c/ml Max	Avg	Prev Avg
Barricade 2*	20	18	7	15	14	11
H Area	15	11	6	16	12	9
F Area	21	8	2	19	10	9
TC-1*	13	8	6	15	13	7
Barricade 4*	7	6	5	7	7	10
Barricade 1*	4	4	3	7	7	7
300/700 Area	3	3	3	7	7	7
400 Area	4	2	2	19	11	7
TNX	4	2	2	10	9	7
Classification Yards	2	1	1	15	8	8
C Area	2	1	1	14	8	10
Pump House 1*	2	1	1	7	7	7
K Area	1	1	1	12	9	9
R Area	1	1	1	12	9	8
P Area	1	1	1	12	8	8
L Area	1	1	1	10	8	9
Central Shops*	1	1	1	8	8	7
Barricade 3*	1	1	1	7	7	7
Barricade 5*	1	1	1	7	7	9
Pump House 2*	1	1	1	7	7	7

* Quarterly samples.

Further analysis of samples from Barricade 2, H Area and F Area showed that the alpha activity was not due to uranium or plutonium, and therefore was not attributable to Plant operations.

Radioactivity in Public Water Supplies

Samples of public drinking water were collected monthly from the 14 surrounding towns shown in figure 3. The results of analyses of 84 samples collected during the report period are summarized in the following table.

Radioactivity in Water

Location	Alpha, 1×10^{-3} d/m/ml Max	Avg	Prev Avg	Nonvolatile β, 1×10^{-15} c/ml Max	Avg	Prev Avg
Bath	8	7	4	14	9	14
Jackson	8	6	7	8	7	11
Aiken	8	6	5	8	7	8
Langley	7	5	5	13	10	11
Williston	4	3	2	15	9	7
New Ellenton	4	2	3	17	12	8
North Augusta	3	2	3	10	8	19
Barnwell	2	1	1	24	10	8
Allendale	1	1	1	23	11	7
Waynesboro	1	1	1	20	9	11
Clearwater	1	1	1	15	9	13
Augusta	1	1	1	13	9	11
Blackville	1	1	1	12	8	8
Sardis	1	1	1	10	8	7

Radioactivity in Seepage Basins

700 AREA

Waste discharged to the 700-Area seepage basins during the report period was approximately 39 mc nonvolatile beta and 28 mc alpha in 600,000 gallons of water. Results of analyses of monthly water samples collected from Basin 1 are summarized in the following table.

Alpha, d/m/ml Max	Avg	Prev Avg	Nonvolatile Beta, 1×10^{-12} c/ml Max	Avg	Prev Avg
5.0	3.0	0.8	140	47	53

TNX

TNX and CMX discharge waste to a seepage basin which overflows to the Savannah River swamp. Results of analyses of 26 weekly water samples samples from the basin are summarized in the following table.

Alpha, d/m/ml			Nonvolatile Beta, 1×10^{-12} c/ml		
Max	Avg	Prev Avg	Max	Avg	Prev Avg
17	4.2	3.4	55	11	3.2

200 AREAS

The F and H seepage basins and monitoring well systems are shown in figure 5.

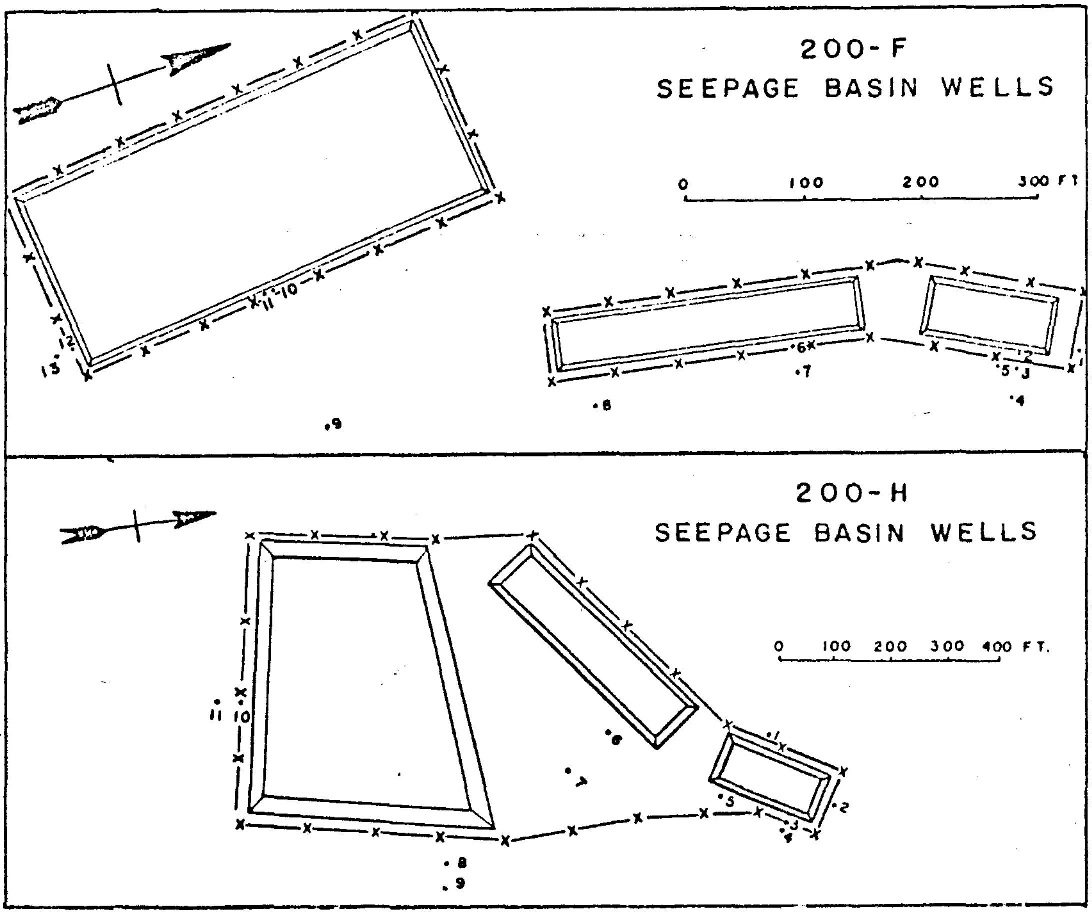

Figure 5. Seepage-Basin Monitoring Wells in F and H Areas

F AREA. During the report period, the average liquid waste input to the system was 3.8×10^4 gal/day and the average seepage and evaporation rate was 2.3×10^4 gal/day.

Waste released to the system is shown in the table below.

	Radioactivity Released in 6.8×10^6 Gallons of Water
Alpha, mc	520
Nonvolatile Beta, c	13
Radioiodine, c	1.1

Results of analyses of 66 water samples collected from the basins during the report period are summarized in the following table.

	Radioactivity in Water					
	Alpha, d/m/ml			Nonvolatile Beta, 1×10^{-12} c/ml		
Basin Number	Max	Avg	Prev Avg	Max	Avg	Prev Avg
1	134	40	25	940	470	1200
2	26	18	15	537	290	640
3	21	13	30	550	225	730

Specific analyses of samples from Basin 1 showed that the nonvolatile beta was composed of approximately 35% zirconium-niobium, 30% rare earths, 21% ruthenium, and 8% strontium. The alpha was approximately 60% uranium and 40% plutonium.

H AREA. During the report period the average liquid waste input to the basins was 6.4×10^4 gal/day and the average seepage and evaporation rate was 5.1×10^4 gal/day.

	Radioactivity Discharged in 11.6×10^6 Gallons of Water
Alpha, mc	130
Nonvolatile Beta, c	14
Radioiodine, c	10

Results of analyses of 66 water samples collected from the basins are summarized in the following table.

	Radioactivity in Water								
	Alpha, d/m/ml			Nonvolatile Beta, 1 × 10^{-12} c/ml			Radioiodine, 1 × 10^{-12} c/ml		
Basin No.	Max	Avg	Prev Avg	Max	Avg	Prev Avg	Max	Avg	Prev Avg
1	15	5	12	700	325	560	690	160	1050
2	6	2	3	140	70	100	140	30	480
3	1.5	0.7	2	150	40	60	14	4	230

Specific analyses of samples collected from Basin 1 showed that the nonvolatile beta was composed of approximately 59% ruthenium, 30% zirconium-niobium, 7% rare earths, and 1% strontium. The alpha was approximately 80% uranium and 20% plutonium.

MONITORING WELLS; F AREA. Results of analyses of 75 samples are summarized in the following table.

			Radioactivity in Water					
			Alpha 1 × 10^{-3} d/m/ml			Nonvolatile Beta, 1 × 10^{-15} c/ml		
Well No.	Depth to Water, ft	Distance from Basin, ft	Max	Avg	Prev Avg	Max	Avg	Prev Avg
1	22.8 - 23.6	34	410	146	290	43,000	30,000	40,000
2	64.5 - 68.0	5	6	3	4	340	89	1,200
3	63.5 - 66.6	29	5	4	4	21	15	18
4	64.1 - 68.6	73	4	2	-	10	9	-
5	16.4 - 16.5 (Dry)	24	50*	-	-	<76*	-	-
6	12.0 - 13.5	6	54	48	88	21,000	15,000	21,000
7	11.5 - 13.3 (Dry)	46	38	31	54	13,000	7,900	13,000
8	63.0 - 66.3	63	2	2	3	12	10	26
9	56.9 - 59.4	150	2	1	2	38	14	24
10	6.0 - 8.2	9	1400	900	420	120,000	85,000	122,000
11	64.6 - 67.9	9	4	3	2	55	39	42
12	10.2 - 12.3	29	140	43	190	24,000	15,000	52,000
13	12.1 - 12.9	58	69	44	6	34,000	21,000	9,200

* One sample only.

MONITORING WELLS; H AREA. Results of analyses of 66 samples are summarized in the following table.

Well No.	Depth of Water, ft	Distance from Basin, ft	Alpha, 1 x 10^{-3} d/m/ml Max	Alpha Avg	Alpha Prev Avg	Nonvolatile Beta, 1 x 10^{-15} c/ml Max	Beta Avg	Beta Prev Avg	Radioiodine, 1 x 10^{-15} c/ml Max	Radioiodine Avg	Radioiodine Prev Avg
1	20.7 - 24.0	24	310	200	200	19,000	9700	11,000	110	67	430
2	19.2 - 23.1	25	2	1	2	29	14	56	-	-	-
3	16.7 - 20.2	15	1	1	1	62	34	40	-	-	-
4	16.2 - 19.5	[illegible]	1	1	2	25	16	31	-	-	-
5	18.4 - 21.3	13	82	44	180	15,000	5600	76,000	1100	360	79,000
6	21.2 - 24.[illegible]	6	2	1	1	44	18	46	-	-	-
7	20.0 - 23.6	66	4	1	2	78	21	41	-	-	-
8	15.4 - 17.0	18	2	1	1	41	19	38	-	-	-
9	12.3 - 14.1	78	2	1	1	140	40	42	-	-	-
10	15.4 - 17.8	19	3	1	1	110	30	42	-	-	-
11	11.4 - 13.6	79	1	1	1	75	41	42	-	-	-

100-AREA SEEPAGE BASINS

R AREA. The R-Area seepage basins and monitoring wells are shown in figure 6.

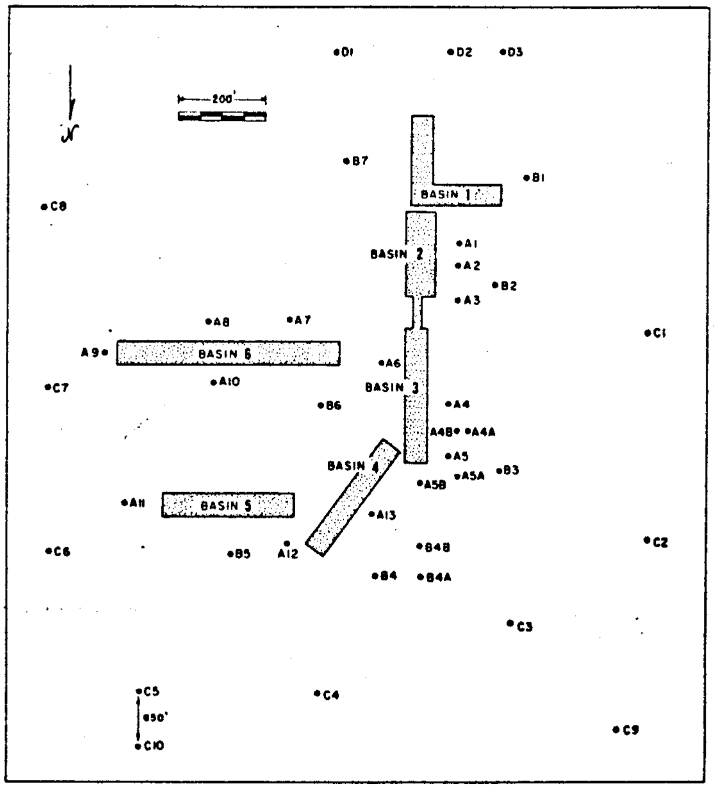

Figure 6. 100-R Seepage Basins and Monitoring Wells

Basins 5 and 6 are not connected directly to Basin systems 2, 3, and 4. Discharge to the Basin 5 was begun in January and was directly from the emergency section of the R-Area disassembly basin. Discharge to Basin 6 (begun in March) was accomplished by pumping water from Basin systems 2, 3, and 4.

Nonvolatile beta discharged to the basins and results of analyses of 113 weekly water samples collected from the basins are shown in the following table.

	Nonvolatile Beta Discharged to Basins, curies	Nonvolatile Beta in Water, 1×10^{-9} c/ml				
		Basin 2	Basin 3	Basin 4	Basin 5	Basin 6
January	251	45	36	41	-	-
February	148	25	24	21	11	-
March	94	17	17	14	11	-
April	5	8.4	9.0	9.6	5.8	3.9
May	9	3.6	6.3	5.6	0.7	2.2
June	0	3.0	4.8	4.4	1.2	1.3
Total	507					
Previous Total	2130*					
Average		17	16	16	5.9	2.5
December 1957 Avg		54	52	56	-	-

* To Basins 1, 2, 3, and 4 during November and December.

Radiostrontium concentrations in water collected from the basins ranged from 30 to 70% of the nonvolatile beta concentrations.

Dispersion of radioactivity from the basins was detected by radioautographs of adhesive papers placed in vertical positions on the fences surrounding the basins. The results of radioautographs of 414 weekly samples are compared to radioautographs of samples from control locations (influenced only by bomb fallout) in the following table.

	Particles/Square Foot/Week					
	Control*	Basin 2	Basin 3	Basin 4	Basin 5	Basin 6
January	1.4	1.3	2.8	1.2	5.5	-
February	0.1	6.0	0	0.9	200	-
March	0.7	0.9	0.7	1.1	3.4	-
April	2.2	4.1	4.4	9.7	5.0	3.2
May	1.4	8.0	5.3	7.0	7.9	2.0
June	1.1	8.1	7.0	3.9	7.8	3.6
Average	1.2	4.7	3.4	4.0	38.3	2.9

* Burial ground fence.

The high concentration at Basin 5 during February was due to the deposition of large quantities of particulate or droplet radioactivity on the papers in place at the basins during January 30 through February 5. One paper, collected from the fence at the east end of the basin showed the deposition of 3600 particles/square foot, and beta-gamma radiation from the radioactivity on the paper was approximately 2500 counts per minute (Thyac). The occurrence of the deposition at the only basin not covered by screening suggests the possibility of water fowl spreading contamination from the basin.

From April through June, radioactive insects and spiders were observed on the adhesive papers, and individual mosquitoes contained as much as 20,000 d/m beta activity, due primarily to radiostrontium and radiocesium.

Seepage of radioactivity from the basins was detected in two of the monitoring wells. Seventeen water samples collected from the A-4 well contained an average of 28×10^{-12} c/ml nonvolatile beta with a maximum of 34×10^{-12} c/ml in a sample collected on February 13, and 16 water samples collected from the A-5 well contained an average concentration of 7.8×10^{-12} c/ml with a maximum of 11.2×10^{-12} c/ml in a sample collected on March 6. All of the nonvolatile beta was due to radiostrontium. Both of these wells are approximately 40 feet from the basin water. The average DF between the wells and the basin was approximately 600 for well A-4 and 2000 for well A-5.

Readings of 107 film badges exposed at the seepage basin fences in the zones most greatly influenced by radiation from the basins are summarized in the following table.

Basin No.	Radiation Level, mr/week	
	Max	Avg
2	350	230
3	5300	1900
4	275	170
5	495	250
6	95	60*

* Three-month average.

P AREA. Nonvolatile beta discharged to the P-Area seepage basins was approximately 0.7 curie, due to vacuum cleaner discharge and radioactivity associated with a failed fuel element. The results of analyses of 26 water samples collected from Basin 1 are summarized in the following table.

Nonvolatile Beta in Water, 1×10^{-12} c/ml		
Max	Avg	Previous Avg
280	33	2000*

* Five-month average.

Film badges exposed at the fence surrounding the basins showed that radiation levels were highest at the end of Basin 1 near the inlet pipe. The average radiation level at this location was 110 mr/week, with a maximum of 445 mr/week indicated by a badge exposed during January 9 through 15.

Radioautographs of adhesive papers placed at the basin fence showed no significant spread of particulate radioactivity from the basins.

C AREA. Waste released to the C-Area seepage basin consisted of intermittent discharges of nonvolatile beta due to vacuum cleaner operations in the C-Area disassembly basin. Results of analyses of 26 water samples collected from the seepage basin are summarized in the following table.

Nonvolatile Beta in Water, 1×10^{-12} c/ml

Max	Avg	December 1957 Average
130	7.8	7.6

Film badges exposed at the seepage basin fence in the zone of greatest radiation showed that the six-month average radiation level was 100 mr/week, with a maximum of 595 mr during the two-week period ending June 25.

No spread of particulate radioactivity from the basin was observed.

L AREA. The L-Area seepage basin received radioactive waste from two sources. Decontamination of filters and equipment at the basin during January through May released an estimated 15 curies of nonvolatile beta to the basin, and the dewatering of a section of the L-Area disassembly basin resulted in the discharge of approximately 16 curies of nonvolatile beta to the basin in June. Most of the radioactivity due to the dewatering operations was in the form of a sludge which had accumulated on the disassembly basin floor. Results of analyses of 26 water samples collected from the basin are summarized in the following table.

Nonvolatile Beta in Water, 1×10^{-12} c/ml

Max	Avg	Previous 3-Month Average
840	260	130

Film badges located at the seepage basin fence in the zone of highest radiation levels indicated a six-month average radiation level of 620 mr/week, with a maximum of 1600 mr/week during the week ending April 16.

Adhesive papers located on the basin fence collected an average of 2.0 radioactive particles/ft^2/week, as compared to the collection of 1.2 particles/ft^2/week at control locations.

Radioactivity in Biological Specimens

TERRESTRIAL SPECIMENS

The uptake of radioactivity by 18 terrestrial animals collected at random on the Plant site was generally confined to thyroid concentration of radioiodine (maximum 680 $\times 10^{-12}$ c/gm) and low level concentrations of nonvolatile beta in the bones (maximum 50 $\times 10^{-12}$ c/gm). One exception worthy of note was a raccoon collected near Lower Three Runs in March which contained 75 $\times 10^{-12}$ c/gm of nonvolatile beta in the fleshy tissues, due primarily to the presence of Cs-134 and Cs-137.

AQUATIC SPECIMENS

A total of 614 aquatic specimens, including 110 algae samples, 246 fish, 100 shrimp, 84 minnows, 18 crayfish, 14 turtles, 39 oysters, 2 otters, and one alligator were collected and radioanalyzed. Radioisotopes found in algae included the rare earths, Sr-89, Sr-90, Ru-103, Ru-106, Zr-Nb-95, Cr-51, Cs-134, Cs-137, and trace amounts of Fe-59 and Co-60. Since Lower Three Runs and Steel Creek continued to be the main contributors of radioactivity to the Savannah River, emphasis continued on the collection and radioanalysis of aquatic specimens from these streams. Aquatic specimens collected from Pen Branch, Four Mile Creek, and Upper Three Runs generally did not contain significant concentrations of radioactivity.

LOWER THREE RUNS. Algae contained higher concentrations of radioactivity than other aquatic specimens. Although the upstream algae concentrations of radioactivity were lower by a factor of 4 than reported last period, downstream algae concentrations remained essentially the same. The greater part of the radioactivity found in Lower Three Runs algae was due to the presence of Cs-134 and Cs-137.

Location, miles downstream from R Area	Nonvolatile Beta in Algae, 1 $\times 10^{-12}$ c/gm		
	Max	Avg	Prev Avg
2	32,000	15,000	39,000
18	1,000	870	800

Turtles collected from Lower Three Runs generally contained substantial concentrations of nonvolatile beta in the bones (maximum 1400 $\times 10^{-12}$ c/gm) and flesh (maximum 900 $\times 10^{-12}$ c/gm) due to the presence of radiostrontium in the bones and radiocesium in the flesh.

Two otters collected 15 miles below R Area in January and an alligator collected four miles below R Area in March contained very low level concentrations of nonvolatile beta in the bones (maximum 25×10^{-12} c/gm) and flesh (maximum 40×10^{-12} c/gm). Clams collected ten miles below the area contained a maximum of 880×10^{-12} c/gm in the shells and 280×10^{-12} c/gm in the flesh. Concentrations of nonvolatile beta in crayfish and shrimp collected 10 miles downstream from R Area decreased, while concentrations in samples collected 15 miles downstream from R Area showed no significant changes. Results of the analyses are shown in the following table.

Location, miles downstream from R Area	Nonvolatile Beta in Crayfish and Shrimp, 1×10^{-12} c/gm		
	Max	Avg	Prev Avg
10	1000	600	1400
15	650	410	430

Nonvolatile beta concentrations in the organs of Lower Three Runs fish increased and maximum concentrations ranged from 2 to 10 times higher than maximum concentrations reported the last period. Radiostrontium and radiocesium were the primary contributors of radioactivity in the bony structures and in the fleshy tissues, respectively.

Location, miles downstream from R Area	Nonvolatile Beta in Fish, 1×10^{-12} c/g					
	In Bone			In Flesh		
	Max	Avg	Prev Avg	Max	Avg	Prev Avg
4	4500	1600	420	800	460	20
10	600	300	170	150	75	10
15	440	160	60	100	30	10

Detectable concentrations of Sr-90 were found in flesh of Lower Three Runs fish in May and June. The concentrations in the flesh of fish collected at downstream locations were less than the concentration observed in fish collected near R Area and, equally important, the percentage of fish containing detectable flesh concentrations of Sr-90 also decreased as the distance downstream increased.

Radioactivity in Flesh of Fish Collected During May and June, 1×10^{-12} c/g

Location, miles downstream from R Area	Samples: Total	Samples: Containing Detectable Radiostrontium	Nonvolatile Beta	Total Sr	Sr-90
2	7	7	465	6.1	3.9
4	15	7	160	3.4	2.0
15	12	1	60	1.2	0.7

STEEL CREEK. Nonvolatile beta concentrations in algae samples collected two miles below P Area decreased by a factor of 11 while concentrations in algae collected ten miles below the area were essentially the same as those observed during the previous report period.

Location, miles downstream from P Area	Nonvolatile Beta in Algae, 1×10^{-12} c/gm: Max	Avg	Prev Avg
2	18,000	7000	80,000
10	2,000	800	700

Steel Creek fish collected routinely from a location 11 miles downstream from P Area contained significant but decreased concentrations of radioactivity in the bones, gills, scales and intestinal tracts. The fleshy tissues did not contain significant concentrations of radioactivity. The bones continued to be the highest concentrator of radioactivity and radiostrontium contributed approximately 45% of the total bone radioactivity. The average concentration of nonvolatile beta in the bones of fish collected during this period was lower by a factor of three than reported last period.

Radioactivity in Fish Bone, 1×10^{-12} c/g

Nonvolatile Beta			Radiostrontium		
Max	Avg	Prev Avg	Max	Avg	Prev Avg
230	80	240	100	35	130

SAVANNAH RIVER. An algae sample collected near the mouth of Lower Three Runs contained the maximum nonvolatile beta concentration (680×10^{-12} c/gm) found in Savannah River algae during the report period. Samples collected 15 miles downstream from the mouth of Lower Three Runs contained as much as 140×10^{-12} c/g. The maximum nonvolatile beta concentration found in algae collected above the mouth of Lower Three Runs was 130×10^{-12} c/gm.

Fish collected from the Savannah River near the mouth of Lower Three Runs generally contained low level concentrations of nonvolatile beta in the bones (maximum 400×10^{-12} c/gm; average 80×10^{-12} c/gm) and with the exception of one fish collected in June (flesh 30×10^{-12} c/gm) there were no significant concentrations in the fleshy tissues. Fish collected from Stokes Bluff, 60 miles below the mouth of Lower Three Runs, and from the mouth of Steel Creek did not contain significant concentrations of radioactivity in any organ. Oysters collected at the mouth of the Savannah River, approximately 150 miles below the Plant site in April, May, and June did not contain significant concentrations of radioactivity in either the shells or fleshy tissues.

TEA:bzs