Virgil C. Summer Environmental Surveillance Laboratory
Jenkinsville, South Carolina

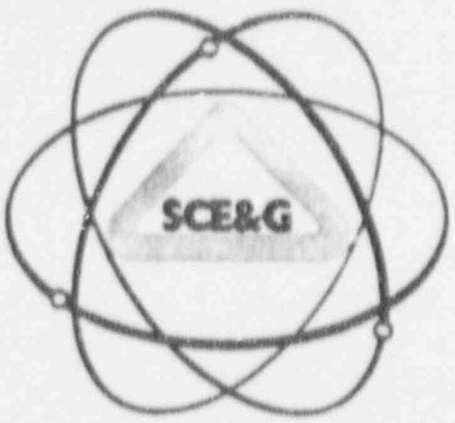
RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

VIRGIL C. SUMMER NUCLEAR STATION

FOR THE OPERATING PERIOD

JANUARY 1, 1990 - DECEMBER 31, 1990

APRIL 1991



V. C. SUMMER NUCLEAR STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY

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Executive Summary

1. Results of the 1990 Land Use Census indicated no significant movement of critical receptors except for a new maximally exposed individual 1.1 miles in the East sector. There were no locations identified where a calculated dose exceeded limits specified in VCSNS Technical Specifications, Section 4.11.2.3.

2. There was no detection of radioactivity in environmental media attributed to gaseous effluent releases from VCSNS.

3. Activated corrosion products attributed to liquid effluent releases from VCSNS were detected in fish and sediment. Radiation dose to the general public attributed to this activity is a small fraction of the observed variation in natural background radiation.

4. Detection of fission product activity in environmental media is attributed to liquid effluent releases from VCSNS and residual fallout from other sources. Radiation dose to the general public attributed to this activity is a small fraction of the observed variation in natural background.

5. Results of the Radiological Environmental Monitoring Program substantiate the continuing adequacy of source control at VCSNS and conformance of station operation to 10 CFR 50, Appendix I design goals.

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Introduction

Virgil C. Summer Nuclear Station (VCSNS) utilizes a pressurized water reactor rated at 2775 MWt (900 MWe gross). The station is located adjacent to the Monticello Reservoir near Jenkinsville, South Carolina, and approximately 26 miles northwest of Columbia. VCSNS achieved initial criticality on October 22, 1982, reached 50% power on December 12, 1982, and 100% power on June 10, 1983, following steam generator feedwater preheater modifications. VCSNS is currently operating in its sixth fuel cycle.

VCSNS is operated in conjunction with the adjacent Fairfield Pumped Storage Facility (FPSF) which consists of eight reversible pump-turbine units of 60 MWe capacity each. During periods of off-peak power demand, base load generating capacity is used to pump water from Parr Reservoir to Monticello Reservoir. Monticello Reservoir has a surface area of approximately 6800 acres and lies about 150 feet above Parr Reservoir whose full pool area is approximately 4400 acres. The pump-turbine units operate in the generating mode to meet peak system loads, while Monticello Reservoir also provides condenser cooling water for VCSNS. Cooling water intake and discharge structures are separated by a jetty to ensure adequate circulation within the reservoir.

VCSNS is located in Fairfield County which, with Newberry County, make up the principle area within a 10 mile radius of the plant. This area is mainly forest with only about 30% devoted to small-farming activities principally producing small grains, feed crops, and beef cattle. Significant portions of Lexington and Richland Counties are encompassed within the 20 mile radius of the plant and exhibit similar agricultural activities. Columbia, the state capital, is the only large city within the 50 mile radius of the plant. Small agricultural concerns are predominant, but make up less than 50% of the land area. The main industrial activity is concentrated around Columbia and is generally greater than 20 miles from VCSNS.

Liquid effluents from VCSNS are released into the Monticello/Parr Reservoirs at two discharge points: the Circulating Water Discharge Canal (CWDC) and the FPSF Penstocks. Unprocessed steam generator blowdown and non-nuclear drains are released to the CWDC. Effluent from the liquid waste processing system and processed steam generator blowdown is released through the penstocks. Radioactive gaseous effluents from VCSNS are released from two main points: the Main Plant Vent and the Reactor Building Purge Exhaust, both are considered to be ground level releases.

Radioactive liquid and gaseous releases from the facility, and their potential influence on the surrounding biota and man, are the primary concern of the Radiological Environmental Monitoring Program at VCSNS. This report summarizes the results of the Radiological Environmental Monitoring Program conducted during 1990. Data trends, control/indicator and preoperational/operational data intercomparisons and other data interpretations are presented.

Effluent dispersion characteristics, demography, hydrology, land use, anticipated source terms, and the critical paths specific to VCSNS have been considered in the selection of sample media, sampling and analysis frequencies, sample locations, and types of samples. These criteria were used to establish both the preoperational and operational phases of the Radiological Environmental Monitoring Program. A census of land use, perhaps the most dynamic of the criteria, is performed within a 5 mile radius of VCSNS to verify the adequacy of the program. The results of the land use census performed in 1990 are included in Table 2. A verification of the critical receptor (maximum exposed individual) in each sector around VCSNS based on 1990 meteorological data, VCSNS Final Safety Analysis Report, and VCSNS Operating License Environmental Report source terms is included in Table 2a.

Sector	Nearest Residence	Miles	Nearest Garden	Miles	Cattle	No. Milked	Miles	Goats	No. Milked	Miles
N	M. Martin	3.8	M. Martin[B]	3.8	E. Robinson	0	3.3			
NNE	Crumblin	3.9	I. Robinson[B]	3.4	E. Robinson	0	3.3			
NE	Herndon[A]	3.5	J. Robinson	2.9	Stone	0	2.1			
ENE	Willingham[A]	1.5	R. Martin[B]	1.6	R. Martin	0	1.6			
E	Joyner[A]	1.1	Joyner[B]	1.1	Boyd	0	1.8			
ESE	W. Martin	1.1	W. Martin	1.1						
SE	Pearson[A]	1.4	Summer	1.5						
SSE	Crumpton	2.5	Shealy	2.7						
S	L. Yarborough	3.4	Eargle	3.9	H. Yarborough[C]	0	3.9			
SSW	Ashe[A]	3.3	Airial	3.4	Miller	0	3.0	Cromer	0	3.4
SW	Nichols[A]	3.3	Nichols	3.3	Miller	0	2.8			
WSW	Hope	3.1	Davis[B]	3.1	Livingston	0	1.9			
W	B. Smith[A]	2.5	B. Smith	2.5	Livingston	0	2.7			
WNW	Weideman[A]	4.2	Ringer[B]	4.8	Graham[C]	0	4.7			
NW	Wright	3.9	Cole	4.1	Cole	0	4.1			
NNW	J. March	2.9	F. March	3.0	F. March	0	3.0			

A. Change in closest residence.
B. Change in closest garden.
C. Change in closest beef cattle.

Table 2 - Results of the August 1990 Land Use Census Verification

The most notable census items are: the nearest resident and garden are still located in the ESE sector at 1.1 miles and the E sector at 1.1 miles; there were no milking animals being milked within 5 miles of V. C. Summer Nuclear Station at the time of the census; the Radiological Analytical Services environmental garden is located ESE 1.0 miles from the plant, all other gardens analyzed are at local residences.

SECTOR	DISTANCE (Miles)	NAME	PATHWAY	1975 METEOROLOGICAL DATA			1990 METEOROLOGICAL DATA		
				X/Q	D/Q	DOSE RATE mRem/y	X/Q	D/Q	DOSE RATE mRem/y
[redacted]	3.7	E. Robinson	Beef (D)	1.6E-07	7.4E-10	8.0E-02	2.8E-07	7.2E-10	8.2E-02
N	3.8	M. Martin (B)*	Res/Gar	1.5E-07	7.0E-10	1.8E-01	2.7E-07	6.8E-10	1.9E-01
NNE	2.9	Crumblin	Res	3.2E-07	1.5E-09	1.2E-02	3.8E-07	1.2E-09	1.4E-02
NNE	3.3	E. Robinson	Beef (D)	2.5E-07	1.1E-09	1.2E-01	3.0E-07	8.6E-10	9.7E-02
NNE	3.3	I. Robinson (B)*	Res/Gar	2.5E-07	1.1E-09	2.9E-01	3.0E-07	8.6E-10	2.4E-01
NE	1.5	Herndon (A)	Res	1.4E-06	8.1E-09	5.4E-02	1.9E-06	7.3E-09	7.2E-02
NE	2.1	Stone	Res/Beef	6.8E-07	3.6E-09	3.8E-01	9.4E-07	3.2E-09	3.6E-01
NE	2.8	J. Robinson*	Res/Gar/Beef	3.7E-07	1.8E-09	6.5E-01	5.2E-07	1.6E-09	6.0E-01
ENE	1.5	Willingham (A)	Res	1.2E-06	6.8E-09	4.6E-02	2.1E-06	6.8E-09	7.9E-02
ENE	1.6	R. Martin (B)*	Res/Gar/Beef	1.1E-06	5.8E-09	2.1E+00	1.8E-06	5.8E-09	2.2E+00
E	1.1	J. Joyner (A,B)*	Res/Gar	2.2E-06	1.2E-08	3.1E+00 (E)	2.6E-06	8.2E-09	2.2E+00
E	1.7	M. Boyd	Beef	8.4E-07	4.2E-09	(F)	9.9E-07	2.8E-09	(F)
E	1.8	M. Boyd	Res/Gar	7.4E-07	3.6E-09	1.4E+00	8.7E-07	2.4E-09	9.5E-01
ESE	1.1	W. Martin, Jr.*	Res/Gar	2.2E-06	8.4E-09	2.2E+00	1.8E-06	5.8E-09	1.6E+00
SE	1.4	Pearson (A)	Res	1.9E-06	7.0E-09	7.2E-02	6.4E-07	2.3E-09	2.4E-02
SE	1.5	Summer*	Res/Gar	1.6E-06	5.8E-09	1.6E+00	5.5E-07	2.0E-09	.4E-01
SSE	2.5	Crumpton	Res	3.5E-07	1.2E-09	1.3E-02	1.2E-07	5.0E-10	4.6E-03
SSE	2.7	Shealy*	Res/Gar	3.0E-07	1.0E-09	2.7E-01	1.0E-07	4.2E-10	1.1E-01
S	3.4	L. Yarborough	Res	2.1E-07	5.0E-10	7.8E-03	5.8E-08	4.8E-10	3.8E-03
S	3.9	Eargle*	Res/Gar	1.7E-07	3.7E-10	1.1E-01	7.4E-08	3.5E-10	9.2E-02
S	3.9	H. Yarborough (C)	Beef (D)	1.7E-07	3.7E-10	4.3E-02	7.4E-08	3.5E-10	3.8E-02
SSW	2.9	Miller	Beef (D)	2.8E-07	1.0E-09	1.1E-01	1.9E-07	1.4E-09	1.5E-01
[redacted] SW	3.3	Ashe (A)	Res	2.1E-07	7.0E-10	7.9E-03	1.4E-07	1.1E-09	5.6E-03
SSW	3.4	Ariail*	Res/Gar	2.0E-07	6.4E-10	1.7E-01	1.3E-07	9.8E-10	2.5E-01
SW	2.8	Miller	Beef (D)	3.6E-07	1.5E-09	1.6E-01	1.9E-07	1.7E-09	1.8E-01
SW	3.3	Nichols (A)*	Res/Gar	2.6E-07	1.0E-09	2.7E-01	1.3E-07	1.1E-09	2.8E-01
WSW	1.9	Livingston*	Beef (D)	6.4E-07	3.2E-09	3.4E-01	3.2E-07	2.1E-09	2.2E-01
WSW	3.1	Hope	Res	2.3E-07	1.0E-09	8.7E-03	1.1E-07	6.6E-10	4.3E-03
WSW	3.1	Davis (B)	Res/Gar	2.3E-07	1.0E-09	2.6E-01	1.1E-07	6.6E-10	1.7E-01
W	2.5	B. Smith (A)	Res/Gar	2.5E-07	1.1E-09	2.9E-01	1.4E-07	6.3E-10	1.7E-01
W	2.2	Livingston	Beef	3.2E-07	1.5E-09	(G)	1.8E-07	8.6E-10	(G)
W	2.7	Livingston*	Res/Gar	2.2E-07	9.2E-10	3.9E-01	1.2E-07	5.3E-10	2.3E-01
WNW	4.2	Weideman (A)	Res	7.6E-08	2.9E-10	2.9E-03	3.8E-08	1.4E-10	1.4E-03
WNW	4.8	Ringer (B)*	Res/Gar	5.9E-08	2.2E-10	5.9E-02	2.9E-08	1.0E-10	2.7E-02
WNW	4.9	Graham (C)	Beef(D)	5.7E-08	2.1E-10	2.3E-02	2.8E-08	9.9E-11	1.1E-02
NW	3.9	Wright	Res	1.1E-07	4.6E-10	4.2E-03	9.3E-08	3.0E-10	3.5E-03
NW	4.1	Cole*	Res/Gar	9.6E-08	4.1E-10	1.1E-01	8.4E-08	2.7E-10	7.3E-02
NNW	2.9	J. March	Res	1.9E-07	1.1E-09	7.4E-03	3.3E-07	1.0E-09	1.2E-02
NNW	3.0	F. March*	Res/Gar/Beef	1.8E-07	9.8E-10	3.5E-01	3.1E-07	9.2E-10	3.4E-01

* Denotes Critical Receptor for the sector.
(A) Change of closest residence for the sector (from 1989 Census).
(B) Change of closest garden for the sector.
(C) Change of closest beef cattle for the sector.
[redacted] Residence assumed in calculations.
(E) Maximum exposed individual for the site.
(F) Dose rate calculations based on residence & garden at 1.8 miles and beef cattle at 1.7 miles. (See East sector at 1.8 miles for dose rate.)
(G) Dose rate calculations based on residence & garden at 2.7 miles and beef cattle at 2.2 miles. (See West sector at 2.7 miles for dose rate.)

Table 2a - Critical Receptors in 1990
Based on FSAR/OLER Projected Source Terms

In addition to preoperational/operational data intercomparisons, control/indicator data intercomparisons are utilized to assess the probability that any observed abnormal measurement of radioactivity concentration is due to random or regional fluctuations rather than to a true increase in local environmental radioactivity concentration. Monitoring sites indicative of plant operating conditions are generally located within a 5 mile radius of the plant as shown in Table 3 and Figures 1-2 and 1-3. Monitoring sites at distances greater than 10 miles from the plant are shown in Figure 1-1 and are indicative of conditions away from plant influence.

Information is gained through multiple types of sampling and measurements at specific locations. Several multiple sampling combinations are in use around the VCSNS. All air sampling locations are also environmental dosimetry monitoring locations. At these points airborne plant effluents are monitored for gamma immersion dose (noble gases), airborne particulates, and radioiodine. Three of these locations have additional complementary sampling/measurement pathways for monitoring plant effluents. Sampling locations 6 (1.0 mi ESE) and 8 (1.5 mi ENE) have broadleaf vegetation gardens for monitoring the gaseous effluent deposition and ingestion pathway in the two sectors having the highest deposition coefficients (D/Q). Sampling location 18 (16.5 mi S) also has a broadleaf vegetation garden for monitoring the gaseous effluent deposition and ingestion pathway at a control location.

Liquid effluents are monitored through three pathways (fish, bottom sediment, and surface water) at the three most probable affected bodies of water around the plant: Site 21, Parr Reservoir (2.7 mi SSW); Site 23, Monticello Reservoir (0.5 mi ESE); and Site 24, Recreation Lake (5.5 mi N). The control location for liquid effluent comparisons is at Site 22, Neal Shoals (30.0 mi NNW) on the Broad River.

The Radiological Environmental Monitoring Program participated in four laboratory intercomparison programs during 1990. Results of the 1990 EPA Intercomparison Program are included in Table 4. Results of the intercomparison program with the count room at VCSNS are included in Table 5. Results of an intercomparison program with SCDHEC outlined in Table 6 are reported by SCDHEC. Results of an environmental dosimetry intercomparison with the NRC are included in Table 7. The results of each of these four quality control checks of the Radiological Environmental Monitoring Program verify the technical credibility of analytical data generated and reported by the program.

The program, as it has evolved since the preoperational (baseline) monitoring program, incorporating all the elements of the VCSNS Technical Specifications and additional special studies is detailed in Tables 8 and 9.

Results and Discussion

The results of the Radiological Environmental Monitoring Program for 1990 are summarized in Table 10. For comparative purposes, preoperational data is summarized in Table 11. Certain samples were not collected during 1990 and are not included in the annual summary. A listing of these program exceptions and their respective causes are included in Table 12. Despite the program exceptions, the Radiological Environmental Monitoring Program was able to attain a completion rate of 99%. Detailed analysis of the impact of these omissions verified that program quality has not been affected, and there were no violations of Technical Specification requirements.

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
1	Borrow Pit	1.2	182.0 S	DQ
2	Transmission Line	1.2	225.0 SW	AP,RI,DQ
3	Firing Range	1.2	270.0 W	DQ
4	Fairfield Hydro	1.2	289.5 WNW	DQ
5	Transmission Line Entrance	0.9	145.5 SE	AP,RI,DQ
6	Env. Lab Garden	1.0	104.0 ESE	AP,RI,DQ,GR,GA
7	Monticello Peninsula	1.2	83.0 E	DQ
8	Monticello Res. S of Rd 224	1.5	63.0 ENE	AP,DQ,GA
9	Ball Park	2.2	44.0 NE	DQ
10	Meteorological Tower #2	2.5	25.5 NNE	AP,RI,DQ
11	Residence	3.3	8.0 N	DQ
12	Old Hwy 99	4.2	349.0 N	DQ
13	North Dam	2.9	334.0 NNW	AP,DQ
14	Dairy	6.3	270.0 W	AP,RI,DQ,MK,GR
15	Parr Village	2.5	204.0 SSW	DQ
16	Dairy	28.0	281.0 W	DQ,GW,MK,GR
17	Columbia Water Works	24.7	144.0 SE	AP,RI,DQ,SW,DW,BS
18	Residence/Pine Island Club[4]	16.5	165.0 S	DQ,SW,GA
19	Residence/Little Saluda	17.9	207.0 SSW	DQ
20	Residence/Whitmire	22.0	310.0 NW	DQ
21	Parr Reservior	2.7	199.5 SSW	SW,FH,BS
22	Neal Shoals[6]	30.0	343.0 NNW	SW,FH,BS
23	Discharge Canal (Mont. Res.)	0.5	104.5 ESE	SW,FH,BS
24	Recreation Lake	5.5	2.0 N	SW,FH,BS
25	Fairfield Pumped Storage (Monticello Res.)	0.9	302.0 WNW	SW
26	On Site Well (P2)	460 Ft	270.0 W	GW
27	On Site Well (P5)	510 Ft	180.0 S	GW
28	Nuclear Training Center (EOF)[5]	2.4	168.0 SSE	DW
29	Trans. Line WSW of VCSNS	0.9	248.0 WSW	DQ
30	Oak Tree North of Borrow Pit	1.0	197.0 SSW	DQ
31	McCrorey-Liston School	5.8	12.5 NNE	DQ
32	Dirt Rd off Rd 205	4.5	25.0 NNE	DQ
33	Rd 48 near Hwy 213	4.2	70.0 ENE	DQ
34	Rd 419 North of Hwy 60	4.8	112.5 ESE	DQ
35	Unnamed Circle Road off Hwy 215	4.8	137.5 SE	DQ
36	Woods Behind Jenk. Post Office	3.1	151.5 SSE	DQ
37	Residence	4.9	305.5 NW	DQ
38	FPSF Trailrace	1.3	280.0 W	BS
39	LMWTF	14.0	168.0 SSE	DW
41	End of Catwalk	3.9	185.0 S	DQ
42	Store	3.9	199.0 SSW	DQ

Table 3 - Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
43	Hwy 176 and Rd 435	5.2	236.0 SW	DQ
44	Rd 28 at Cannon's Creek	2.9	255.5 WSW	DQ
45	Rd 33 at Pomaria	5.9	253 WSW	DQ
46	Rd 28 at Heller's Creek	3.7	292.0 WNW	DQ
47	Fairfield Tailrace	1.0	316.0 NW	DQ
48	Cemetary	2.3	318.5 NW	DQ
49	North Rd 383	4.0	332.5 NNW	DQ
50	New Rd 99 (West Shore)	5.5	1.0 N	DQ
51	New Rd 99 (East Shore)	5.5	5.0 N	DQ
52	Monticello (Rd 11)	3.9	14.0 NNE	DQ
53	Rd 359	3.0	48.0 NE	DQ
54	Jenkinsville School	1.7	73.0 ENE	DQ
55	St. Barnabas Church	2.9	94.0 E	DQ
56	Old Jenkinsville Diner	2.0	144.0 SE	DQ
57	Residence/Highway 213 and 215	2.7	146.0 SE	DQ
58	Residence	2.5	158.0 SSE	DQ
59	Nuclear Training Center (EOF)[5]	2.4	168.0 SSE	DQ,AP
60	Rd 98 near Rd 28	3.5	275.0 W	DQ
61	Switchyard, SE Entrance to Plant	0.1	180.0 S	DQ
62	East of Training Bldg.	0.13	220.0 SW	DQ
63	East of Daniel's Office	0.17	270.0 W	DQ
64	Riprap W of Intake	0.13	338.5 NNW	DQ,BS
65	Guard Tower	0.13	22.5 NNE	DQ,BS
66	Jetty	0.6	33.0 NNE	DQ
67	Service Water Pond (East Side)	0.5	72.0 ENE	DQ
68	Fuel Oil Storage Tank	0.2	108.5 ESE	DQ
69	Exclusion Buoy NNW on Monticello Res.	1.0	337.0 NNW	DQ
70	Exclusion Buoy N on Monticello Res.	1.0	0.0 N	DQ
71	Temperature Buoy on Monticello Res.	5.4	3.0 N	DQ
72	Yard Drain Outfall	0.4	146.0 SE	BS
73	Yard Drain Outfall	0.4	270.0 W	BS
74	Yard Drain Outfall	0.5	246.0 WSW	SW
75	Onsite Well (P)	265 ft.	270.0 W	GW
76	Onsite Well (P)	270 ft.	330.0 NNW	GW
84	Congaree River	54.2	135.0 SE	BS
85	Congaree River	53.8	135.0 SE	BS
87	Lake Marion	72.0	138.0 SE	BS
88	Lake Marion	72.0	138.0 SE	BS

Table 3 - Sampling Site Locations (continued)

FOOTNOTES

1. Distance given is the distance between the site location and the center of the VCSNS reactor containment building.

2. Direction given is direction in degrees from true north-south line through the center of the reactor containment building.

3. Sample Types:

AP = Air Particulate	DW = Drinking Water
RI = Air Radioiodine	MK = Milk
DQ = Quarterly TLD	GR = Grass (Forage)
SW = Surface Water	GA = Garden
GW = Ground Water	FH = Fish
	BS = Bottom Sediment

4. Site 18 consists of 3 locations in close proximity next to Lake Murray. Garden product samples are taken at the Wyse residence. Surface water is taken near the shoreline in Lake Murray. The TLD is located on Pine Island.

5. Site 28 for drinking water and site 59 for quarterly TLD measurements and continuous air sampling are co-located at the location of the SCE&G Nuclear Training Center which also serves as the Virgil C. Summer Station Emergency Offsite Facility.

Table 3 - Sampling Site Locations (continued)

Comparison Study (Measurement Unit)	Date	Nuclide	EPA Value (precision)	Laboratory Results (error)	Agreement
Air filter (pCi/filter)	3/90	alpha	5 (5)	6 (1)	Yes
		beta	31 (5)	36 (1)	Yes
		Cs-137	10 (5)	12 (2)	Yes
	8/90	alpha	10 (5)	13 (1)	Yes
		beta	62 (5)	68 (2)	Yes
		Cs-137	20 (5)	25 (1)	Yes
Gamma in Water(pCi/liter)	2/90	Ba-133	74 (7)	80 (3)	Yes
		Co-60	15 (5)	15 (1)	Yes
		Zn-65	139 (14)	142 (6)	Yes
		Ru-106	139 (14)	129 (1)	Yes
		Cs-134	18 (5)	17 (1)	Yes
		Cs-137	18 (5)	18 (2)	Yes
	6/90	Ba-133	99 (10)	102 (3)	Yes
		Co-60	24 (5)	23 (2)	Yes
		Zn-65	148 (15)	144 (4)	Yes
		Ru-106	210 (21)	207 (1)	Yes
		Cs-134	24 (5)	22 (2)	Yes
		Cs-137	25 (5)	24 (3)	Yes
	10/90	Ba-133	110 (11)	113 (2)	Yes
		Co-60	20 (5)	22 (2)	Yes
		Zn-65	115 (12)	113 (5)	Yes
		Ru-106	151 (15)	144 (9)	Yes
		Cs-134	12 (5)	13 (1)	Yes
		Cs-137	12 (5)	12 (0)	Yes
Gross Alpha/Beta in Water (pCi/liter)	1/90	alpha	12 (5)	8 (2)	Yes
		beta	12(5)	13(1)	Yes
	5/90	alpha	22(6)	9 (1)	No*
		beta	15 (5)	30 (1)	No*
	9/90	alpha	10 (5)	6 (1)	Yes
		beta	10 (5)	16 (1)	Yes
Iodine in Water (pCi/liter)	2/90	I-131	106 (11)	111 (3)	Yes
	8/90	I-131	39 (6)	40 (1)	Yes
Laboratory Blind (pCi/liter)	4/90	beta	52 (5)	44 (0)	Yes
		Cs-134	15 (5)	15 (0)	Yes
		Cs-137	15 (5)	17 (2)	Yes
	10/90	alpha	62 (16)	53 (3)	Yes
		beta	53 (5)	47 (3)	Yes
		Cs-134	7 (5)	8(0)	Yes
		Cs-137	5 (5)	6 (1)	Yes
Radionuclides in Milk (pCi/liter)	4/90	I-131	99 (10)	108 (5)	Yes
		Cs-137	24 (5)	26 (3)	Yes
	9/90	I-131	58 (6)	65 (3)	Yes
		Cs-137	20 (5)	22 (2)	Yes
Tritium in Water (pCi/liter)	2/90	H-3	4976 (498)	3838 (251)	No +
	6/90	H-3	2933 (358)	2739 (152)	Yes
	11/90	H-3	7203 (720)	6941 (46)	Yes

*The results reported to the EPA were inadvertently switched. The actual results were within EPA acceptable range.

+ An instrument setting problem caused the results to be biased low. The problem was subsequently corrected.

Table 4 - Results of 1990 EPA Intercomparison Program

Comparison Study (Measurement Unit)	Date	Nuclide	Envir. Laboratory Results	2nd Lab Results(1)	Agreement
Tritium (µCi/ml) (Analytics)	2/90	H-3	2.50E-4	2.63E-4	Yes
Tritium (µCi/ml) (Analytics)	11/90	H-3	1.89E-3	2.04E-3	Yes
(VCSNS)	12/90	H-3 (undistilled)	2.37E-5	2.38E-5	Yes
(VCSNS)	12/90	H-3 (distilled)	2.46E-5	2.40E-5	Yes
Gross Beta Liquid (µCi/ml)	2/90	N/A	1.25E-3	1.25E-3	Yes
Gross Alpha Liquid (µCi/ml)	2/90	N/A	7.66E-5	9.76E-5	Yes
Charcoal Canister (µCi/filter)	5/90	I-131	1.86E-1	2.98E-1	No (2)
Gross Beta (µCi/ml)	8/90	N/A	2.28E-3	2.44E-3	Yes
Gross Alpha (µCi/ml)	8/90	N/A	7.54E-4	7.98E-4	Yes
Gamma Isotopic Liquid (µCi/ml)	2/90	Ce-144	8.80E-3	8.73E-3	Yes
		Ce-141	8.40E-3	8.54E-3	Yes
		Cr-51	2.41E-2	2.31E-2	Yes
		Cs-134	5.23E-3	5.62E-3	Yes
		Cs-137	4.13E-3	3.83E-3	Yes
		Mn-54	8.27E-3	7.99E-3	Yes
		Fe-59	1.21E-2	1.15E-2	Yes
		Zn-65	5.85E-3	5.55E-3	Yes
		Co-60	1.25E-2	1.24E-2	Yes
	5/90	Ce-144	1.19E-2	1.14E-2	Yes
		Ce-141	4.49E-3	4.51E-3	Yes
		Cr-51	1.68E-2	1.60E-2	Yes
		Cs-134	4.57E-3	4.79E-3	Yes
		Cs-137	6.15E-3	5.98E-3	Yes
		Co-58	4.17E-3	4.20E-3	Yes
		Mn-54	8.15E-3	7.88E-3	Yes
		Fe-59	8.41E-3	8.04E-3	Yes
		Zn-65	8.25E-3	8.01E-3	Yes
		Co-60	1.13E-2	1.10E-2	Yes
	8/90	Ru-103	7.40E-3	7.14E-3	Yes
		Ce-144	1.18E-2	1.10E-2	Yes
		Ce-141	1.04E-2	9.92E-3	Yes
		Cr-51	4.05E-2	4.23E-2	Yes
		Cs-134	6.26E-3	6.90E-3	Yes
		Cs-137	5.65E-3	5.61E-3	Yes
		Co-58	4.22E-3	4.10E-3	Yes
		Mn-54	8.25E-3	7.92E-3	Yes
		Fe-59	8.35E-3	7.94E-3	Yes
		Zn-65	1.31E-2	1.26E-2	Yes
		Co-60	8.93E-3	8.85E-3	Yes
NRC Liquid (µCi/ml)	10/90	H-3 (distilled)	4.96E-5	5.53E-5	Yes
Gamma Isotopic Point Source(µCi/ml)	5/90	Ce-144	4.11E-2	3.79E-2	Yes
		Ce-141	1.61E-2	1.49E-2	Yes
		Cr-51	5.67E-2	5.30E-2	Yes
		Cs-134	1.56E-2	1.59E-2	Yes
		Cs-137	2.05E-2	1.98E-2	Yes
		Co-58	1.39E-2	1.39E-2	Yes
		Mn-54	2.75E-2	2.61E-2	Yes
		Fe-59	2.75E-2	2.66E-2	Yes
		Zn-65	2.75E-2	2.65E-2	Yes
		Co-60	3.81E-2	3.65E-2	Yes

Comparison Study (Measurement Unit)	Date	Nuclide	Envir. Laboratory Results	2nd Lab Results(1)	Agree-ment
Gamma Isotopic Filter (µCi/filter)	8/90	Ce-144	4.51E-2	4.24E-2	Yes
		Ce-141	3.83E-2	3.83E-2	Yes
		Cr-51	1.54E-1	1.63E-1	Yes
		Cs-134	2.32E-2	2.66E-2	Yes
		Cs-137	2.29E-2	2.17E-2	Yes
		Co-58	1.68E-2	1.58E-2	Yes
		Mn-54	3.43E-2	3.06E-2	Yes
		Fe-59	3.50E-2	3.06E-2	Yes
		Zn-65	5.58E-2	4.88E-2	Yes
		Co-60	3.54E-2	3.42E-2	Yes
Silver Zeolite Canister (µCi/filter)	11/90	I-131	3.45E-2	3.17E-2	Yes
Gas Sample (µCi/ml)	5/90	Xe-133	5.05E0	4.67E0	Yes
		Kr-85	9.30E+1	8.27E+1	Yes

(1) Independent Laboratory was Analytics, Inc., except for some tritium intercomparisons.

(2) The charcoal canister was inadvertently counted on the wrong side, producing a low result.

Table 5-Results of 1990 Intercomparison Program with Independent Lab

Pathway (Units)	Sample Location	Frequency	Nuclide[1]
Surface Water (pCi/liter)	No. 21	Monthly	^{3}H Mixed Gamma
	No. 22	Monthly	^{3}H Mixed Gamma
Air (pCi/m^3)	No. 6	Monthly	Gross Beta Iodine Mixed Gamma
	No. 17	Monthly	Gross Beta Iodine Mixed Gamma
Milk (pCi/liter)	No. 14	Monthly	Mixed Gamma
Sediment (pCi/kg)	No. 23	Semiannually	Mixed Gamma
Fish (pCi/kg)	No. 23	Semiannually	Mixed Gamma
Vegetation (pCi/kg)	No. 6	Semiannually	Mixed Gamma

1. Intercomparison results were not yet available for publication in this report. Results will be reported by SCDHEC.

Table 6 - Summary of 1990 Intercomparison Program with South Carolina Department of Health and Environmental Control

NRC TLD STATION NO.	LABORATORY TLD STATION NO.	1989 FOURTH QUARTER RESULTS (uR/hr)			1990 FIRST QUARTER RESULTS (uR/hr)			1990 SECOND QUARTER RESULTS (uR/hr)			1990 THIRD QUARTER RESULTS (uR/hr)		
		NRC	Laboratory	Percent Difference	NRC	Laboratory	Percent Difference	NRC	Laboratory	Percent Difference	NRC	Laboratory	Percent Difference
1	42	11.4	6.7	-41.2	9.2	6.6	-28.3	10.6	7.5	-29.2	9.6	6.9	-28.1
2	6	---	7.6	---	9.0	7.5	-16.7	7.0	8.9	27.1	9.5	8.5	-10.5
5	54	9.6	10.6	10.6	10.2	10.7	4.9	8.8	12.2	38.6	11.0	7.9	-28.2
7	*53	11.6	11.3	-2.8	11.9	11.3	-5.0	10.9	13.1	20.2	12.8	11.9	-7.0
9	*52	12.8	11.7	-8.7	11.6	11.3	-2.6	12.2	12.6	3.3	11.9	12.2	2.5
11	*12	7.6	8.3	8.6	7.6	7.8	2.6	---	9.9	---	10.6	8.9	-16.0
13	13	11.8	11.4	-3.1	10.4	11.0	5.8	11.6	13.8	19.0	11.2	13.7	22.3
14	*44	---	6.2	---	9.1	5.9	-35.2	6.8	6.9	1.5	9.4	6.6	-29.8
19	*56	9.0	8.1	-10.0	9.4	8.3	-11.7	8.9	9.0	1.1	9.6	8.6	-10.4
22	58	8.6	5.8	-32.6	6.7	5.5	-17.9	8.2	6.2	-24.4	7.6	6.0	-21.0
24	41	8.9	8.3	-6.6	7.7	8.9	15.6	8.9	9.8	10.1	8.3	9.6	15.7
29	*60	10.8	10.6	-1.8	10.3	10.1	-1.9	10.3	11.5	11.7	11.2	10.6	-5.4
30	46	10.1	8.4	-17.2	10.5	7.8	-25.7	9.2	10.0	8.7	12.1	13.9	14.9

* Co-located dosimeters within 10 feet of NRC dosimeter.

Table 7 - Results of Environmental Dosimetry Intercomparison with NRC TLD Direct Radiation Monitoring Network

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
AIRBORNE:				
I. Particulate	A) 3 Indicator samples to be taken at locations (in different sectors) beyond, but as close to the exclusion boundary as practicable, where the highest offsite sectorial ground level concentrations are anticipated.	Continuous sampler operation with weekly collection.	2 5 10	Gross beta following filter change; monthly composite (by location) for gamma isotopic.
	B) 1 Indicator sample to be taken in the sector beyond, but as close to the exclusion boundary as practicable, corresponding to the residence having the highest anticipated offsite ground level concentration or dose.	Continuous sampler operation with weekly collection.	6	Gross beta following filter change; monthly composite (by location) for gamma isotopic.
	C) 1 Indicator sample to be taken at the location of one of the dairies most likely to be affected.	Continuous sampler operation with weekly collection.	14	Gross beta following filter change; monthly composite (by location) for gamma isotopic.
	D) 1 Control sample to be taken at a location at least 10 air miles from the site and not in the most prevalent wind directions.	Continuous sampler operation with weekly collection.	17	Gross beta following filter change; monthly composite (by location) for gamma isotopic.
II. Radioiodine	A) 3 Indicator samples to be taken at two locations as given in I(A) above.	Continuous sampler operation with weekly canister collection.	2 5 10	Gamma isotopic for Iodine 131
	B) 1 Indicator sample to be taken at the location as given in I(B) above.	Continuous sampler operation with weekly canister collection.	6	Gamma isotopic for Iodine 131
	C) 1 Indicator sample to be taken at the location as given in I(C) above.	Continuous sampler operation with weekly canister collection.	14	Gamma isotopic for Iodine 131
	D) 1 Control sample to be taken at a location similar in nature to I(D) above.	Continuous sampler operation with weekly canister collection.	17	Gamma isotopic for Iodine 131

Table 8-Radiological Environmental Monitoring Program Specifications

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
III. Direct	A) 13 Indicator stations to form an inner ring of stations in the 13 accessible sectors within 1 to 2 miles of the plant.	Quarterly exchange; two or more dosimeters at each location.	1,2,3,4, 5,6,7,8, 9,10,29, 30,47	Gamma dose quarterly.
	B) 16 Indicator stations to form an inner ring of stations in the 16 accessible sectors within 3 to 5 miles of the plant.	Quarterly exchange; two or more dosimeters at each location.	12,14,32, 33,34,35 36,37,41, 42,43,45, 46,49, 53,55	Gamma dose quarterly.
	C) 20 Stations to be placed in special interest areas such as population centers, nearby residences, schools, and in 2 or 3 areas to serve as controls.	Quarterly exchange; two or more dosimeters at each location.	11,13,15, 16,17,18, 19,20,31, 44,48,50, 51,52,54, 56,57,58 59,60	Gamma dose quarterly.
WATERBORNE: IV. Surface Water	A) 1 Indicator sample downstream to be taken at a location which allows for mixing and dilution in the ultimate receiving river.	Time composite samples with collection every month.	21	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.
	B) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Time composite samples with collection every month.	22	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.
	C) 1 Indicator sample from a location immediately upstream of the nearest downstream municipal water supply.	Time composite samples with collection every month.	17	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.

Table 8-Radiological Environmental Monitoring Program Specifications

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
WATERBORNE: IV. Surface Water (continued)	D) 1 Indicator sample to be taken in the upper reservoir of the pumped storage facility.	Time composite samples with collection every month.	23	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.
	E) 1 Indicator sample to be taken in the upper reservoir's non-fluctuating recreational area.	Grab sampling monthly.	24	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.
	F) 1 Control sample to be taken at a location on a separate unaffected watershed reservoir.	Grab sampling monthly.	18	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.
V. Ground Water	A) 2 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly grab sampling.	26 27	Gamma isotopic and tritium analyses quarterly.
	B) 1 Control sample from unaffected location.	Quarterly grab sampling.	16	Gamma isotopic and tritium analyses quarterly.
VI. Drinking Water	A) 1 Indicator sample from a nearby public ground water supply source.	Monthly grab sampling.	28	Monthly gamma isotopic, gross beta and tritium analyses.
	B) 1 Indicator (finished water) sample from the nearest downstream water supply.	Monthly composite sampling.	17	Monthly gamma isotopic, gross beta and tritium analyses.
	C) 1 Control (finished water) sample from the nearest unaffected public water supply.	Monthly composite sampling.	39	Monthly gamma isotopic, gross beta and tritium analyses.

Table8-Radiological Environmental Monitoring Program Specifications

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
INGESTION:				
VII. Milk	A) Samples from milking animals in 3 locations within 5 km having the highest dose potential. If there are none, then 1 sample from milking animals in each of 3 areas between 5 to 8 km distance where doses are calculated to be greater than 1 mrem per year.	Biweekly grab sample	[illegible]	Gamma isotopic and I-131 analysis biweekly.
	B) 1 Control sample to be taken at the location of a dairy > 20 miles distance and not in the most prevalent wind direction.	Biweekly grab sample	16	Gamma isotopic and I-131 analysis biweekly.
	C) 1 Indicator grass (forage) sample to be taken at one of the locations beyond, but as close to the exclusion boundary as practicable, where the highest offsite sectorial ground level concentrations are anticipated.	Monthly when available	6	Gamma isotopic.
	D) 1 Indicator grass (forage) sample to be taken at the location of VII(A) above when animals are on pasture.	Monthly when available	[illegible]	Gamma isotopic.
	E) 1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly when available	16	Gamma isotopic.
VIII. Food Products	A) Two samples of broadleaf vegetation grown in 1 location of special interest and 1 in the nearest offsite location of highest calculated annual average ground level D/Q if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5-10 km where the doses are calculated to be greater than 1 mrem/yr.	Monthly when available	6 8	Gamma isotopic on edible portion.
	B) 1 Control sample for the same foods in VIII(A) taken at a location at least 10 miles distance and not in the most prevalent wind direction.	Same as for VIII(A), as appropriate.	18	Gamma isotopic on edible portion.

Table 8-Radiological Environmental Monitoring Program Specifications

osure thway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & F ncy of Analysis
IX. Fish	A) 1 indicator sample to be taken at a location in the upper reservoir.	Semiannual collection of the following specie types if available: bass; bream; crappie; catfish; carp; forage fish (shad).	23	Gamma isotopic on edible portions semiannually.
	B) 1 Indicator sample to be taken at a location in the lower reservoir.	Semiannual collection of the following specie types if available: bass; bream; crappie; catfish; carp; forage fish (shad).	21	Gamma isotopic on edible portions semiannually.
	C) 1 Indicator sample to be taken at a location in the upper reservoir's non-fluctuating recreational area.	Semiannual collection of the following specie types if available: bass; bream; crappie; catfish; carp; forage fish (shad).	24	Gamma isotopic on edible portions semiannually.
	D) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual collection of the following specie types if available: bass; bream; crappie; catfish; carp; forage fish (shad).	22	Gamma isotopic on edible portions semiannually.
AQUATIC: X. Sediment	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual grab sample.	23	Gamma isotopic.
	B) 1 Indicator sample to be taken at a location in the upper reservoir's non-fluctuating recreational area.	Semiannual grab sample.	24	Gamma isotopic.
	C) 1 Indicator sample to be taken on the shoreline of the lower reservoir.	Semiannual grab sample.	21	Gamma isotopic.
	D) 1 Control sample to be taken at a location on the receiving river sufficiently far upstream such that no effects of pumped storage operation are anticipated.	Semiannual grab sample.	22	Gamma isotopic.

Table 8-Radiological Environmental Monitoring Program Specifications

Exposure Pathway and/or Sample		Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
AIRBORNE:					
I. Particulate	E)	3 Indicator samples to be taken at locations (in different sectors) beyond, but as close to the exclusion boundary as practicable, and nearer to the plant than the nearest critical receptor for the chosen sector.	Continuous sampler operation with weekly collection.	8 13 59	Gross beta following filter change; Monthly Composite (by location) for gamma isotopic
III. Direct	D)	8 Stations to be placed within the exclusion boundary (Special Study).	Quarterly exchange; two or more dosimeters at each location.	61,62 63,64 65,66 67,68	Gamma dose quarterly.
	E)	3 Stations to be placed on buoys on Monticello Reservoir (Background Study).	Quarterly exchange; two or more dosimeters at each location.	69 70 71	Gamma dose quarterly.
WATERBORNE:					
IV. Surface Water	G)	1 indicator sample to be taken in the upper reservoir at the intake of the pumped storage facility.	Time composite samples with collection every month.	25	Gamma isotopic monthly with quarterly composite (by location) or monthly sample to be analyzed for tritium.
INGESTION:					
VII. Milk	F)	Samples from milking animals in 3 locations within 5 km having the highest dose potential. If there are none then 1 sample from milking animals in each of 3 areas between 5 to 8 km distance where doses are calculated to be greater than 1 mrem per year.	Biweekly grab sample	14	Gamma isotopic and I-131 analysis biweekly.
	G)	1 Indicator grass (forage) sample to be taken at the location of VII(A) above when animals are on pasture.	Monthly when available	14	Gamma isotopic.

Table 9-Supplemental Radiological Environmental Monitoring Progr...1

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
VIII. Food Products	C) 1 Indicator sample of each of the various types of foods grown in the area surrounding the plant.	Annually during growing season.	6	Gamma isotopic on edible portion.
	D) 1 Control sample of the same foods collected in VIII(c) at a location at least 10 miles distance and not in the most prevalent wind direction.	Annually during growing season.	18	Gamma isotopic on edible portion.
AQUATIC: X. Sediment	E) 1 Indicator sample to be taken at a location immediately upstream of the nearest downstream municipal water supply.	Semiannual grab sample.	17	Gamma isotopic.
	F) Four (4) additional indicator samples to be taken at various locations on Congaree River between Broad River and Lake Marion.	Semiannual grab sample.	84,85 87,88	Gamma isotopic.

Table 9-Supplemental Radiological Environmental Monitoring Program

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (Range)		
Air Particulate (pCi/m^3)	Gross Beta (312)	(1.0E-2)	2.1E-2 (260/260) (0.6E-2 to 5.0E-2)	Site 14, Dairy (6.3 mi W)	2.2E-2(52/52) (1.1E-2 to 4.3E-2)	2.0E-2 (52/52) (0.8E-2 to 3.5E-2)	0
	Gamma Spec (72)						
	Cs-134	1.8E-3 (5.0E-2)	All < LLD			All < LLD	0
	Cs-137	2.0E-3 (6.0E-2)	All < LLD			All < LLD	0
Air Radioiodine (pCi/m^3)	I-131(312)	2.0E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] (μR/hr)	Gamma(136) Quarterly	5E0	9.2E0 (116/116) (6.1E0 to 12.9E0)	Site 55, St. Barnabas Church (2.8 mi, E)	13.2E0 (4/4) (12.7E0 to 13.8E0)	9.2E0 (20/20) (6.8E0 to 12.4E0)	0
	Gamma(60) Special Interest	5E0	9.3E0 (60/60) (5.9E0 to 12.9E0)	Site 13, North Dam (2.9 mi, NNW)	12.9E0 (4/4) (5.9E0 to 12.9E0)	N/A	0
Surface Water (pCi/l)	H-3(84)	4.5E + 2 (2.0E + 3)	5.7E + 2 (3/60) (5.1E + 2 to 6.9E + 2)	Site 21, Parr Reservoir (2.7 mi, SSW)	6.9E + 2 (1/12) (< LLD to 6.9E + 2) LLD = 4.6E + 2	All < LLD	0
	Gamma Spec (90)						
	Mn-54	2.8E0 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	3.4E0 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	6.9E0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	3.2E0 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	6.2E0 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	5.0E0 (3.0E + 1)	All < LLD			All < LLD	0
	Nb-95	3.4E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-134	2.6E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	2.9E0 (1.8E + 1)	All < LLD			All < LLD	0

Table 10 - 1990 Radiological Environmental Monitoring Program Summary

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (Range)		
	Ba-140	1.8E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	6.0E0 (1.5E + 1)	All < LLD			All < LLD	0
Ground Water (pCi/l)	H-3(12)	4.7E2 (2.0E + 3)	All < LLD			All < LLD	0
	Gamma Spec (8)					Gamma Spec (4)	
	Mn-54	3.4E0 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	3.1E0 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	6.9E0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	3.5E0 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	7.2E0 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	4.9E0 (3.0E + 1)	All < LLD			All < LLD	0
	Nb-95	3.4E0 (1.5E + 1)	All < LLD			All < LLD[8]	0
	Cs-134	2.8E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	3.2E0 (1.8E + 1)	All < LLD			All < LLD	0
	Ba-140	1.1E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	5.1E0 (1.5E + 1)	All < LLD			All < LLD[8]	0
Drinking Water[6] (pCi/l)	Gross Beta (36)	2.1E0 (4.0E0)	4.0E0 (18/20) (2.5E0 to 7.9E0)	Site 28, NTC (2.4 mi, SSE)	4.4E0 (10/13) (2.8E0 to 7.9E0)	3.3E0 (9/13) (2.4E0 to 4.7E0)	0
	H-3(36)	4.6E + 2 (2.0E + 3)	All < LLD			All < LLD	0
	Gamma Spec (36)						
	Mn-54	2.9E0 (1.5E + 1)	All < LLD			All < LLD	0

Table 10 - 1990 Radiological Environmental Monitoring Program Summary

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual (Max.)	All Indicator Locations Mean[3] (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (Range)		
	Co-58	3.1E0 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	7.1E0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	3.2E0 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	6.5E0 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	5.2E0 (3.0E + 1)	All < LLD			All < LLD	0
	Nb-95	3.4E0 (1.5E + 1)	All < LLD			All < LLD	0
	I-131	6.6E-1 (1.0E0)	All < LLD			All < LLD	0
	Cs-134	2.7E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	3.0E0 (1.8E + 1)	All < LLD			All < LLD	0
	Ba-140	1.8E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	7.2E0 (1.5E + 1)	All < LLD			All < LLD	0
Milk (pCi/l)	Gamma Spec (52)						
	I-131	5.7E-1 (1.0E0)	All < LLD			All < LLD	0
	Cs-134	3.2E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	3.7E0 (1.8E + 1)	3.0E0 (13/26) (1.7E0 to 4.2E0)	Site 14, Dairy (6.3 mi W)	3.0E0 (13/26) (1.7E0 to 4.2E0)	2.0E0 (4/26) (1.2E0 to 2.6E0)	0
	Ba-140	11.5E0 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	4.0E0 (1.5E + 1)	All < LLD			All < LLD	0
Grass (pCi/kg wet)	Gamma Spec (35)						

Table 10 - 1990 Radiological Environmental Monitoring Program Summary

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection[2] Actual (Mean)	All Indicator Locations Mean[3] (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (Range)		
	I-131	2.1E+1 (6.0E+1)	All < LLD			All < LLD	0
	Cs-134	1.7E+1 (6.0E+1)	All < LLD			All < LLD	0
	Cs-137	1.9E+1 (8.0E+1)	All < LLD			All < LLD	0
Broadleaf Vegetation (pCi/kg wet)	Gamma Spec (36)						
	I-131	1.7E+1 (6.0E+1)	All < LLD			All < LLD	0
	Cs-134	1.3E+1 (6.0E+1)	All < LLD			All < LLD	0
	Cs-137	1.6E+1 (8.0E+1)	All < LLD			All < LLD	0
Other Vegetation (pCi/kg wet)	Gamma Spec(4)						
	I-131	3.0E+1 (6.0E+1)	All < LLD			All < LLD	0
	Cs-134	9.4E0 (6.0E+1)	All < LLD			All < LLD	0
	Cs-137	9.6E0 (8.0E+1)	All < LLD			All < LLD	0
Fish (pCi/kg wet)	Gamma Spec (33)						
	Mn-54	1.1E+1 (1.3E+2)	All < LLD			All < LLD	0
	Co-58	1.1E+1 (1.3E+2)	All < LLD			All < LLD	0
	Fe-59	2.7E+1 (2.6E+2)	All < LLD			All < LLD	0
	Co-60	1.5E+1 (1.3E+2)	All < LLD			All < LLD	0
	Zn-65	3.4E+1 (2.6E+2)	All < LLD			All < LLD	0
	Cs-134	9.5E+1 (1.3E+2)	All < LLD			All < LLD	0

Table 10 - 1990 Radiological Environmental Monitoring Program Summary

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed[1]	Lower Limit of Detection[2] Actual[3] (Max.)	All Indicator Locations Mean[3] (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (Range)		
	Cs-137	1.2E + 1 (1.5E + 2)	1.8E + 1 (15/23) (9.3E0 to 3.5E + 1)	Site 21, Parr Res. (2.7mi, SSW)	2.1E + 1 (4/10) (1.2E + 1 to 3.5E + 1)	1.5E + 1 (8/8) (9.7E0 to 2.3E + 1)	0
Sediment (pCi/kg)[7]	Gamma Spec (16)						
	Mn-54	2.2E + 1	4.7E + 1 (1/12) (Single Value)	Site 23, Discharge Canal (Monticello Res.) (0.5 mi, ESE)	1.6E + 1 (1/4) (Single Value)	All < LLD	0
	Co-58	2.3E + 1	All < LLD			All < LLD	0
	Co-60	3.5E + 1	9.7E + 1 (8/12) (2.0E + 1 to 1.4E + 2)	Site 23, Discharge Canal (Monticello Res.) (0.5 mi, ESE)	1.1E + 2 (4/4) (6.5E + 1 to 1.4E + 2)	All < LLD	0
	Cs-134	2.5E + 1 (1.5E + 2)	3.9E + 1 (7/12) (1.1E + 1 to 8.6E + 1)	Site 23, Discharge Canal (Monticello Res.) (0.5 mi, ESE)	5.1E + 1 (3/4) (2.5E + 1 to 8.6E + 1)	All < LLD	0
	Cs-137	(1.8E + 2)	2.0E + 2 (12/12) (5.2E + 1 to 3.6E + 2)	Site 23, Discharge Canal (Monticello Res.) (0.5 mi, ESE)	2.5E + 2 (4/4) (2.3E + 2 to 2.9E + 2)	8.1E + 1 (4/4) (3.1E + 1 to 1.6E + 2)	0

Table 10 - 1990 Radiological Environmental Monitoring Program Summary

Footnotes

1. Does not include supplemental samples. All supplemental sample results were consistent with the tabulated results shown.

2. Values given are MDA values calculated from the program data analyses with maximum acceptable LLD values allowed from NRC guidelines given in parentheses.

3. Mean and range are based on detectable measurements only. The fractions of detectable measurements at specific locations are indicated in parentheses.

4. Any confirmed measured level of radioactivity in any environmental medium that exceeds the reporting requirements of VCSNS Technical Specification 3.12.1.

5. Detection sensitivity is approximately 5 mrem/yr (0.5 μR/hr) determined from the analyses of five years of preoperational data.

6. Elevated levels of Pb-214 and Bi-214 were observed in all Jenkinsville drinking water samples. The values are not reported here because they are naturally occurring (do not originate from VCSNS) and furnish no quantifiable information of interest.

7. Elevated levels of Pb-214 and Bi-214 plus other Ra-226 daughter products and Ac-228 plus other Th-232 daughter products were observed in all sediment samples. The values are not reported here because they are naturally occurring (do not originate from VCSNS) and furnish no quantifiable information of interest.

8. Maximum LLDs were not met in one control sample because of high Bi-214 and Pb-214 activity interference.

Table 10 - 1990 Radiological Environmental Monitoring Program Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection [1] Actual (Max.)	All Indicator Locations Mean[2] (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (Range)		
Air Particulate (pCi/m^3) (1981-1982)	Gross Beta (1300)	4.1E-3 (1.0E-2)	1.1E-1 (562/564)[4] (1.3E-2 to 5.5E-1) 2.7E-2 (456/462)[4] (9.3E-3 to 6.6E-2)	Site 13, North Dam (2.9 mi NNW) Site 8, Mon. Res. S of Rd 224 (1.5 ENE)	1.3E-1(52/52) (2.1E-2 to 5.5E-1) 3.0E-2(42/42) (1.2E-2 to 6.0E-2)	1.2E-1 (153/155) (7.9E-3 to 6.1E-1) 2.8E-2 (125/126) (1.2E-2 to 5.8E-2)	0
	Gamma Spec (307)						
	Cs-134	3.0E-3 (1.0E-2)	All < LLD			All < LLD	0
	Cs-137	3.1E-3 (1.0E-2)	3.2E-3 (22/241) (1.5E-3 to 5.2E-3)	Site 10, Met Tower (2.4 mi NNE)	3.8E-3 (2/22) (2.5E-3 to 5.2E-3	4.2E-3 (4/66) (3.2E-3 to 5.6E-3)	0
Air Radioiodine (pCi/m^3) (1982)	I-131(290)	3.6E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] (uR/hr) (1978-1982)	Gamma(1220) Monthly	0.5	9.9(915/915) (6.7 to14.7)	Site 13, North Dam (2.9 mi NNW)	13.1(61/61) (12.2 to 14.2)	9.7(305/305) (6.4 to 13.5)	0
	Gamma(161) Quarterly	0.5	10.2(154/154) (6.8 to14.7)	Site 55, St. Barnabas Church (2.8 mi E)	14.0(7/7) (13.1 to 14.7)		0
Surface Water (pCi/l) (1981-1982)	H-3(43)	1.1E + 3 (2.0E + 3)	1.4E + 3 (18/29) (1.1E + 3 to 2.4E + 3)	Site 17, Columbia Canal (24.7 mi, SE)	1.6E + 3 (2/7) (1.4E + 3 to 1.8E + 3)	1.2E + 3 (6/14) (6.7E + 2 to 1.6E + 3)	0
	Gamma Spec (140)						
	Mn-54	2.7E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	2.9E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	6.0E0 (3.0E + 1)	All < LLD			All < LLD	0

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection [1] Actual (Max.)	All Indicator Locations Mean[2] (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (Range)		
	Co-60	2.4E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	7.9E-1 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	5.2E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Nb-95	3.3E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-134	3.0E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	2.2E-1 (1.8E + 1)	All < LLD			All < LLD	0
	Ba-140	2.2E0 (6.0E + 1)	All < LLD			All < LLD	0
	La-140 (1982 only)	5.5E-1 (1.5E + 1)	All < LLD			All < LLD	0
Ground Water (pCi/l)(1-1982)	H-3(29)	9.0E + 2 (2.0E + 3)	1.5E + 3 (16/16) (9.5E + 2 to 2.3E + 3)	Site 26, Onsite Well P4 (265 ft, W)	1.6E + 3 (8/8) (9.5E + 2 to 2.3E + 3)	1.3E + 3 (13/13) (1.0E + 3 to 1.9E + 3)	0
	Gamma Spec (32)						
	Mn-54	3.7E0 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	3.8E0 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	7.8E0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	3.8E0 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	8.1E0 (3.0E + 1)	All < LLD			All < LLD	0

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection[1] Actual (Max.)	All Indicator Locations Mean[2] (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (Range)		
	Zr-95	6.8E0 (1.5E + 1)	All < LLD			All < LLD	0
	Nb-95	4.6E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-134	3.7E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	3.8E0 (1.8E + 1)	All < LLD			All < LLD	0
	Ba-140	1.9E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	La-140 (1982 only)	5.0E0 (1.5E + 1)	All < LLD			All < LLD	0
Drinking Water[6] (pCi/l) (1981-1982)	Gross Beta[7]	(2.0E0)					
	H-3(14)	6.3E + 2 (1.0E + 3)	7.8E + 2 (6/14) (6.8E + 2 to 9.8E + 2)	Site 28, Jenkinsville (2.0 mi SE)[7]	8.4E + 2 (3/7) (7.0E + 2 to 9.8E + 2)		
	Gamma Spec (44)						0
	Mn-54	3.0E-1 (1.5E + 1)	All < LLD				0
	Co-58	2.7E-1 (1.5E + 1)	All < LLD				0
	Fe-59	9.6E0 (3.0E + 1)	All < LLD				0
	Co-60	2.6E-1 (1.5E + 1)	All < LLD				0
	Zn-65	3.4E-1 (3.0E + 1)	All < LLD				0
	Zr-95	4.8E-1 (1.5E + 1)	All < LLD				0

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection [1] Actual (Max.)	All Indicator Locations Mean[2] (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (Range)		
	Nb-95	3.4E-1 (1.5E + 1)	All < LLD				0
	I-131	7.4E-1 (1.0E0)	All < LLD				0
	Cs-134	2.2E-1 (1.0E + 1)	All < LLD				0
	Cs-137	2.4E-1 (1.8E + 1)	All < LLD				0
	Ba-140	2.5E0 (6.0E + 1)	All < LLD				0
	La-140 (1982 only)	4.4E-1 (1.5E + 1)	All < LLD				0
Milk (pCi/l) (1981-1982)	Gamma Spec (94)						
	I-131	6.3E-1 (1.0E0)	All < LLD			All < LLD	0
	Cs-134	3.3E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	4.6E0 (1.5E + 1)	4.1E0 (8/47) (2.8E0 to 6.1E0)	Site 14, Dairy (5.1 mi., W)	4.1E0 (8/47) (2.8E0 to 6.1E0)	5.7E0 (37/47) (3.7E0 to 9.2E0)	0
	Ba-140	1.1E + 1 (1.5E + 1)	All < LLD			All < LLD	0
	La-140	4.4E0 (1.5E + 1)	All < LLD			All < LLD	0
Grass (pCi/kg wet) (1981-1982)	Gamma Spec (82)						
	I-131	6.7E + 1 (6.0E + 1)	All < LLD			All < LLD	0

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection [1] Actual (Max.)	All Indicator Locations Mean[2] (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (Range)		
	Cs-134	2.7E + 1 (8.0E + 1)	All < LLD			All < LLD	0
	Cs-137	3.3E + 1 (8.0E + 1)	5.0E + 1 (13/51) (1.6E + 1 to 1.6E + 2)	Site 14, Dairy (5.1 mi W)	5.9E + 1 (5/29) (1.6E + 1 to 1.6E + 2)	1.3E + 2 (6/31) (1.3E + 1 to 3.4E + 2)	0
Broadleaf Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (10)						
	I-131	3.7E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	Cs-134	1.9E + 1 (8.0E + 1)	All < LLD			All < LLD	0
	Cs-137	2.1E + 1 (8.0E + 1)	5.1E + 1 (2/7) (1.8E + 1 to 3.6E + 1)	Site 2, Trans. Line (1.2 mi SW)	3.6E + 1 (1/1) (Single Value)	All < LLD	0
Other Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (32)						
	Cs-134	8.4E0 (8.0E + 1)	All < LLD			All < LLD	0
	Cs-137	1.0E + 1 (8.0E + 1)	All < LLD			All < LLD	0
Fish (pCi/kg wet) (1980-1982)	Gamma Spec (92)						
	Cs-134	1.4E + 1 (1.3E + 2)	All < LLD			All < LLD	0
	Cs-137	1.8E + 1 (1.3E + 2)	2.8E + 1 (50/71) (1.1E + 1 to 1.0E + 2)	Site 24, Recreation Lake (5.5 mi, N)	3.4E + 1 (17/23) (1.2E + 1 to 1.0E + 2)	3.1E + 1 (19/21) (1.0E + 1 to 7.9E + 1)	0
	Co-58	2.6E + 1 (1.3E + 2)	All < LLD			All < LLD	0

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Medium or Pathway Sampled (Unit of Measurement and Reporting Period)	Type and Total Number of Analyses Performed	Lower Limit of Detection [1] Actual (Max.)	All Indicator Locations Mean[2] (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (Range)		
	Mn-54	1.8E + 1 (1.3E + 2)	All < LLD			All < LLD	0
	Fe-59	9.0E + 1 (2.6E + 2)	All < LLD			All < LLD	0
	Zn-65	4.1E + 1 (2.6E + 2)	All < LLD			All < LLD	0
	Co-60	1.8E + 1 (1.3E + 2)	All < LLD			All < LLD	0
Sediment (pCi/kg) (1980-1982)	Gamma Spec (24)						
	Cs-134	2.3E + 1 (1.5E + 2)	All < LLD			All < LLD	0
	Cs-137	2.4E + 1 (1.5E + 2)	1.7E + 2 (12/18) (2.6E + 1 to 4.5E + 2)	Site 21, Parr Reservoir (2.7 mi,SSW)	2.6E + 2 (6/6) (2.6E + 1 to 4.5E + 2)	4.2E + 2 (6/6) (1.8E + 1 to 1.0E + 3)	0

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Footnotes

1. Values given are MDA values calculated from the program data analyses with maximum acceptable LLD values allowed from NRC guidelines given in parentheses.

2. Mean and range are based on detectable measurements only. The fractions of detectable measurements at specific locations are indicated in parentheses.

3. A nonroutine measurement is any confirmed measured level of radioactivity in any environmental medium that exceeds the reporting requirements of VCSNS Technical Specification 3.12.1.

4. The baseline values are high because of the fallout from the Chinese bomb test in 1980. The first set of data reflects the 1981 baseline. The second set of data reflects the 1982 baseline, essentially free of bomb test fallout. The 1982 data covers the period 1/1/82 - 10/22/82.

5. Detection sensitivity is approximately 5 mrem/yr (0.5 μR/hr) determined from the analyses of five years of preoperational data.

6. No control location was specified for drinking water during the preoperational monitoring period.

7. Inconclusive data. Refer to the Preoperational Radiological Environmental Monitoring Report.

Table 11 - Radiological Environmental Monitoring Program Summary
Preoperational (Baseline) Summary

Media	Sample Location	Month (Week No.)	Cause for Exception
Air	6	September (36)	Incomplete samples attributed to air sampler power outages.
Grass	6	January (02) February (07) November (45) December (50)	Seasonal Unavailability
Broadleaf Vegetation	6	April (15) November (46)	Seasonal Unavailability
	8	January (02)	Seasonal Unavailability
Groundwater	16	September	Third quarter sample exceeded 100 day limit. Sample was taken in October (All Activity ≤ LLD).
Surface Water	22	January (02) May (19) June (23)	Grab samples were taken instead of time composite samples due to equipment failure.

Table 12 - 1990 Environmental Sampling Program Exceptions

Airborne gross beta activity measured in air particulate samples collected at indicator locations around VCSNS were consistent with preoperational levels and comparable to operational control levels. Mean preoperational control and indicator levels were 2.8E-2 and 2.7E-2 pCi/m^3, respectively. Mean indicator and control location measurements during 1990 were 2.0E-2 and 2.1E-2 pCi/m^3, respectively. The highest site specific mean activity was measured at indicator location no. 14 (Dairy, 6.3 mi, W) to be 2.2E-2 pCi/m^3. The results indicate that operation of VCSNS has not resulted in detectable increases of airborne gross beta activity in the environment.

Gamma spectroscopy measurements of air particulate samples and activated charcoal cartridges support the gross beta activity trend. Only natural background activities of Be-7, Ra-226, and K-40 were detected. Minimum detectable activity (MDA) levels for Cs-134, Cs-137, and I-131 were 1.8E-3, 2.0E-3, and 2.0E-2 pCi/m^3, respectively. The results agree with gaseous effluent release data reported in the 1990 Semiannual Effluent and Waste Disposal Reports for VCSNS. Only 3.00E-2 and 1.33E-3 Ci of particulate and iodine, respectively, were released. These activity levels are not discernable in ambient samples upon consideration of dispersion and dilution factors experienced during releases.

Environmental dosimetry measurements during 1990 did not differ significantly from preoperational measurements for same seasonal time periods. Indicator and control dosimetry measurements showed no appreciable differences during 1990. Sampling location at Barnabas Church near Jenkinsville (2.8 mi, E) was the indicator location showing the highest mean exposure rate of 13.2 µR/hr. This value compares favorably with the mean exposure rate of 14.0 µR/hr measured during the preoperational period and confirms the long-term stability of background levels measured at this monitoring location. Gaseous effluent release data reported for 1990 indicated a total of 7.5E2 Ci of fission and activation gases released from VCSNS. An extensive search of environmental dosimetry data and meteorological data during the release periods indicated no evidence of detectable activity attributable to the releases with only natural background variations evidenced.

Gamma spectroscopy measurements of surface water samples did not indicate the presence of activated corrosion and most fission products above the respective MDA's. Liquid effluent release data reported for 1990 in the Semiannual Effluent and Waste Disposal Reports indicated a total of 3.6E-1 Ci of measureable fission and activated corrosion product activity was released from VCSNS, a level not discernable in surface water based upon consideration of dilution factors experienced during the releases and the detection limits of analytical methods.

Tritium analyses of surface water samples during 1990 yielded results which were not noticeably different from preoperational data. The highest mean indicator tritium activity of 6.9E + 2 pCi/liter was measured at Site 21, Parr Reservoir (2.7 mi, SSW). Activity levels measured at the indicator locations are within the normal background variation for environmental tritium and consistent with the preoperational mean of 1.4E + 3 pCi/liter. Total tritium released in liquid effluents during 1990 was reported to be 4.2E + 2 Ci, a level not discernable in surface water upon consideration of dilution factors experienced during the releases and the detection limitations of analytical equipment.

Gamma spectroscopy measurements of ground water samples did not indicate the presence of activated corrosion or fission products above the MDA's for the

respective radionuclides. High background levels of Pb-214 and Bi-214, daughters of Ra-226, were again detected at control sampling location no. 16 (28 mi, W). The presence of these radionuclides is attributed to the uranium found in the large amount of granite in this area of South Carolina. The radionuclides Pb-214 and Bi-214 are major gamma emitting daughters in the uranium series decay scheme produced through the decay of dissolved Rn-222 gas in the ground water. No evidence of radioactivity from VCSNS operation was detected.

Tritium analyses of ground water samples during 1990 yielded results which were not significantly different from preoperational results, or indicator significantly different than control. All results were below MDA's.

Gamma spectroscopy measurements of drinking water samples collected from the Jenkinsville and Columbia water supplies did not indicate the presence of activated corrosion or fission product activity above the MDA's of the respective radionuclides. The radionuclides Ra-226, Pb-214, and Bi-214 from the naturally occurring uranium series decay scheme were observed in the Jenkinsville water supply at levels above those found in surface water. These elevated activity levels were also observed in the preoperational program and are attributed to a series of deep water wells in local granite aquifers.

Gross beta activity showed a trend similar to the uranium series decay scheme daughters; normal low beta activity at Columbia (surface water source) and elevated beta activity at Jenkinsville (deep well source). This data is again comparable to the preoperational data and is attributed to the naturally occurring uranium associated with the aquifer supplying the Jenkinsville water system.

All drinking water tritium analyses were below MDA's.

Gamma spectroscopy measurements of milk samples collected in 1990 were not significantly different from those observed during the preoperational program. Naturally occurring K-40, Ra-226, and Cs-137 attributed to fallout was detected at both sampling locations at concentrations similar to those measured during the preoperational period. There were no identified radionuclides in milk attributed to VCSNS operation.

Gamma spectroscopy measurements of grass (forage) samples collected in 1990 indicated the presence of Be-7 and K-40 in all samples. The naturally occurring radionuclides Be-7 and K-40 were detected at levels similar to those found during the preoperational program. There was no indication of the presence of any radionuclide in grass due to the operation of VCSNS which again supports the findings presented in the Semiannual Effluent and Waste Disposal Reports for gaseous effluent releases in 1990.

Broadleaf vegetation collected from gardens at location no's. 6, 8, and 18 were the principal food products analyzed during 1990. Naturally occurring contributions from Ra-226, K-40, Th-228 and Be-7 were measured. All radionuclide measurements are comparable to and consistent with the results obtained during the preoperational program.

Other vegetation sampled in 1990 included squash, corn, tomatoes, and radishes representing the non-leafy vegetation group. Naturally occurring K-40 was observed in all samples at concentrations consistent with those observed during the preoperational period.

Fish species sampled at three indicator and one control location included bass, bream, shad, catfish and carp. Cesium-137 was detected in 15 of 23 samples collected at all sampling locations and in all five species. The highest mean Cs-137 concentration was 2.1E + 1 pCi/kg (Parr Reservoir). The levels of Cs-137 in both control and indicator locations were consistent with preoperational levels and are primarily attributed to residual fallout from atmospheric weapons testing and the 1986 Chernobyl incident. Liquid effluent releases are assumed to contribute to the presence of Cs-137. However, this contribution is not discernible from the levels of Cs-137 present due to fallout. Liquid effluent releases during 1990 included 3.2E-2 Ci of Cs-137. The presence of Cesium-137 attributed to liquid effluent releases from VCSNS would be limited to Parr and Monticello Reservoirs.

Gamma spectroscopy measurements of sediment samples collected during 1990 also indicated the presence of activated corrosion and fission product activity. Cesium-137 was detected in sediment from all indicator and control locations. Cesium-134 activity was found in Monticello and Parr. Cobalt-60 activity was limited to Monticello and Parr Reservoirs. Mn-54 activity was limited to Monticello. The highest mean concentrations, observed in Parr Reservoir, were 7.9E + 1, and 3.0E + 1 pCi/kg for Co-60, and Cs-134, respectively. The highest mean activity for Cs-137 was 2.5E + 2 pCi/kg found in Monticello. Naturally occurring K-40 was ubiquitous because of the concentration of organic matter in the sediment. Potassium-40 activity was consistent with preoperational and control measurements. Naturally occurring U-235 was also detected in sediment collected at all sampling locations at levels consistent with preoperational measurements. Cesium-137 concentrations were consistent with preoperational and control measurements and concentrations expected due to residual fallout from atmospheric weapons testing and Chernobyl. The contribution of Cs-137 from VCSNS liquid effluents is not discernible from the levels of Cs-137 present due to fallout. Cesium-134 activity limited to Parr and Monticello Reservoirs may be attributed to liquid effluent releases from VCSNS. Activated corrosion product activity detected in Parr and Monticello Reservoirs is attributed to liquid effluent releases from VCSNS. The relatively low activity in Monticello Reservoir is primarily attributed to the injection of the liquid waste stream directly into the penstocks during FPSF's generating mode and subsequent operation of the reversible pump-turbine units during periods of off-peak power demand.

Radiation doses to man, corresponding to the concentrations of activity in sediment, were calculated using Regulatory Guide 1.109 methodology. A 500 hr/year exposure to shoreline sediment containing mean detected concentrations of Co-60 and Cs-134 was assumed. The results are included in Table 13.

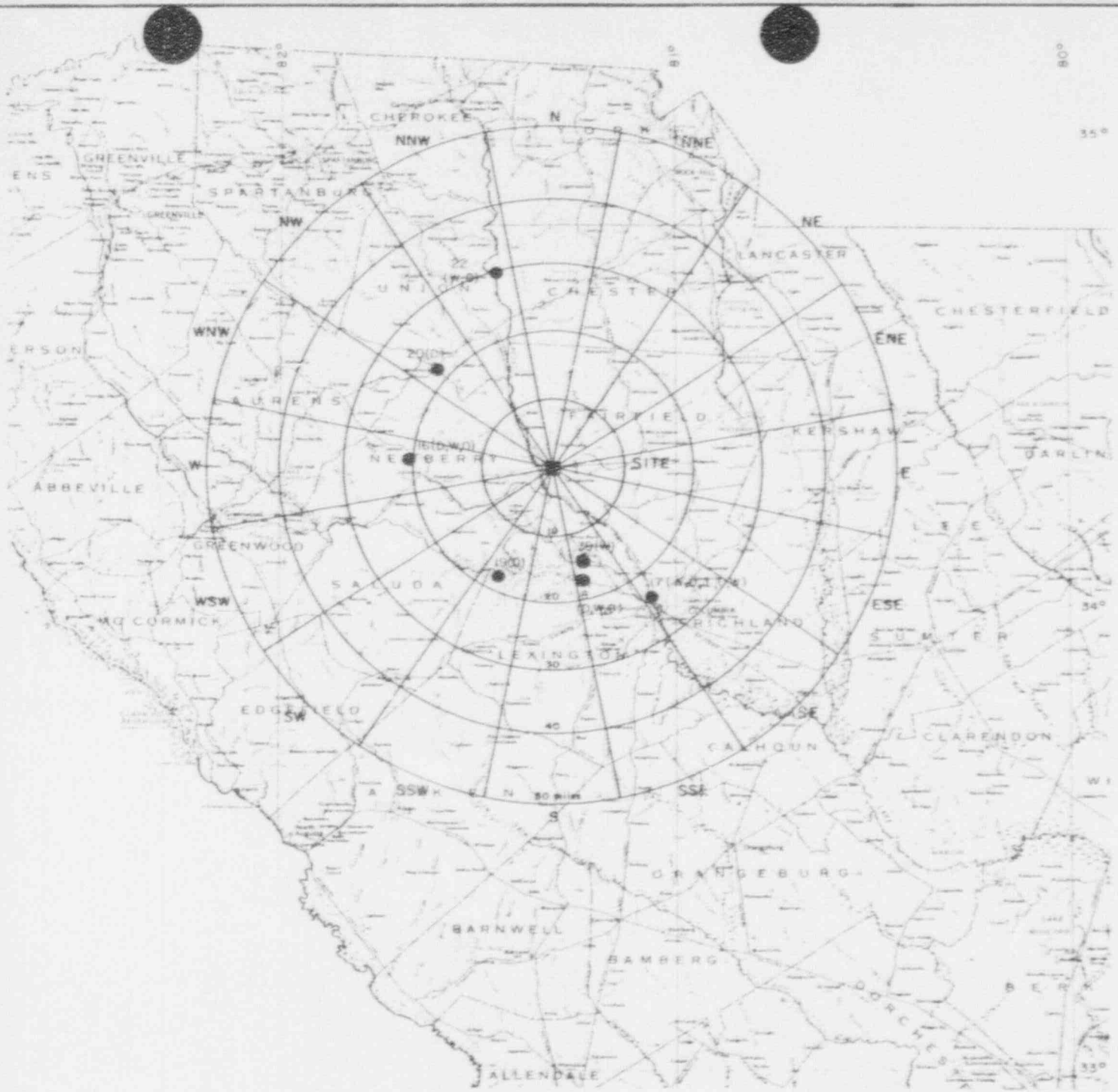
Location	Radionuclide	Activity (pCi/kg)		Corresponding Calculated Annual Dose Equivalent (mrem)
		Maximum	Mean	Whole Body
Monticello Reservoir	Co-60	1.4E + 2	1.1E + 2	1.1E-2
	Cs-134	8.6E + 1	5.1E + 1	3.7E-3
	Total			1.5E-2
Parr Reservoir	Cs-134	4.8E + 1	3.0E + 1	2.1E-3
	Co-60	1.2E + 2	7.9E + 1	8.0E-3
	Total			1.0E-2

Table 13 - 1990 Activated Corrosion Product and Cs-134 Activity in Sediment

Conclusion

The BEIR Committee and the VCSNS Final Environmental Statement (NUREG-0719) both suggest that the conservatism inherent in the radiation exposure limits and calculated doses to man is also applicable to other biota. The calculated dose equivalent to man attributed to Co-60 and Cs-134 in sediment is a highly conservative estimate. The absence of any discernible ecological impact on biota substantiates the fact that species population stability has been unaffected by the activated corrosion and fission product activity released from VCSNS. The absence of any impact is anticipated since the concentrations were much less than acceptable limits during 1990 and since most biotic species are not as radiosensitive as man.

The presence of Cs-137 activity is attributed to residual fallout from the 1986 Chernobyl incident, atmospheric weapons testing, and to some extent, operation of VCSNS. The results of the Radiological Environmental Monitoring Program support the results reported in the Semiannual Effluent and Waste Disposal Reports for VCSNS during 1990. The calculated potential radiation dose to the public attributed to activated corrosion product activity and Cs-134 in Broad River media is 2.5E-2 mrem. This figure compares with the 5.67E-2 mrem whole body dose reported in the 1990 Semiannual Effluent and Waste Disposal Reports and is a small fraction of observed variations in local, natural background. These insignificant doses will not result in observable effects on the ecosystem or the public. The results of the Radiological Environmental Monitoring Program, therefore, substantiate the continuing adequacy of source control at Virgil C. Summer Nuclear Station and conformance of station operation to 10 CFR 50, Appendix I design goals.



LEGEND

- ● CONTROL SAMPLE LOCATIONS
- A= AIR PARTICULATE SITE
- D= DIRECT(TLD) SITE
- I= AIRBORNE RADIOIODINE SITE
- W= WATER SITE
- O= OTHER (GARDEN PRODUCTS, F
  SEDIMENT, GRASS, MIL

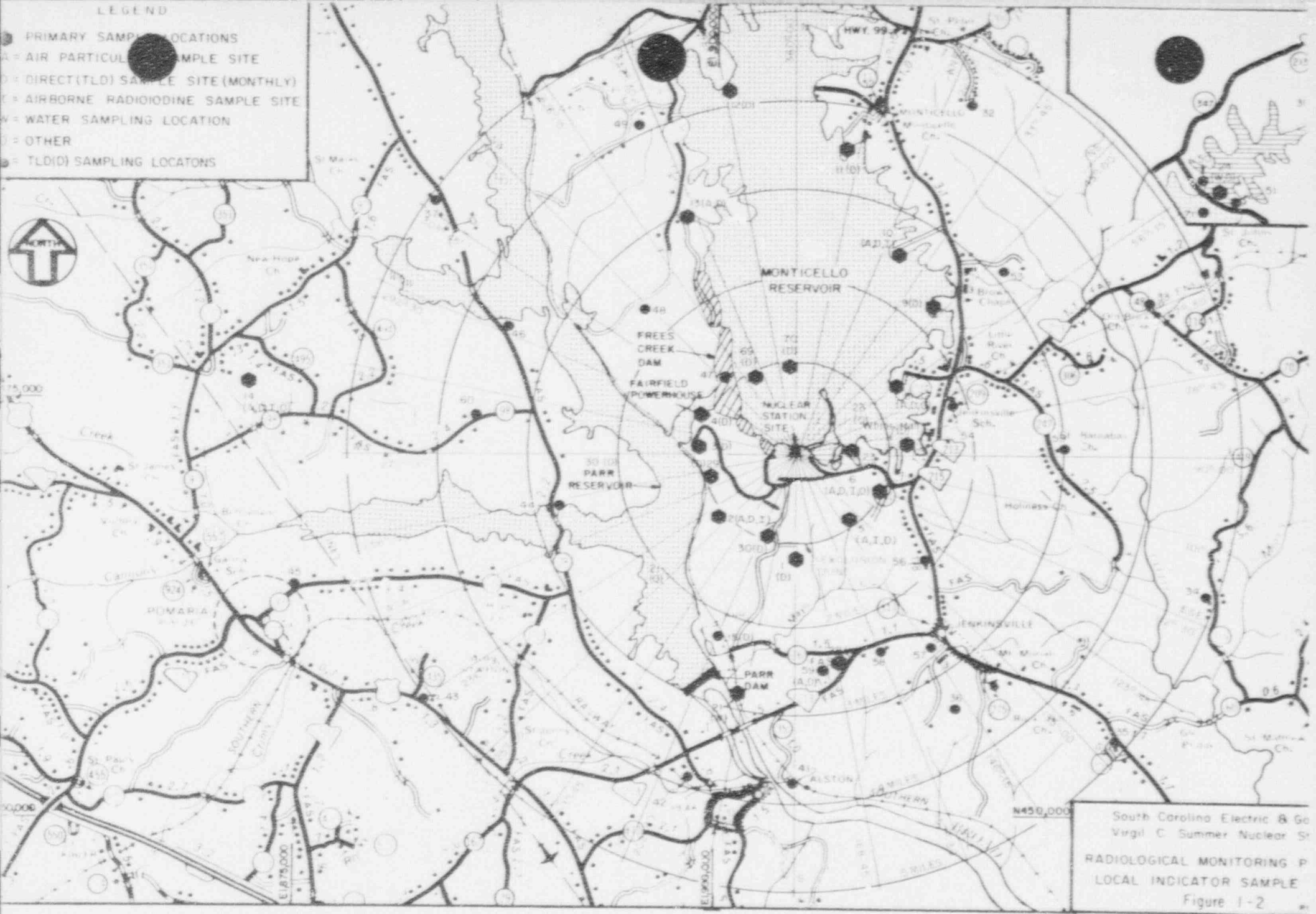
REFERENCE:
THE BASE FOR THIS MAP WAS PREPARED
PORTION OF USGS STATE OF GEORGIA,

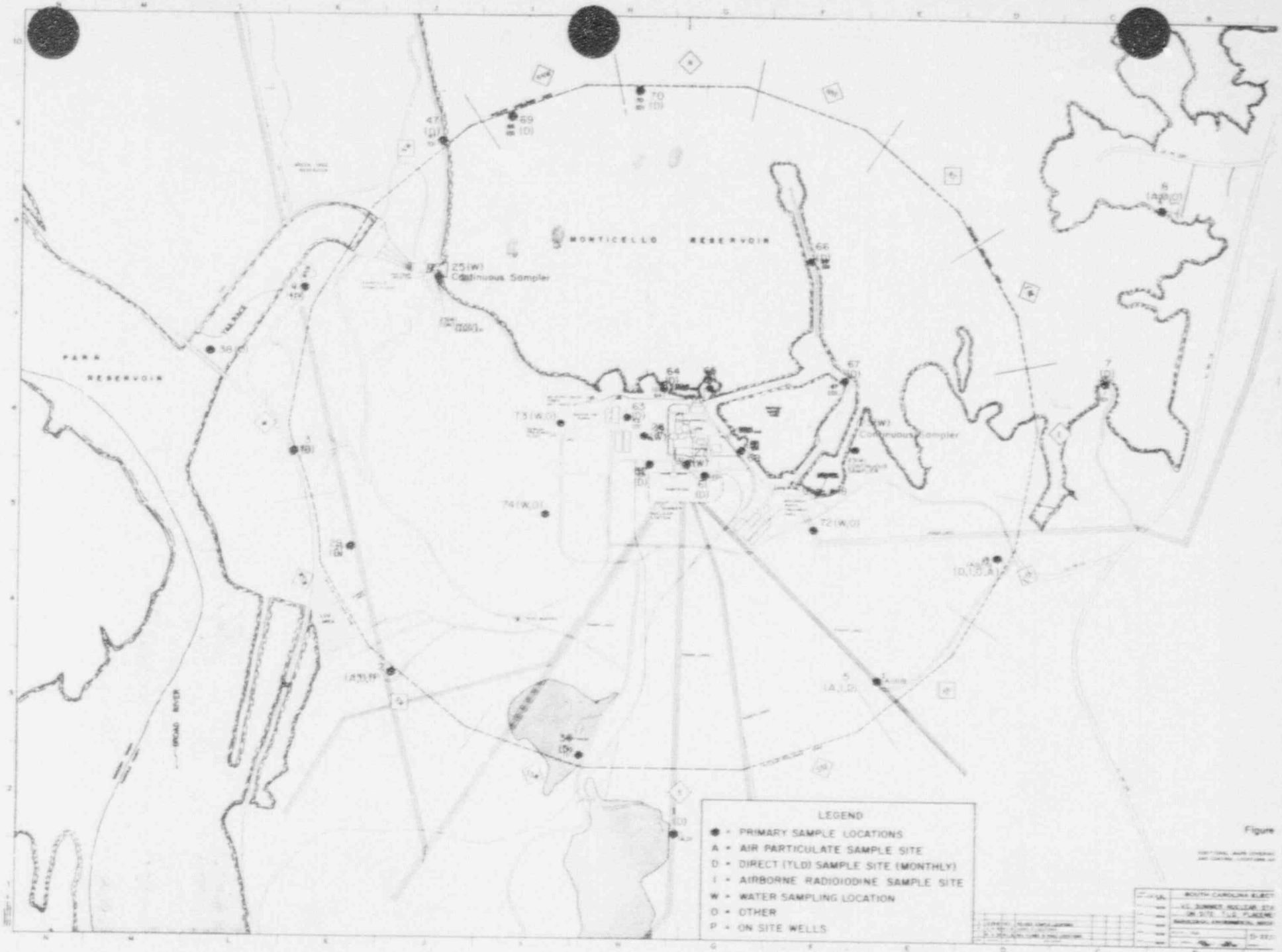
South Carolina Electric &
Virgil C. Summer Nuclear

Regional Location

Figure 1-1

REV


LEGEND
PRIMARY SAMPLE LOCATIONS
A = AIR PARTICULATE SAMPLE SITE
D = DIRECT (TLD) SAMPLE SITE (MONTHLY)
I = AIRBORNE RADIOIODINE SAMPLE SITE
W = WATER SAMPLING LOCATION
O = OTHER
TLD(D) SAMPLING LOCATONS
NORTH
MONTICELLO RESERVOIR
FREES CREEK DAM
FAIRFIELD POWERHOUSE
NUCLEAR STATION SITE
PARR RESERVOIR
PARR DAM
HWY. 99
POMARIA
ALSTON
JENKINSVILLE
E 875,000
E 900,000
N 450,000
South Carolina Electric & Go
Virgil C. Summer Nuclear St
RADIOLOGICAL MONITORING P
LOCAL INDICATOR SAMPLE
Figure 1-2


MONTICELLO RESERVOIR
PARR RESERVOIR
25(W)
Continuous Sampler
LEGEND
● - PRIMARY SAMPLE LOCATIONS
A - AIR PARTICULATE SAMPLE SITE
D - DIRECT (TLD) SAMPLE SITE (MONTHLY)
I - AIRBORNE RADIOIODINE SAMPLE SITE
W - WATER SAMPLING LOCATION
O - OTHER
P - ON SITE WELLS

Figure