Virgil C. Summer Environmental Surveillance Laboratory
Jenkinsville, South Carolina

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT

VIRGIL C. SUMMER NUCLEAR STATION

FOR THE OPERATING PERIOD

JANUARY 1, 1987 - DECEMBER 31, 1987

APRIL 1988

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

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Executive Summary

1. Results of the 1987 Land Use Census neither indicated significant movement of critical receptors since the previous annual census, nor identified locations 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.

4. Detection of fission product activity in environmental media is attributed to residual fallout from the Chernobyl incident and atmospheric weapons testing.

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 December 12, 1982 and 100% power June 10, 1983 following steam generator feedwater modifications. VCSNS completed its third fuel cycle on March 6, 1987. The fourth fuel cycle began after criticality was achieved on June 6, 1987 following a 94 day refueling and maintenance outage.

VCSNS is used 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, along with Newberry County, makes 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 makeup 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 Reservoir 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 are 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 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 1987. Data trends, control/indicator and preoperational/operational data intercomparisons and other data interpretations are presented.

Description of the Radiological Environmental Monitoring Program

The Radiological Environmental Monitoring Program is carried out in its entirety by South Carolina Electric and Gas Company. The program has been designed to meet the following general commitments:

1. To analyze selected samples in important anticipated pathways for the qualification and quantification of radionuclides released to the environment surrounding VCSNS.

2. To establish correlations between levels of environmental radioactivity and radioactive effluents from VCSNS operation.

The program utilizes the concepts of control/indicator and preoperational/operational intercomparisons in order to establish the adequacy of radioactivity source control and to realistically verify the assessment of environmental radioactivity levels and subsequent radiation dose to man.

Specific measurement, sampling and analysis methodology has been programmatically developed to sensitively monitor the pathways expected to represent the most significant source of radiation exposure to the public and the environment. Elements of the program monitor the impact of gaseous and liquid effluents released from VCSNS. Specific methods used in monitoring the pathways of these effluents which may lead to radiation exposure of the public, based on existing demography, are summarized in Table 1.

Effluent Release Type	Exposure Pathway	Monitoring Media
Gaseous	Immersion Dose and other External Dose	Thermoluminescent Dosimetry (TLD) Area Monitoring, Air Sampling
	Vegetation (Ingestion)	Vegetation and Food Crop Sampling, Air Sampling
	Milk (Ingestion)	Milk Sampling, Vegetation Sampling, Grass (Forage) Sampling, Air Sampling
Liquid	Fish (Ingestion)	Surface Water Sampling, Bottom Sediment Sampling, Fish Sampling
	Water & Shoreline Exposure (Ingestion and Immersion)	TLD Area Monitoring, Surface Water Sampling, Shoreline and Bottom Sediment Sampling
	Drinking Water (Ingestion)	Ground Water Sampling, Drinking Water Sampling

Table 1 - Monitoring Methods for Critical Radiation Exposure Pathways

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 1987 are presented in Table 2. A verification of the critical receptor (maximum exposed individual) in each sector around VCSNS based on 1987 meteorological data and Updated Final Safety Analysis Report source terms is included in Table 2a.

Sector	Nearest Residence	Miles	Nearest Garden	Miles	Cattle	No. Milked	Miles
N	Martin	3.8	Fuller	4.0	Robinson	0	3.3
NNE	Crumblin	2.9	Robinson (B)	3.3	Robinson	0	3.3
NE	Stone	2.1	Robinson	2.9	Stone	0	2.1
ENE	Johnson	1.4	Willingham	1.5			
E	Martin	1.5	Pearson	3.1			
ESE	Martin (A)	1.1	Martin	1.1			
SE	White	1.5	Summer	1.5			
SSE	Crumpton	2.5	Sheely	2.7			
S	Pinner	3.8	Eargle	3.9	Yarborough	0	3.8
SSW	Weber	3.2	Nash (B)	3.4	Miller	0	3.0
SW	Davis	3.1	Nichols	3.3	Summer	0	2.5
WSW	Hope	3.1	Summer	3.3	Livingston	0	1.9
W	Amick	2.5	Smith	2.5	Livingston	0	2.1
WNW	Palmer	2.7	Williams	4.5	Williams(C)	0	4.5
NW	Wright	3.9	Cole (B)	4.1	Cole	0	4.1
NNW	March	2.9	March	3.0	March	0	3.0

A. Change in closest residence
B. Change in closest garden
C. Milking animal not milked

Table 2 - Results of the August 1987 Land Use Census Verification

SECTOR	DISTANCE (Miles)	NAME	PATHWAY	1975 METEOROLOGICAL DATA			1987 METEOROLOGICAL DATA		
				$\overline{X/Q}$	$\overline{D/Q}$	DOSE RATE mRem/y	$\overline{X/Q}$	$\overline{D/Q}$	DOSE RATE mRem/y
N	3.3	Robinson	Beef (C)	2.0E-07	9.5E-10	1.0E-01	2.8E-07	7.8E-10	8.9E-02
N	3.8	Martin	Res	1.5E-07	7.0E-10	5.7E-03	2.1E-07	5.7E-10	7.8E-03
N	4.0	Fuller*	Res/Gar	1.4E-07	6.2E-10	1.6E-01	1.9E-07	5.1E-10	1.4E-01
NNE	2.9	Crumblin	Res	3.2E-07	1.5E-09	1.2E-02	3.6E-07	1.1E-09	1.4E-02
NNE	3.3	I. Robinson	Res/Gar	2.5E-07	1.1E-09	2.9E-01	2.8E-07	7.9E-10	2.2E-01
NNE	3.6	R. Robinson*	Res/Gar/Beef	2.1E-07	8.9E-10	3.5E-01(E)	2.3E-07	6.5E-10	2.6E-01(E)
NE	2.1	Stone	Res/Beef	6.8E-07	3.6E-09	3.8E-01	8.9E-07	2.6E-09	2.9E-01
NE	2.9	J. Robinson*	Res/Gar/Beef	3.4E-07	1.7E-09	6.1E-01	4.6E-07	1.2E-09	4.6E-01
ENE	1.4	Johnson	Res	1.4E-06	8.0E-09	5.4E-02	2.4E-06	6.9E-09	9.0E-02
ENE	1.5	Willingham*	Res/Gar	1.2E-06	6.8E-09	1.8E+00	2.1E-06	5.8E-09	1.6E+00
E	3.1	Pearson*	Res/Gar	2.4E-07	9.6E-10	2.5E-01	4.8E-07	9.3E-10	2.7E-01
E	1.5	N. Martin	Res	1.1E-06	5.6E-09	4.2E-02	2.1E-06	5.3E-09	7.8E-02
ESE	1.1	Jr. Martin*(D)(A)	Res/Gar	2.2E-06	8.4E-09	2.2E+00	2.6E-06	7.4E-09	2.0E+00
SE	1.5	White	Res	1.6E-06	5.8E-09	6.0E-02	8.8E-07	3.2E-09	3.3E-02
SE	1.5	Summer*	Res/Gar	1.6E-06	5.8E-09	1.6E+00	8.8E-07	3.2E-09	8.8E-01
SSE	2.5	Crumpton	Res	3.5E-07	1.2E-09	1.3E-02	1.5E-07	6.9E-10	5.7E-03
SSE	2.7	Shealy*	Res/Gar	3.0E-07	1.0E-09	2.7E-01	1.3E-07	5.8E-10	1.5E-01
S	3.8	Yarborough	Beef (C)	1.8E-07	3.8E-10	4.5E-02	8.9E-08	3.8E-10	4.1E-02
S	3.8	Pinner	Res	1.8E-07	3.8E-10	6.6E-03	8.9E-08	3.8E-10	3.4E-03
S	3.9	Eargle*	Res/Gar	1.7E-07	3.7E-10	1.1E-01	8.4E-08	3.6E-10	9.5E-02
SSW	3.2	Weber	Res	2.3E-07	7.5E-10	8.6E-03	1.4E-07	7.2E-10	5.4E-03
SSW	3.4	Ash*(B)	Res/Gar	2.0E-07	6.4E-10	1.7E-01	1.2E-07	6.2E-10	1.6E-01
SSW	3.4	Miller	Res/Beef	2.0E-07	6.4E-10	9.4E-02(F)	1.2E-07	6.2E-10	8.7E-02(F)
SW	2.5	Summer	Beef (C)	4.6E-07	1.9E-09	2.1E-01	2.7E-07	1.7E-09	1.8E-01
SW	3.1	Davis	Res	2.9E-07	1.2E-09	1.1E-02	1.7E-07	1.0E-09	6.6E-03
SW	3.2	Nichols*	Res/Gar	2.6E-07	1.0E-09	2.7E-01	1.5E-07	9.1E-10	2.3E-01
SW	3.3	Miller	Res	2.6E-07	1.0E-09	9.8E-03(J)	1.5E-07	9.1E-10	5.8E-03(J)
WSW	1.9	Livingston	Beef (C)	6.4E-07	3.2E-09	3.4E-01	4.4E-07	3.0E-09	3.2E-01
WSW	3.1	Hope	Res	2.3E-07	1.0E-09	8.7E-03	1.5E-07	9.5E-10	5.9E-03
WSW	3.3	Summer*	Res/Gar	2.0E-07	8.7E-10	2.3E-01(I)	1.3E-07	8.2E-10	3.8E-01(I)
W	2.5	Amick	Res	2.5E-07	1.1E-09	9.5E-03	3.2E-07	1.2E-09	1.2E-02
W	2.5	Smith	Res/Gar	2.5E-07	1.1E-09	2.9E-01	3.2E-07	1.2E-09	3.2E-01
W	2.7	Livingston*	Res/Gar/Beef (G)	2.2E-07	9.3E-10	4.2E-01(H)	2.7E-07	1.0E-09	4.5E-01(H)
WNW	2.7	Palmer	Res	1.8E-07	7.6E-10	6.8E-03	1.3E-07	4.8E-10	4.9E-03
WNW	4.5	Williams*	Res/Gar/Beef	6.6E-08	2.5E-10	9.2E-02	4.6E-08	1.5E-10	5.6E-02
NW	3.9	Wright	Res	1.1E-07	4.6E-10	4.2E-03	1.2E-07	3.4E-10	4.5E-03
NW	4.1	Cole*(B)	Res/Gar/Beef	9.2E-08	4.0E-10	1.5E-01	1.1E-07	3.0E-10	1.1E-01
NNW	2.9	J. March	Res	1.9E-07	1.1E-09	7.4E-03	3.6E-07	9.1E-10	1.3E-02
NNW	3.0	F. March*	Res/Gar/Beef	1.8E-07	9.7E-10	3.5E-01	3.4E-07	8.4E-10	3.2E-01

* Denotes Critical Receptor for the Sector.

(A) Change in Closest Residence for the Sector (from 1986 Census).

(B) Change in closest garden.

(C) Residence assumed in calculations.

(D) Maximum exposed individual for the site (1975 met data).

(E) Cattle assumed to graze at 3.3 miles NNE.

(F) Cattle assumed to graze at 3.0 miles SSW.

(G) Cattle assumed to graze at 2.1 miles W.

(H) Assuming Livingston eats beef from his herd in the WSW, Livingston's dose rate would be as follows:
.56 mRem/y ($^{75}\overline{X/Q}$, $\overline{D/Q}$), .57 mRem/y ($^{87}\overline{X/Q}$, $\overline{D/Q}$).

(I) Assuming Summer eats beef from his herd in the SW, Summer's dose rate would be as follows:
.42 mRem/y ($^{75}\overline{X/Q}$, $\overline{D/Q}$), .38 mRem/y ($^{87}\overline{X/Q}$, $\overline{D/Q}$).

(J) Assuming Miller eats beef from his herd in the SSW, Miller's dose rate would be as follows: .096mRem/y ($^{75}\overline{X/Q}$, $\overline{D/Q}$), .088 mRem/y ($^{87}\overline{X/Q}$, $\overline{D/Q}$).

Table 2a - Critical Receptors in 1987
Based on FSAR 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.

Valuable 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 at selected sites, radioiodine. Four other 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 ($\overline{D/Q}$). Sampling locations 5 (0.9 mi SE) and 18 (16.5 mi S) also have broadleaf vegetation gardens for monitoring the gaseous effluent deposition and ingestion pathway at an indicator and control location, respectively.

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 1987. Results of the 1987 EPA Intercomparison Program are included in Table 4. Results of an intracomparison 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 are detailed in Tables 8 and 9.

Results and Discussion

The results of the Radiological Environmental Monitoring Program for 1987 are summarized in Table 10. For comparative purposes preoperational data is summarized in Table 11. Certain samples were not collected during 1987 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 97%. 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	DM
2	Transmission Line	1.2	225.0 SW	AP,RI,DM
3	Firing Range	1.2	270.0 W	DM
4	Fairfield Hydro	1.2	289.5 WNW	DM
5	Transmission Line Entrance	0.9	145.5 SE	AP,RI,DM
6	Env. Lab Garden	1.0	104.0 ESE	AP,RI,DM,GR,GA
7	Monticello Peninsula	1.2	83.0 E	DM
8	Monticello Res. S of Rd 224	1.5	63.0 ENE	AP,DM,GA
9	Ball Park	2.2	44.0 NE	DM
10	Meteorological Tower No 2	2.5	25.5 NNE	AP,RI,DM
11	Residence	3.3	8.0 N	DM
12	Old Hwy 99	4.2	349.0 N	DM
13	North Dam	2.9	334.0 NNW	AP,DM
14	Dairy	6.3	270.0 W	AP,RI,DM,MK,GR
15	Parr Village	2.5	204.0 SSW	DM
16	Dairy	28.0	281.0 W	DM,GW,MK,GR
17	Columbia Water Works	24.7	144.0 SE	AP,RI,DM,SW,DW,BS
18	Residence/Pine Island Club	16.5	165.0 S	DM,SW,GA
19	Residence/Little Saluda	17.9	207.0 SSW	DM
20	Residence/Whitmire	22.0	310.0 NW	DM
21	Parr Reservior	2.7	199.5 SSW	SW,FH,BS
22	Neal Shoals	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)	2.4	168.0 SSE	DW
29	Trans. Line WSW of VCSNS	0.9	248.0 WSW	DM
30	Oak Tree North of Borrow Pit	1.0	197.0 SSW	DM
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
40	No Sampler			
41	End of Catwalk	3.9	185.0 S	DQ
42	Store	3.9	199.0 SSW	DQ
43	Hwy 176 and Rd 435	5.2	236.0 SW	DQ

Table 3 - Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
44	Rd 28 at Cannon's Creek	2.9	255.5 WSW	DQ
45	Rd 33 at Pomaria	5.9	253.0 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	2.8	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)	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	DM
62	East of Training Bldg.	0.13	220.0 SW	DM
63	East of Daniel's Office	0.17	270.0 W	DM
64	Riprap W of Intake	0.13	338.5 NNW	DM,BS
65	Guard Tower	0.13	22.5 NNE	DM,BS
66	Jetty	0.6	33.0 NNE	DM
67	Service Water Pond (East Side)	0.5	72.0 ENE	DM
68	Fuel Oil Storage Tank	0.2	108.5 ESE	DM
69	Exclusion Buoy NNW on Monticello Res.	1.0	337.0 NNW	DM
70	Exclusion Buoy N on Monticello Res.	1.0	0.0 N	DM
71	Temperature Buoy on Monticello Res.	5.4	3.0 N	DM
72	Yard Drain Outfall	0.4	146.0 SE	SW
73	Yard Drain Outfall	0.4	270.0 W	SW
74	Yard Drain Outfall	0.5	246.0 WSW	SW
80	Congaree River	30.2	147.0 SSE	BS
81	Congaree River	30.1	147.0 SSE	BS
82	Congaree River	30.0	147.0 SSE	BS
83	Congaree River	28.5	147.0 SSE	BS
84	Congaree River	54.2	135.0 SE	BS
85	Congaree River	53.8	135.0 SE	BS
86	Congaree River	54.0	135.0 SE	BS
87	Lake Marion	72.0	138.0 SE	BS
88	Lake Marion	72.0	138.0 SE	BS
89	Lake Marion	72.0	138.0 SE	BS

Table 3 - Sampling Site Locations (continued)

FOOTNOTES

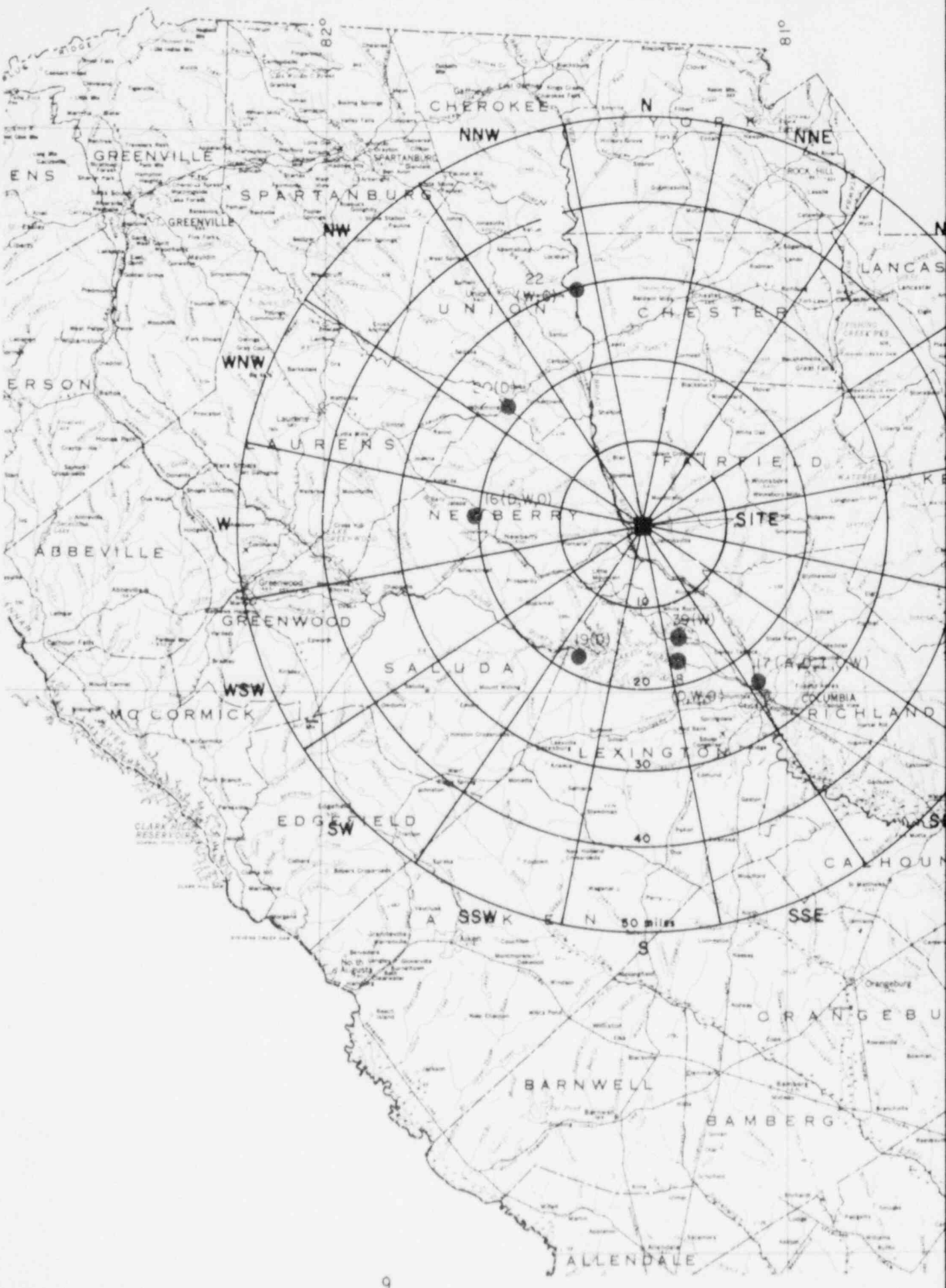
1. Distance given is the distance between the site location and the center of the VCSNS reactor containment building.

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

3. Sample Types:

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

Table 3 - Sampling Site Locations (continued)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81°
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GREENVILLE
SPARTANBURG
GREENWOOD
UNION
CHESTER
LANCAS
LAURENS
FAIRFIELD
NEWBERRY
SITE
ABBEVILLE
SALUDA
MC CORMICK
LEXINGTON
COLUMBIA
EDGEFIELD
CALHOUN
ORANGEBU
BARNWELL
BAMBERG
ALLENDALE
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NNW
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N

LEGEND

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

REFERENCE:
THE BASE FOR THIS MAP WAS PREPARED FROM A PORTION OF USGS STATE OF GEORGIA, 1970.

STATUTE MILES
0 0 10 20

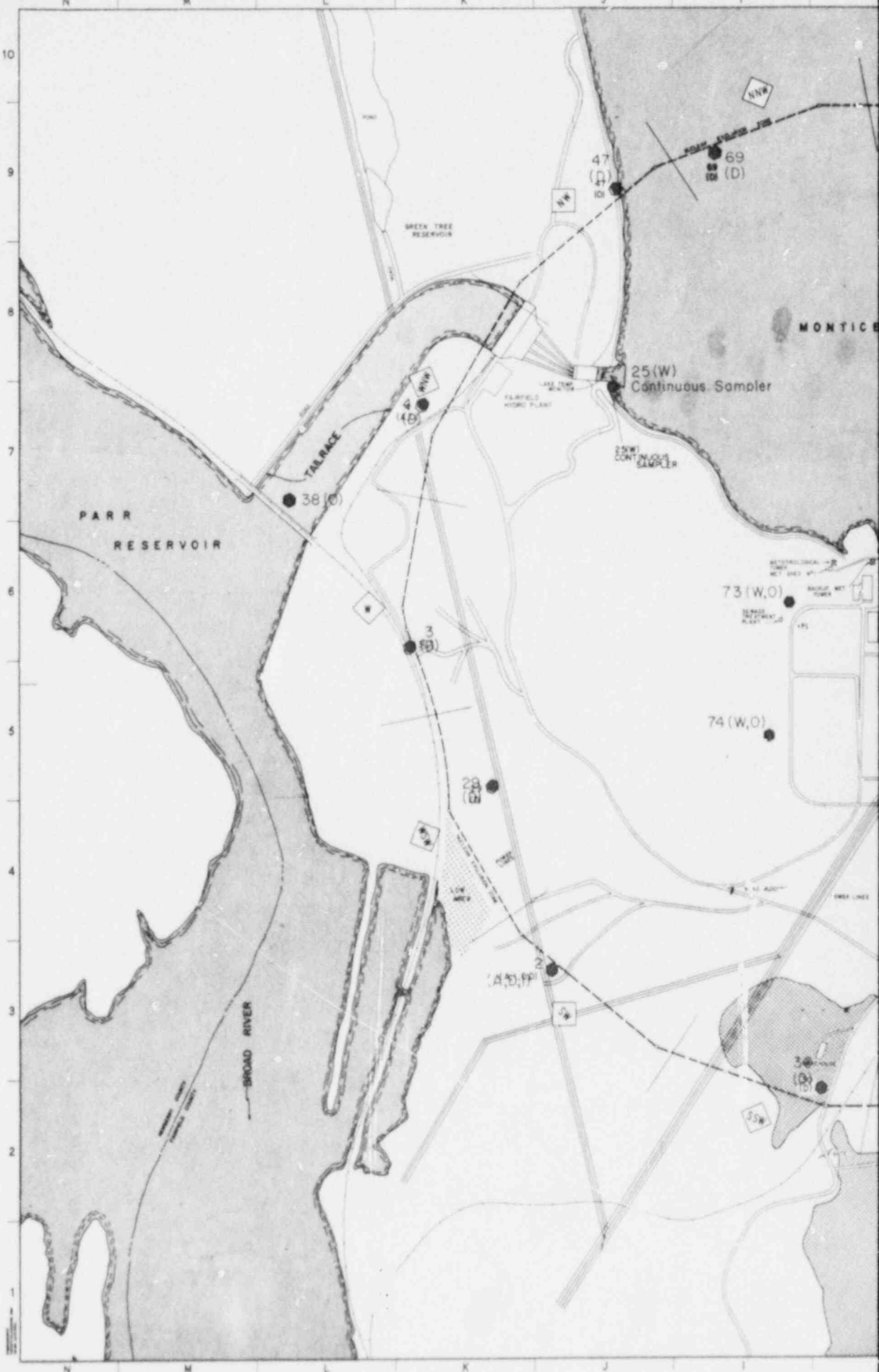
8805200004-01

South Carolina Electric & Gas Co.
Virgil C. Summer Nuclear Station

Regional Location Map

Figure 1-1

REV. DATE 12-87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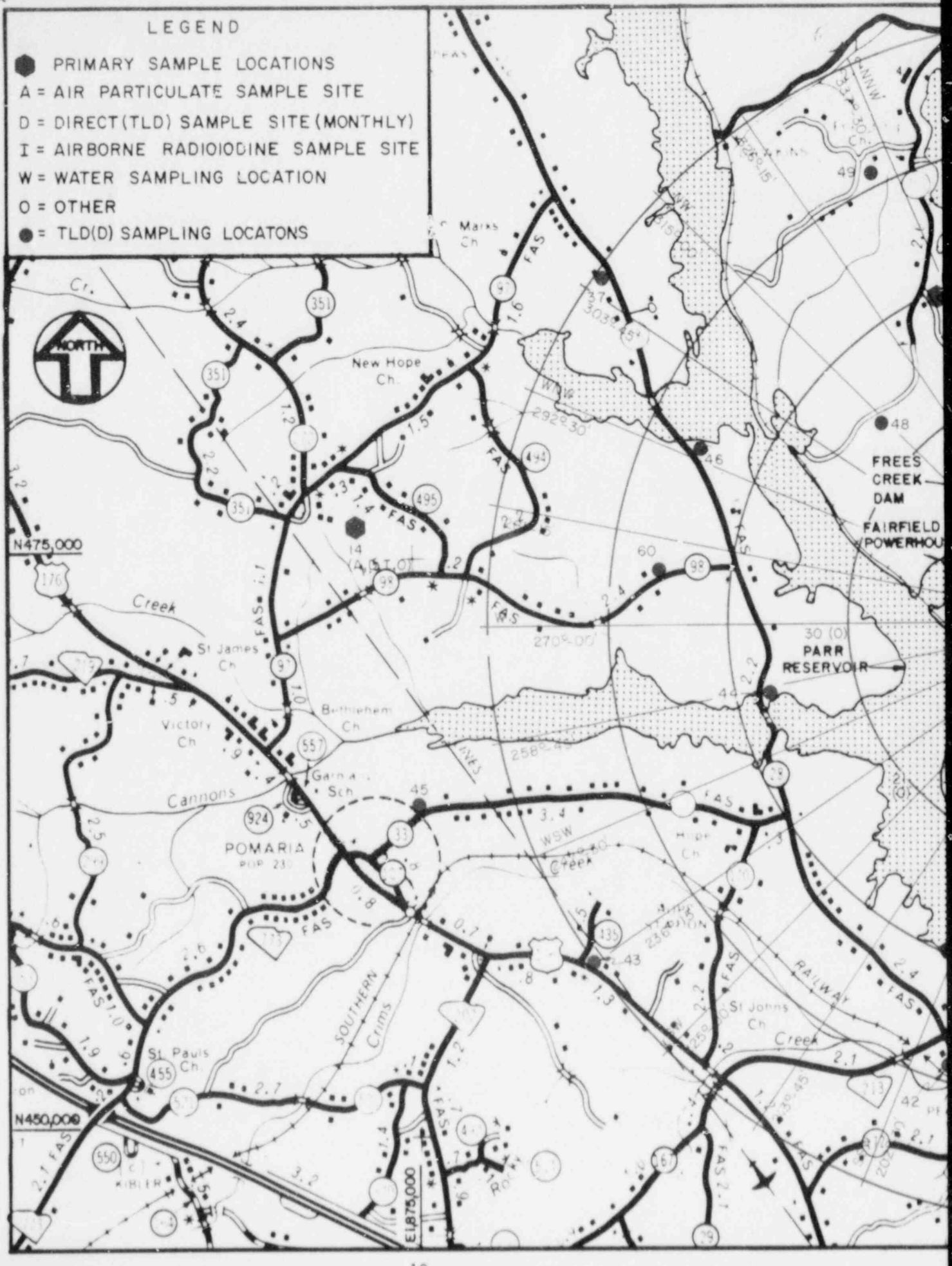
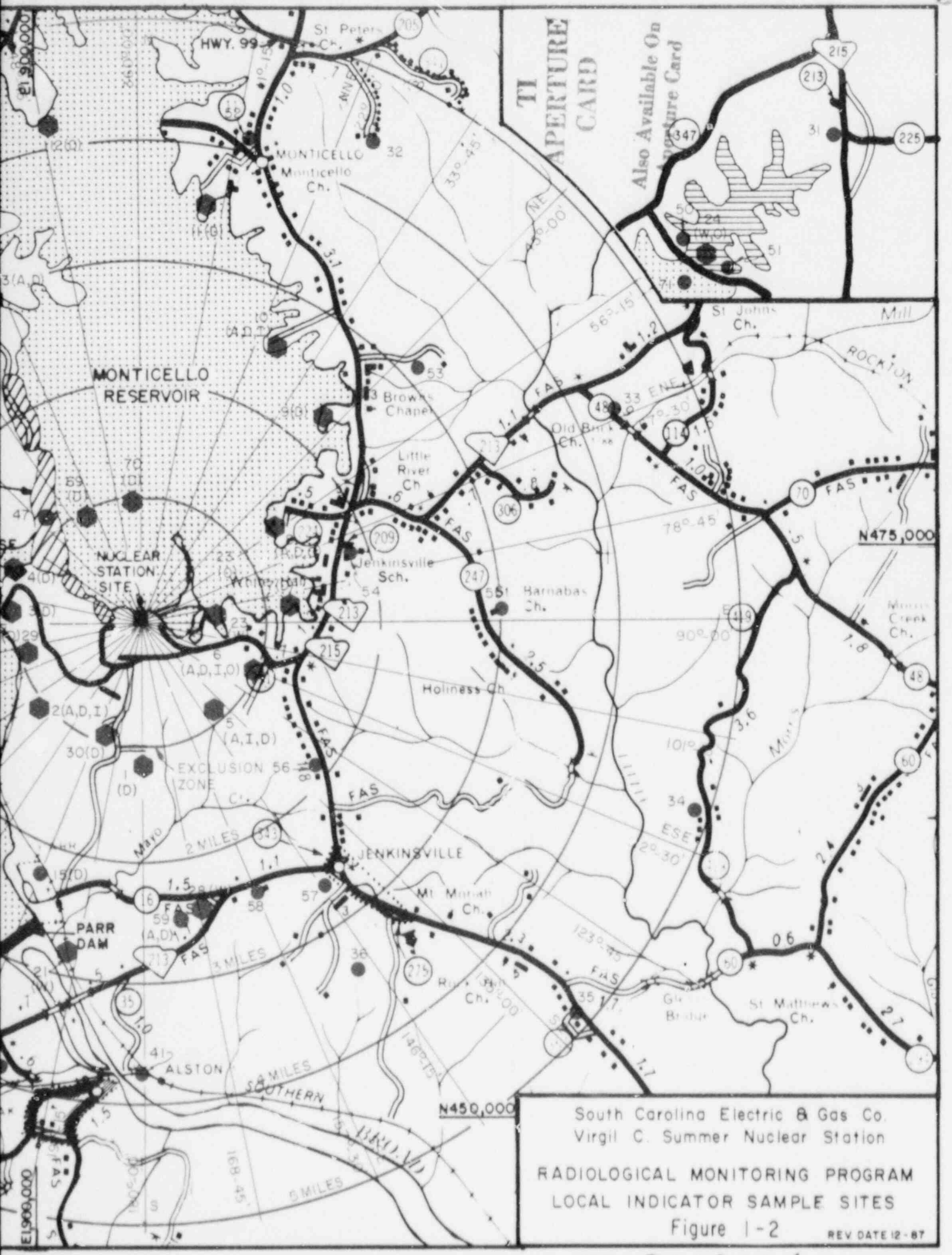
10
9
8
7
6
5
4
3
2
1
47
(D)
69
(D)
MONTICE
25(W)
Continuous Sampler
4
(D)
TAILRACE
38 (D)
PARR
RESERVOIR
73 (W,O)
3
(D)
74 (W,O)
2
(D)
2
(D,W)
BROAD RIVER

Figure 1-3

SOUTH CAROLINA ELECTRIC & GAS CO.
V.C. SUMMER NUCLEAR STATION
ON SITE TLD PLACEMENT AREA MAP
RADIOLOGICAL ENVIRONMENTAL MONITORING SITES
D-22052

8805200004-03


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
N475,000
N450,000
E1,875,000
New Hope Ch.
St James Ch.
Victory Ch.
Bethlehem Ch.
Cannons Creek
POMARIA
St Pauls Ch.
Marks Ch.
FREES CREEK DAM
FAIRFIELD POWERHOU
PARR RESERVOIR
St Johns Ch.
Creek
SOUTHERN RAILWAY
FAS



South Carolina Electric & Gas Co.
Virgil C. Summer Nuclear Station

RADIOLOGICAL MONITORING PROGRAM
LOCAL INDICATOR SAMPLE SITES
Figure 1-2

REV DATE 12-87

8805200004-02

Comparison Study (Measurement Unit)	Date	Nuclide	EPA Value (± 1σ)	Laboratory Results (± 1σ)	Agreement
Air filter (pCi/filter)	4/87	beta	43 (5)	56 (0)	Yes
		Cs-137	8 (5)	9 (0)	Yes
	8/87	beta	30 (5)	34 (1)	Yes
		Cs-137	10 (5)	10 (1)	Yes
Gamma in Water (pCi/liter)	2/87	Cr-51	Not tested		
		Co-60	50 (5)	56 (2)	Yes
		Zn-65	91 (5)	101 (5)	Yes
		Ru-106	100 (5)	111 (4)	Yes
		Cs-134	59 (5)	60 (2)	Yes
		Cs-137	87 (5)	94 (5)	Yes
	6/87	Cr-51	41 (5)	40 (3)	Yes
		Co-60	64 (5)	65 (2)	Yes
		Zn-65	10 (5)	11 (1)	Yes
		Ru-106	75 (5)	74 (4)	Yes
		Cs-134	40 (5)	36 (2)	Yes
		Cs-137	80 (5)	79 (4)	Yes
	10/87	Cr-51	70 (5)	63 (8)	Yes
		Co-60	15 (5)	16 (1)	Yes
		Zn-65	46 (5)	45 (1)	Yes
		Ru-106	61 (5)	55 (4)	Yes
		Cs-134	25 (5)	22 (1)	Yes
		Cs-137	51 (5)	49 (2)	Yes
Gross Beta in Water (pCi/liter)	1/87	beta	10(5)	12(5)	Yes
	3/87	beta	13 (5)	11 (1)	Yes
	5/87	beta	7 (5)	8 (1)	Yes
	7/87	beta	5 (5)	5 (0)	Yes
	9/87	beta	12 (5)	11 (1)	Yes
	11/87	beta	19 (5)	15 (2)	Yes

Table 4 - Results of 1987 EPA Intercomparison Program

Comparison Study (Measurement Unit)	Date	Nuclide	EPA Value (± 1σ)	Laboratory Results (± 1σ)	Agreement
Iodine in Water (pCi/liter)	4/87	I-131	7 (1)	7 (2)	Yes
	8/87	I-131	48 (6)	49 (2)	Yes
	12/87	I-131	26 (6)	26 (2)	Yes
Laboratory Blind (pCi/liter)	4/87	beta	66 (5)	58 (2)	Yes
		Co-60	8 (5)	9 (0)	Yes
		Cs-134	20 (5)	18 (1)	Yes
		Cs-137	15 (5)	16 (1)	Yes
	10/87	beta	72 (5)	65 (1)	Yes
		Co-60	16 (5)	16 (1)	Yes
		Cs-134	16(5)	16(0)	Yes
		Cs-137	24 (5)	25 (1)	Yes
Radionuclides in Milk (pCi/liter)	2/87	I-131	9 (1)	9 (1)	Yes
	6/87	I-131	59(6)	68 (3)	Yes
		Cs-137	74 (5)	78 (2)	Yes
Tritium in Water (pCi/liter)	2/87	H-3	4209 (421)	4650 (321)	Yes
	6/87	H-3	2895 (357)	2798 (116)	Yes
	10/87	H-3	4492 (449)	4582 (91)	Yes
Radionuclides in Food (pCi/kg)	1/87	I-131	78 (8)	86 (2)	Yes
		Cs-137	84(5)	94(2)	Yes
	7/87	I-131	80 (8)	84 (3)	Yes
		Cs-137	50(5)	54(2)	Yes

Table 4 - Results of 1987 EPA Intercomparison Program (continued)

Comparison Study (Measurement Unit)	Date	Nuclide	Laboratory Results[1]	VCSNS Count Room Results[1]	Agree-ment
25 ml Gas Sample (μCi/ml)	3/87	Kr-85	4.51E-4	N/O	N/A
		Kr-85m	2.97E-5	1.33E-5	Yes
		Xe-131m	6.93E-4	7.12E-4	Yes
		Xe-133	6.15E-2	7.36E-2	Yes
		Xe-133m	8.96E-4	9.64E-4	Yes
		Xe-135	5.81E-4	6.40E-4	Yes
1 l Liquid Sample (μCi/ml)	7/87	Cr-51	1.22E-6	N/O	N/A
		Mn-54	7.79E-7	6.33E-7	Yes
		Co-57	1.10E-7	N/O	N/A
		Co-58	1.47E-5	1.23E-5	Yes
		Co-60	5.46E-6	4.08E-6	Yes
		Nb-95	4.48E-7	3.11E-7	Yes
		Cs-134	1.04E-7	N/O	N/A
		Cs-137	1.24E-7	N/O	N/A
		Am-241	1.07E-4	1.37E-4	Yes
Charcoal Filter ($\mu Ci/m^3$)	9/87	Co-57	2.35E-2	1.81E-2	Yes
		Co-60	4.53E-2	3.56E-2	Yes
		Y-88	2.15E-2	1.69E-2	Yes
		Cd-109	1.25E0	1.01E0	Yes
		Sn-113	1.57E-2	1.31E-2	Yes
		Cs-137	5.30E-2	4.25E-2	Yes
		Ce-139	1.23E-2	9.53E-3	Yes
		Hg-203	2.41E-3	1.89E-3	Yes
25 ml Gas Sample (μCi/ml)	10/87	Ar-41	1.67E-4	2.16E-3	No[2]
		Kr-85	4.03E-3	N/O	N/A
		Kr-85m	9.89E-5	1.11E-4	Yes
		Kr-87	4.60E-5	4.43E-5	Yes
		Kr-88	1.41E-4	1.74E-4	Yes
		Rb-88	2.19E-2	2.60E-3	No[2]
		Xe-131m	1.22E-3	N/O	N/A
		Xe-133	5.55E-2	5.95E-2	Yes
		Xe-133m	3.20E-4	3.48E-4	Yes
		Xe-135	2.18E-3	2.23E-3	Yes
		Xe-135m	N/O	2.48E-5	N/A
		Cs-138	N/O	1.39E-4	N/A
Filter Paper ($\mu Ci/m^3$)	12/87	Co-57	4.94E-3	5.66E-3	Yes
		Co-60	5.94E-2	6.18E-2	Yes
		Y-88	1.38E-3	1.44E-3	Yes
		Cd-109	6.50E-1	7.86E-1	Yes
		Sn-113	1.45E-3	1.58E-3	Yes
		Cs-137	7.78E-2	8.08E-2	Yes
		Ce-139	1.51E-3	1.66E-3	Yes

1. N/O = not observed
2. Disagreement attributed to differences in extrapolation of respective calibration curves at high energies. Corrective action is being taken to resolve discrepancy.

Table 5 - Results of 1987 Intracomparison Program with VCSNS Count Room

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. 13	Monthly	Gross Beta 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 1987 Intercomparison Program with South Carolina Department of Health and Environmental Controls

NRC TLD STATION NO	LABORATORY TLD STATION NO	1986 FOURTH QUARTER RESULTS (uR/hr)			1987 FIRST QUARTER RESULTS (uR/hr)			1987 SECOND QUARTER RESULTS (uR/hr)			1987 THIRD QUARTER RESULTS (uR/hr)		
		NRC	Laboratory	Percent Difference	NRC	Laboratory	Percent Difference	NRC	Laboratory	Percent Difference	NRC	Laboratory	Percent Difference
1	42	10.6	7.7	27.4	9.1	7.6	16.5	10.6	7.9	25.0	9.6	7.5	21.9
2	6	8.7	8.7	0	9.2	8.4	8.7	8.4	8.7	-3.4	9.4	8.1	13.8
5	54	11.2	12.7	-13.4	10.5	11.5	-9.5	--	12.3	--	11.1	11.8	-6.3
7	*53	13.4	12.5	6.7	11.8	12.5	-5.9	13.4	12.6	6.0	13.1	12.5	4.6
9	*52	13.2	13.5	-2.3	13.1	12.9	1.5	12.7	13.1	-3.1	12.8	12.8	0
11	*12	9.7	9.7	0	8.9	9.5	-6.7	--	9.4	--	13.0	9.2	29.2
13	13	11.5	12.5	-8.7	10.7	12.3	-15.0	12.0	12.4	-3.3	11.7	12.2	-4.3
14	*44	--	7.4	--	10.2	7.0	31.4	8.9	7.4	16.9	11.1	7.1	35.8
19	*56	9.1	9.2	-1.1	10.0	9.3	7.0	8.9	9.7	-9.0	10.5	9.2	12.4
22	58	8.1	6.3	22.2	7.6	6.2	18.4	8.4	6.6	21.0	7.8	6.0	23.1
24	41	9.0	9.2	-2.2	7.8	9.1	-16.7	9.5	9.2	3.2	8.8	9.4	-6.8
29	*60	11.0	11.6	-5.5	10.8	12.1	-12.0	11.3	12.0	-6.2	11.0	11.7	-6.4
30	46	10.6	10.2	3.8	11.9	9.9	16.8	10.0	10.0	0	17.6	10.2	42

* Co-located dosimeters within 10 ft. 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 sectoral 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(E) 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.	Monthly or quarterly exchange; two or more dosimeters at each location.	1,2,3,4, 5,6,7,8, 9,10,29, 30,47	Gamma dose monthly or 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.	Monthly or 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 monthly or 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.	Monthly or 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 monthly or quarterly.

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	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 up-stream 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.
	D) 1 Indicator sample to be taken in the upper reservoir of the pumped storage facility at the plant discharge canal.	Time composite sample 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 separated 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.

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
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.
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.	To be supplied when milk animals are found in accordance with criteria VII.A	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 sectoral 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	To be supplied when milk animals are found in accordance with criteria VII.A	Gamma isotopic.
	E) 1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly when available	16	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
VIII. Food Products	A) Two samples of broadleaf vegetation grown in 1 location of special interest and in the 1 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.
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.

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
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).	Monthly or quarterly exchange; two or more dosimeters at each location.	61,62 63,64 65,66 67,68	Gamma dose monthly or quarterly.
	E) 3 Stations to be placed on buoys on Monticello Reservoir (Background Study).	Monthly or quarterly exchange; two or more dosimeters at each location.	69 70 71	Gamma dose monthly or 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	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	14	Gamma isotopic and I-131 analysis biweekly.
	D) 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 Program

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) 1 Indicator sample to be taken at a location immediately downstream of the VCSNS liquid effluent discharge point.	Semiannual grab sample.	38	Gamma isotopic.
	G) Ten (10) additional indicator samples to be taken at various locations on Congaree River between Broad River and Lake Marion.	Semiannual grab sample.	80,81 82,83 84,85 86,87 88,89	Gamma isotopic.

Table 9 - Supplemental Radiological Environmental Monitoring Program

Virgil C. Summer Nuclear Station
Fairfield County, South Carolina

Docket No. 50-395
Reporting Period: 1/1/87 - 12/31/87

Medium or Pathway Sampled (Unit of Measurement)	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])	Gross Beta[4] (570)	4.4E-3 (1.0E-2)	2.4E-2 (468/468) (0.8E-2 to 4.9E-2)	Site 13, North Dam (2.9 mi NNW)	2.6E-2(52/52) (1.4E-2 to 4.6E-2)	2.5E-2 (104/104) (1.0E-2 to 5.6E-2)	0
	Gamma Spec (132)						
	Cs-134	2.3E-3 (5.0E-2)	All < LLD			All < LLD	0
	Cs-137	2.4E-3 (6.0E-2)	All < LLD			All < LLD	0
Air Radioiodine[5] (pCi/m[3])	I-131(364)	3.1E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[6] (μR/hr)	Gamma(264) Monthly	5.2E-1	9.3 (203/204) (6.8 to 12.9)	Site 9, Ball Park (2.2 mi, NE)	12.3 (11/11) (12.0 to 12.9)	9.8 (60/60) (6.4 to 12.9)	0
	Gamma(108) Quarterly	5.2E-1	9.9 (108/108) (6.0 to 14.9)	Site 55, St. Barnabas Church (2.8 mi, E)	14.3 (4/4) (13.6 to 14.9)		0
Surface Water (pCi/l)	H-3(89)	4.3E + 2 (2.0E + 3)	5.5E + 2 (3/63) (4.8E + 2 to 6.6E + 2)	Site 17, Columbia Canal (24.7 mi, SE)	5.7E + 2 (2/13) (4.8E + 2 to 6.6E + 2)	All < LLD	0
	Gamma Spec (89)						
	Mn-54	1.8E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	2.0E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	6.7E-0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	2.4E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	4.6E-1 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	3.5E-1 (3.0E + 1)	All < LLD			All < LLD	0
	Nb-95	2.4E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-134	1.8E-1 (1.5E + 1)	All < LLD			All < LLD	0

Table 10 - 1987 Radiological Environmental Monitoring Program Summary

Virgil C. Summer Nuclear Station
Fairfield County, South Carolina

Docket No. 50-395
Reporting Period: 1/1/87 - 12/31/87

Medium or Pathway Sampled (Unit of Measurement)	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-137	2.0E-1 (1.8E + 1)	8.3E-1 (5/63) (7.2E-2 to 1.0E0)	Site 21, Parr Reservoir (2.7 mi SSW) Site 25, Fairfield Pumped Storage (0.9 mi., WNW)	1.0E0 (2/13) (9.6E-1 to 1.0E0) 1.0E0 (1/12) (Single Value)	All < LLD	5
	Ba-140	1.5E0 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	6.5E-1 (1.5E + 1)	All < LLD			All < LLD	0
Ground Water (pCi/l)	H-3(12)	4.3E + 2 (2.0E + 3)	6.8E + 2 (2/8) (5.3E + 2 to 8.3E + 2)	Site 26, Onsite Well P4 (265 ft. W)	6.8E + 2 (2/4) (5.3E + 2 to 8.3E + 2)	All < LLD	0
	Gamma Spec (12)						
	Mn-54	3.0E0 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	3.2E0 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	7.3E0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	3.9E0 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	8.8E0 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	5.3E0 (3.0E + 1)	All < LLD			All < LLD	0
	Nb-95	3.9E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-134	3.4E0 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	3.3E0 (1.8E + 1)	All < LLD			All < LLD	0
	Ba-140	1.3E + 1 (6.0E + 1)	All < LLD			All < LLD	0

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Virgil C. Summer Nuclear Station
Fairfield County, South Carolina

Docket No. 50-395
Reporting Period: 1/1/87 - 12/31/87

Medium or Pathway Sampled (Unit of Measurement)	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)		
	La-140	5.6E0 (1.5E + 1)	All < LLD			All < LLD	0
Drinking Water[7] (pCi/l)	Gross Beta (38)	2.5E0 (4.0E0)	6.0E0 (18/25) (2.4E0 to 1.2E + 1)	Site 28, NTC (2.4 mi, SSE)	8.8E0 (12/12) (5.6E0 to 1.2E + 1)	5.2E0 (7/13) (2.8E0 to 1.7E + 1)	0
	H-3(38)	4.3E + 2 (2.0E + 3)	5.0E + 2 (3/38) (4.7E + 2 to 5.2E + 2)	Site 17, Columbia Waterworks (24.7 mi, SE)	5.0E + 2 (3/13) (4.7E + 2 to 5.2E + 2)	All < LLD	0
	Gamma Spec (38)						
	Mn-54	1.6E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Co-58	1.7E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Fe-59	8.7E0 (3.0E + 1)	All < LLD			All < LLD	0
	Co-60	2.0E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Zn-65	4.1E-1 (3.0E + 1)	All < LLD			All < LLD	0
	Zr-95	3.0E-1 (3.0E + 1)	All < LLD			All < LLD	0
	Nb-95	2.0E-1 (1.5E + 1)	All < LLD			All < LLD	0
	I-131	4.8E-1 (1.0E0)	All < LLD			All < LLD	0
	Cs-134	1.6E-1 (1.5E + 1)	All < LLD			All < LLD	0
	Cs-137	1.7E-1 (1.8E + 1)	All < LLD			1.3E0 (1/13) (Single Value)	0
	Ba-140	1.1E0 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	4.7E-1 (1.5E + 1)	All < LLD			All < LLD	0
Milk (pCi/l)	Gamma Spec (51)						

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Medium or Pathway Sampled (Unit of Measurement)	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)		
	I-131	5.0E-1 (1.0E0)	All < LLD			All < LLD	0
	Cs-134	3.2E0 (1.5E + 1)	1.4E0 (1/26) (Single Value)	Site 14, Dairy (6.3 mi W)	1.4E0 (1/26) (Single Value)	All < LLD	0
	Cs-137	3.5E0 (1.8E + 1)	3.4E0 (18/26) (1.5E0 to 7.1E0)	Site 14, Dairy (6.3 mi W)	3.4E0 (18/26) (1.5E0 to 7.1E0)	4.1E0 (14/25) (1.7E0 to 8.4E0)	0
	Ba-140	1.0E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	La-140	3.7E0 (1.5E + 1)	All < LLD			All < LLD	0
Grass (pCi/kg wet)	Gamma Spec (26)						
	I-131	2.1E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	Cs-134	1.6E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	Cs-137	1.9E + 1 (8.0E + 1)	7.1E0 (2/16) (5.6E0 to 8.6E0)	Site 6, Garden (1.0 mi ESE)	7.1E0 (2/7) (5.6E0 to 8.6E0)	5.3E0 (2/10) (5.2E0 to 5.3E0)	0
Broadleaf Vegetation (pCi/kg wet)	Gamma Spec (24)						
	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	1.4E + 1 (8.0E + 1)	All < LLD			2.0E + 1 (1/8) (Single Value)	0
Other Vegetation (pCi/kg wet)	Gamma Spec(4)						
	I-131	2.2E + 1 (6.0E + 1)	All < LLD			All < LLD	0
	Cs-134	9.6E0 (6.0E + 1)	2.8E0 (1/2) (Single Value)	Site 6, Garden (1.0 mi ESE)	2.8E0 (1/2) (Single Value)	All < LLD	1

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Medium or Pathway Sampled (Unit of Measurement)	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-137	1.0E + 1 (8.0E + 1)	6.0E0 (1/2) (Single Value)	Site 6, Garden (1.0 mi ESE)	6.0E0 (1/2) (Single Value)	All < LLD	1
Fish (pCi/kg wet)	Gamma Spec (31)						
	Mn-54	1.1E + 1 (1.3E + 2)	All < LLD			All < LLD	0
	Co-58	1.8E + 1 (1.3E + 2)	4.4E + 1 (1/24) (Single Value)	Site 21, Parr Res. (2.7 mi, SSW)	4.4E + 1 (1/8) (Single Value)	All < LLD	1
	Fe-59	7.1E + 1 (2.6E + 2)	All < LLD			All < LLD	0
	Co-60	1.6E + 1 (1.3E + 2)	1.8E + 1 (2/24) (1.3E + 1 to 2.2E + 1)	Site 21, Parr Res. (2.7 mi, SSW)	1.8E + 1 (2/8) (1.3E + 1 to 2.2E + 1)	All < LLD	2
	Zn-65	3.5E + 1 (2.6E + 2)	All < LLD			All < LLD	0
	Cs-134	1.1E + 1 (1.3E + 2)	7.3E0 (9/24) (5.2E0 to 1.3E + 1)	Site 21, Parr Reservoir (2.7mi, SSW)	9.1E0 (2/8) (5.3E0 to 1.3E + 1)	All < LLD	9
	Cs-137	1.1E + 1 (1.5E + 2)	2.4E + 1 (17/24) (1.0E + 1 to 5.6E + 1)	Site 24, Rec. Lake (5.5mi, N)	3.2E + 1 (6/8) (2.0E + 1 to 5.6E + 1)	1.8E + 1 (5/7) (7.5E0 to 2.6E + 1)	0
Sediment (pCi/kg)[8]	Gamma Spec (42)						
	Mn-54	1.9E + 1	All < LLD			All < LLD	0
	Co-58	2.2E + 1	2.1E + 1 (7/37) (7.4E0 to 5.6E + 1)	Site 21, Parr Reservoir (2.7mi, SSW)	3.5E + 1 (6/16) (7.8E0 to 5.6E + 1)	All < LLD	7
	Co-60	2.6E + 1	6.0E + 1 (15/37) (1.5E + 1 to 1.2E + 2)	Site 21, Parr Reservoir (2.7mi, SSW)	6.4E + 1 (11/16) (1.5E + 1 to 1.2E + 2)	All < LLD	15

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Medium or Pathway Sampled (Unit of Measurement)	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	2.0E + 1 (1.5E + 2)	1.2E + 1 (12/37) (5.7E0 to 2.3E + 1)	Site 21, Parr Reservoir (2.7mi, SSW)	1.6E + 1 (7/16) (7.5E0 to 2.3E + 1)	1.1E + 1 (1/5) (Single Value)	0
	Cs-137	1.7E + 1 (1.8E + 2)	1.1E + 2 (37/37) (6.1E0 to 3.0E + 2)	Site 21, Parr Reservoir (2.7mi, SSW)	1.7E + 2 (16/16) (4.6E + 1 to 3.0E + 2)	1.2E + 2 (5/5) (7.8E + 1 to 1.9E + 2)	0

Table 10 - 1987 Radiological Environmental Monitoring Program 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. Any confirmed measured level of radioactivity in any environmental medium that exceeds ten times the control station value. Radioactivity attributed to the Chernobyl incident was not reported as non-routine measurements provided measurements from control locations were positive for fission product activity.

4. Four samples exceeded maximum LLD because of low sample volume. The calculated LLD's were 2.3E-2, 1.49E-2, 1.02E-2 and 5.13E-2 pCi/m^3.

5. One sample exceeded maximum LLD because of low sample volume. The calculated LLD was 1.53E-1 pCi/m^3.

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

7. 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.

8. 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.

Table 10 - 1987 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/m3) (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. 5 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/m3) (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)(1981-1982)	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
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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 ten times the control station value.

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 Particulate Gross Beta	16 14 15	April (13) July (30) May (15) June (26)	Missed LLD due to low sample volume or incomplete samples attributed to air sampler power outages
Dosimeter	9	April	Lost
Milk	16	April (10)	Closing of control dairy
Grass	6	January February March April October December	Seasonal Unavailability
	14	January February December	Seasonal Unavailability
	16	January February December	Seasonal Unavailability
Broadleaf Vegetation	5	May through December	Seasonal Unavailability
	6	May through October	Seasonal Unavailability
	8	April through November	Seasonal Unavailability
	18	April May August September	Seasonal Unavailability
Fish (bream)	22	May	Seasonal Unavailability

Table 12 - 1987 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 2.9E-2 and 3.0E-2 pCi/m^3, respectively. Mean indicator and control location measurements during 1987 were 2.4E-2 and 2.5E-2 pCi/m^3, respectively. The highest site specific mean activity was measured at indicator location no. 13 (North Dam, 2.9 mi, NNW) to be 2.6E-2 pCi/m^3. The highest mean control activity was also measured to be 2.6E-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 2.3E-3, 2.4E-3 and 3.1E-2 pCi/m^3, respectively. The results agree with gaseous effluent release data reported in the 1987 Semiannual Effluent and Waste Disposal Reports for VCSNS. Only 2.6E-4 and 4.5E-4 Ci of particulate and iodine activity was released, respectively. These activity levels are not discernable in environmental media upon consideration of dispersion and dilution factors experienced during the releases.

Environmental dosimetry measurements during 1987 did not differ significantly from preoperational measurements over the same seasonal time periods. Indicator and control dosimetry measurements also showed no appreciable differences during 1987. The lowest mean exposure rate of 6.2 ± 0.5 µR/hr was observed at sampling location no 58 (residence in Jenkinsville). Sampling location no 55 at St. Barnabas Church near Jenkinsville (2.8 mi, E) was the indicator location showing the highest mean exposure rate of 14.3 ± 1.1 µR/hr. This value compares favorably with the mean exposure rate of 13.6 ± 2.2 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 1987 indicated a total of 6.3E + 2 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. All MDA's were less than the required respective LLD's. Analytical results of five surface water samples collected in Monticello and Parr Reservoirs during August and September, 1987 indicated a mean Cs-137 concentration of 1.0 pCi/liter. Liquid effluent release data reported for 1987 in the Semiannual Effluent and Waste Disposal Reports indicated a total of 4.9E-1 Ci of measureable fission and activated corrosion product activity was released from VCSNS, a level not discernable in environmental media based upon consideration of dilution factors experienced during the releases and the detection limits of analytical methods. The presence of Cs-137 is, therefore, attributed to residual fallout from atmospheric weapons testing and the 1986 Chernobyl incident.

Tritium analyses of surface water samples during 1987 yielded results which were not noticeably different from preoperational data. All but 3 of 63 indicator tritium activity measurements were less than the mean calculated MDA value of 4.3E + 2 pCi/liter. The maximum indicator tritium activity of 6.6E + 2 pCi/liter was measured in Columbia Canal. 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 1987 was reported to be 736.4 Ci; a level not discernable in environmental media 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. All MDA's were less than the respective required LLD's. 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. One ground water sampling location (No. 26) was relocated to a location still within the 1 mile radius of VCSNS. Leakage of rainwater into the collection well was rendering the samples unrepresentative of ground water activity.

Most tritium analyses of ground water samples during 1987 yielded results which were less than the mean calculated MDA of 4.3E + 2 pCi/liter. Two ground water samples collected at the onsite well (No. 26) prior to the relocation indicated the presence of tritium at an average concentration of 6.8E + 2 pCi/liter; a level consistent with the preoperational mean of 1.5E + 3 pCi/liter.

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.

Drinking water tritium analyses, in all but three cases, showed no concentrations in excess of the mean calculated MDA for the indicator locations. An average detected activity of 5.0E + 2 pCi/liter was found in Columbia drinking water. This value is consistent with the preoperational mean activity of 7.8E + 2 pCi/liter. The MDA for tritium in drinking water was 4.3E + 2 pCi/liter.

With the exception of Cs-134, gamma spectroscopy measurements of milk samples collected in 1987 were not significantly different from those observed during the preoperational program. Cesium-134 was detected on one occasion in milk collected at an indicator location. The detected activity of 1.4 pCi/liter is attributed to residual fallout from the 1986 Chernobyl incident. Naturally occurring

K-40, Ra-266 and Cs-137 attributed to fallout was detected at both sampling locations at concentrations simila: 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 1987 indicated the presence of Be-7 and K-40 in all samples. Detectable levels of Cs-137 were found in indicator and control grass samples. The naturally occurring radionuclides Be-7 and K-40 were detected at levels similar to those found during the preoperational program and in 1987 control data. The observation of Cs-137 activity in indicator and control grass samples is attributed to residual fallout from atmospheric weapons testing and the 1986 Chernobyl incident. There is 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 1987.

Broadleaf vegetation collected from gardens at location no's. 5, 6, 8 and 18 were the principal food products analyzed during 1987. Gamma spectroscopy measurements revealed Cs-137 at a concentration of 2.0E + 1 pCi/kg in one sample collected at a control location. Naturally occurring contributions from Ra-226, K-40, Ac-228 and Be-7 were also measured. All radionuclide measurements are comparable to and consistent with the results obtained during the preoperational program. Cesium-137 was detected at control and indicator locations during the preoperational period.

Other vegetation sampled in 1987 included squash, corn, and radish 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. Detectable levels of Cs-134 and Cs-137 were measured in squash collected from the indicator garden location (no.6, 1 mi., ESE) at levels of 2.8 and 6.0 pCi/kg, respectively. The level of Cs-137 was consistent with preoperational data and attributed to residual fallout from atmospheric weapons testing and the 1986 Chernobyl incident. The detection of Cs-134 was attributed to residual fallout from the 1986 Chernobyl incident.

Fish species sampled at three indicator and one control location included bass, bream, shad, catfish and carp. Cesium-137 was detected in 22 of 31 samples collected at all four sampling locations and in all five species. The highest mean Cs-137 concentration of 3.1E + 1 pCi/kg was detected in bass. Cesium-134 was detected in 9 of 31 samples collected primarily during the spring of 1987 and only at one indicator location. The highest mean Cs-134 concentration of 9.4 pCi/kg was also found in bass. Detectable levels of Co-58 and Co-60 were measured in shad and only in samples collected from Parr Reservoir. The highest levels of Co-58 and Co-60 were 4.4E + 1 and 2.2E + 1 pCi/kg, respectively, measured in samples collected in May, 1987. The levels of Cs-137 in both control and indicator locations were consistent with preoperational levels and are attributed to residual fallout from atmospheric weapons testing and the 1986 Chernobyl incident. The presence of Cs-134 is primarily attributed to residual fallout from the 1986 Chernobyl incident and, to a much lesser extent, liquid effluent releases during the first six months of 1987 which included a total of 1.7E-2 Ci of Cs-134. The limitation of Cs-134 from residual fallout to indicator locations may be attributed to a different rate of sediment accumulation in the Broad River at Neal Shoals relative to the indicator locations at Parr Reservoir, Monticello Reservoir and the Recreation Lake. Sedimentation in lakes and reservoirs which characterize the indicator sampling locations is less

dynamic relative to that in a river which characterizes the control sampling location. Cesium-134 attributed to liquid effluent releases from VCSNS would be limited to Parr and Monticello Reservoirs. The detection of Co-58 and Co-60 in Parr Reservoir in the spring of 1987 is attributed to liquid effluent releases of activated corrosion products during the refueling and maintenance outage as the semiannual effluent release reports indicate. The activity of Co-58 and Co-60 released prior to and during the collection period was 1.9E-1 and 6.5E-2 Ci, respectively.

Radiation doses to man, corresponding to the mean concentrations of activated corrosion and fission product activity in fish, were calculated using Regulatory Guide 1.109 methodology. The results are included in Table 13.

Location	Radionuclide	Activity (pCi/kg)		Corresponding Calculated Annual Total Body Deep Dose Equivalent (mrem)
		Maximum	Mean	
Parr Reservoir	Co-58	4.4E + 1	4.4E + 1	1.5E-3
	Co-60	2.2E + 1	1.8E + 1	1.8E-3
	Total			3.3E-3

Table 13 - 1987 Activated Corrosion Product Activity in Fish

Gamma spectroscopy measurements of sediment samples collected during 1987 also indicated the presence of activated corrosion and fission product activity. Cesium-134 and Cs-137 were detected in sediment from all indicator and control locations. Detection of Co-58 and Co-60 was limited to Parr and Monticello Reservoirs. The highest mean concentrations, observed in Parr Reservoir, were 3.5E + 1, 6.4E + 1, 1.6E + 1 and 1.7E + 2 pCi/kg for Co-58, Co-60, Cs-134 and Cs-137, respectively. 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 a mean concentration of 8.9E + 1 pCi/kg; a level 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. Activated corrosion product activity detected in Parr and Monticello Reservoirs is attributed to liquid effluent releases from VCSNS. The relatively low activated corrosion product activity in Monticello Reservoir is 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 activated corrosion product activity in sediment, were calculated using Regulatory Guide 1.109 methodology. A 400 hr/year exposure to shoreline sediment containing mean detected concentrations of Co-58 and Co-60 was assumed. The results are included in Table 14.

Location	Radionuclide	Activity (pCi/kg)		Corresponding Calculated Annual Dose Equivalent (mrem)	
		Maximum	Mean	Shallow	Deep
Monticello Reservoir	Co-58	7.4E0	7.4E0	9.3E-4	8.6E-4
	Co-60	7.0E + 1	5.6E + 1	1.8E-2	1.5E-2
	Total			1.9E-2	1.6E-2
Parr Reservoir	Co-58	5.6E + 1	3.5E + 1	4.6E-3	4.0E-3
	Co-60	1.2E + 2	6.4E + 1	2.0E-2	1.8E-2
	Total			2.5E-2	2.2E-2

Table 14 - 1987 Activated Corrosion Product 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-58 and Co-60 in fish and sediment is a highly conservative estimate. The absence of any discernable ecological impact on biota substantiates the fact that species population stability has been unaffected by the activated corrosion product activity released from VCSNS. The absence of any impact is anticipated since the concentrations were much less than acceptable limits during 1987 and since most biotic species are not as radiosensitive as man.

Based on the data and the interpretations and conclusions discussed, the presence of activated corrosion product activity in fish from Parr Reservoir and sediment from Parr and Monticello Reservoir are the only environmental indicators which can be attributed to operation of VCSNS. The presence of all other fission product activity is attributed to residual fallout from the 1986 Chernobyl incident and atmospheric weapons testing. The results of the Radiological Environmental Monitoring Program support the results reported in the Semiannual Effluent and Waste Disposal Reports for VCSNS during 1987. The calculated potential radiation dose to the public attributed to activated corrosion product activity in Broad River media is 2.5E-2 mrem. This figure compares favorably to the 6.3E-2 mrem dose reported in the 1987 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.

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Dan A. Nauman
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April 27, 1988

88 MAY 2 A8:54

Dr. J. Nelson Grace
Regional Administrator
U. S. Nuclear Regulatory Commission
Region II, Suite 2900
101 Marietta Street, N.W.
Atlanta, Georgia 30323

Subject: Virgil C. Summer Nuclear Station
Docket No. 50/395
Operating Licensing No. NPF-12
Radiological Environmental
Monitoring Report

Dear Dr. Grace:

Enclosed is the South Carolina Electric & Gas Company (SCE&G) Annual Radiological Environmental Monitoring Report as required by Regulatory Guide 4.8 and Sections 6.9.1.6 and 6.9.1.7 of the Virgil C. Summer Nuclear Station Technical Specifications. Also, requirements as specified by Section 4.12.3 of the Technical Specifications have been included in the report

If there are any questions, please call us at your convenience.

Very truly yours,

D. A. Nauman

DCB:DAN:mn
Enclosure

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