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ATTN: Document Control Desk
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DOMINION ENERGY SOUTH CAROLINA, INC. (DESC)
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Enclosed is the DESC Annual Radiological Environmental Operating Report as required by Section 6.9.1.6 of the Virgil C. Summer Nuclear Station Technical Specifications.

If there are any questions, please call Ms. Tracey Stewart at (803) 931-5663.

Sincerely,

Michael S. Moore for

Robin R. Haselden
Director, Nuclear Station Safety and Licensing
V. C. Summer Nuclear Station

Commitments contained in this letter: None

Enclosure

cc: w/o Enclosure unless noted
G. J. Lindamood – Santee Cooper
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ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
VIRGIL C. SUMMER NUCLEAR STATION

FOR THE OPERATING PERIOD
JANUARY 1, 2021 - DECEMBER 31, 2021

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EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report describes the V.C. Summer Environmental Monitoring Program and the program results for the calendar year 2021.

Included are the identification of sample locations, descriptions of environmental sampling and type of analysis. Comparisons of present environmental radioactivity levels and preoperational environmental data, land use census evaluation, doses calculated from environmental measurements, and a summary of environmental radiological sampling results are presented. Quality assurance practices, sampling deviations and unavailable samples are also discussed.

Sampling activities were conducted as prescribed by the Offsite Dose Calculation Manual (ODCM) for V.C. Summer Nuclear Station (VCSNS) and applicable Health Physics Procedures. Required analyses were performed and detection limits met for required samples with deviations noted. Samples were collected comprising one thousand two hundred sixty five analyses (1,265) performed to compile the data for the 2021 Environmental Report. Supplemental samples comprising two hundred ninety-eight (298) analyses were performed on some media for additional information. Based on the results from the annual land use census, the current number of sampling sites for V.C. Summer Nuclear Station is sufficient.

Radionuclides observed in the environment in 2021 from V.C. Summer effluent releases were within the range of concentrations observed in the past. Radiation dose calculated from sample results is less than observed with normal fluctuation in natural background. It is therefore concluded that VCSNS operations have no significant radiological impact on the health and safety of the public or the environment.

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Virgil C. Summer Nuclear Station (VCSNS) utilizes a pressurized water reactor rated at 2900 MWt (990 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 feed water modifications. Steam generators were replaced in the fall of 1994. During the ninth refuel the plant was uprated to 2900 MWt (990 MWe gross). VCSNS is currently operating in the 27th fuel cycle.

VCSNS is operating in conjunction with the adjacent Fairfield Pump 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 principal 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 the 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. Non-nuclear drains are released to the CWDC. Effluent from the liquid waste processing system and processed steam generator blow down are released through the penstocks. Radioactive gaseous effluents from VCSNS are released from two points: the Main Plant Vent and the Reactor Building Purge Exhaust, all considered ground level releases.

In 2012 construction began on the Independent Spent Fuel Storage Installation (ISFSI), and concluded in January 2016. The first dry cask storage campaign began March 26, 2016 and finished in the first week of May 2016. Four casks were loaded during this evolution. Additional campaigns in the second quarter of 2019 and first quarter of 2022 have added eight casks for a total of twelve.

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 2021. Data trends, control/indicator and preoperational/operational data, inter-comparisons, 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 Dominion Energy South Carolina. 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 inter-comparisons in order to evaluate the adequacy of radioactivity source control and to realistically verify the assessment of environmental radioactivity levels and subsequent radiation dose to man.

Sample media and analysis sensitivity requirements have been established to ensure that the maximum dose pathways are monitored and sensitivities represent a small fraction of annual release limits. These required Lower Limits of Detection (LLD's) are verified to have been met by calculating Minimum Detectable Activity (MDA) for each sample based on actual counting parameters relevant to each sample. In all cases the achieved MDA was lower than the LLD. Effluent dispersion characteristics, demography, hydrology and land use have been considered in selection of environmental sampling locations. These criteria were used to establish both the preoperational and operational phases of the Radiological Environmental Monitoring Program. Elements of the program monitor the impact of both 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 below in Table 1. Requirements of the Radiological Environmental Monitoring Program are specified in the VCSNS Offsite Dose Calculation Manual (ODCM).

Table 1 - Monitoring Methods for Critical Radiation Exposure Pathways

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,
	Milk (Ingestion)	Milk Sampling, Grass (Forage) Sampling
Liquid	Fish (Ingestion)	Fish Sampling,
	Water & Shoreline Exposure (Ingestion and Immersion)	Surface Water Sampling, Ground Water Sampling, Shoreline and Bottom Sediment Sampling,
	Drinking Water (Ingestion)	Drinking Water Sampling

Monitoring sites indicative of plant operating conditions are generally located within a 5 mile radius of the plant. Table 5 provides a list of ODCM required sampling locations. Table 6 provides a list of supplemental sampling locations. Maps showing radiological environmental sampling locations within a radius of approximately 5 miles from VCSNS are presented as Figures 1-2 through 1-5. Figure 1-1 shows monitoring sites at distances greater than 10 miles from the plant. Background radiation levels vary across the monitored area of interest.

In addition to pre-operational/operational data inter-comparisons, control/indicator data inter-comparisons are utilized. This is done 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.

Environmental data is gathered through multiple types of sampling and measurements at specific locations. Several multiple sampling combinations are in use around the VCSNS. For example, all air sampling locations serve as environmental dosimetry monitoring locations. At these locations, airborne plant effluents are monitored for gamma immersion dose (noble gases), in addition to air contaminants. Monitoring locations Site 6 (1.0 mile ESE) and Site 7 (1.0 mile E) have broadleaf vegetation gardens for monitoring gaseous effluent deposition (ingestion pathway) in the two sectors having the highest deposition coefficients (D/Q) with real potential for exposure. Monitoring location Site 18 (16.5 miles S) serves as a control location for direct radiation and Site 40 (11.9 miles SSE) serves as a control location for garden monitoring.

Liquid effluents are monitored using three different monitoring media (fish, bottom sediment, and surface water) at the two most probable affected bodies of water around the plant: Site 21, Parr Reservoir (2.7 miles SSW) and Site 23, Monticello Reservoir (0.5 miles ESE). The control location for liquid effluent comparisons is at Site 22, Neal Shoals (26.0 miles NNW) on the Broad River.

Quality of analytical measurements is demonstrated by participation in a laboratory inter-comparison program. Results of the inter-comparison program with an outside vendor and VCSNS Count Room were satisfactory in 2021 with the exception of an Alpha/Beta in Liquid analysis. Results are summarized in Table 9. The results of each of these quality control checks of the Radiological Environmental Monitoring Program verify the technical credibility of analytical data generated and reported by the program.

LAND USE CENSUS

Annually a land use census is performed within a 5 mile radius of VCSNS to verify the appropriate siting of sample locations. In addition, the location of the maximum exposed individual (MEI) is identified to ensure the appropriate location is used for calculation of offsite dose impact from Summer Station gaseous effluents. The results of the land use census performed in 2021 are included in Table 3. A verification of the maximum exposed individual location is presented in Table 4. Identification of the highest offsite dose locations was performed by calculating a hypothetical dose based on source term from the Operating License Environmental Report and 2021 meteorological data. Exposure pathways modeled in the analysis were those identified during the land use census.

The location and pathway presently used in the ODCM for offsite organ dose calculations (E 1.1 miles - residence/garden) was found to have the highest calculated dose. In addition, the ODCM required environmental gardens (ESE 1.0 and E 1.0 miles) were found to have calculated doses higher than any real receptor. There were no milking animals or dairy activity found within 5 kilometers of VCSNS. Therefore, changes to the ODCM gaseous effluent calculations or garden sample locations are not indicated.

MONITORING RESULTS AND DISCUSSION

The results of the Radiological Environmental Monitoring Program for 2021 are summarized in Table 7. For comparison, preoperational data are summarized in Table 8. The Radiological Environmental Program attained a program compliance rate of approximately 99.4%. A listing of program deviations and their respective causes are included in Table 10. Analysis of the impact of these omissions verified that program quality has not been affected.

Corbicula harvest for possible human consumption was observed in Lake Monticello in 2005. Since that time Corbicula analysis has been incorporated in the Supplemental Sampling Program. Samples were collected and analyzed for gamma emitting isotopes. No gamma emitting nuclides were detected.

Gross beta activities measured in air particulate samples collected at indicator locations around VCSNS were consistent with preoperational levels and not statistically significant from control locations. The highest site-specific mean activity (2.36E-2 pCi/m^3) was measured at indicator location Site 30 (Construction Site Gate 0.5 miles SSW). The results indicate that the operation of VCSNS has not contributed to detectable increases of airborne gross beta activity in the environment.

Gamma spectroscopy measurements of composited air particulate samples and activated charcoal cartridges support the gross beta activity trend. Only natural background

activities were detected. The highest MDA values at indicator locations for ^{134}Cs, ^{137}Cs and ^{131}I were 2.29E-3, 2.57E-3 and 1.67E-2 pCi/m^3, respectively and all met program analytical requirements for detection capability. Air sample collection rate for indicator/control air samples was 99%.

Environmental dosimetry measurements did not indicate any significant increase from preoperational measurements or previous historic average. Monitoring location Site 55 (St. Barnabas Church 2.8 miles E) was the indicator location showing the highest mean exposure rate of 1.10E+1 μR/hr. This value is consistent with the highest mean exposure rate of 1.40E+1 μR/hr measured during the preoperational period.

The impact of Independent Spent Fuel Storage Installation (ISFSI) operation, located within the VCSNS Protected Area, which began cask storage on March 26, 2016, was assessed using six TLD locations monitoring the perimeter of the ISFSI site. The TLD locations were monitored for three quarters prior to fuel storage and continued to be monitored through 2021 during which fuel storage casks were stored. Analysis of monitoring results show a statistically significant increase in ISFSI perimeter dose as a result of fuel storage. The highest location shows an increase of 7.3 mrem/calendar quarter compared to pre-operation. Although the applicable limit for a member of the public applies to a real individual, a conservative analysis was used to demonstrate compliance with 40CFR190 and 10CFR72.104 by assuming an individual is located at the perimeter of the ISFSI Protected Area for 2000 hours per year. In this case, the hypothetical individual would have received 6.6 mrem. This level of exposure would be well under the 40CFR190 limit of 25 mrem.

TLD sample collection rate for all indicator/control locations was 99.4%.

Gamma spectroscopy measurements of surface water samples did not indicate the presence of activated corrosion or fission products above the respective MDA for indicator sites. Tritium analysis did not indicate the presence of tritium above the respective MDA for indicator sites. Sample collection rate for all indicator/control surface water samples was 100%.

Gamma spectroscopy measurements of the ODCM required ground water samples did not indicate the presence of activated corrosion or fission products above the respective MDAs. Tritium was detected within the site boundary at Site 123 (NPDES Well GW-16 0.34 miles SSE), in four quarterly samples at concentrations of 2.25E+3 pCi/L, 2.63E+3 pCi/L, 2.02E+3 pCi/L, and 1.99E+3 pCi/L. GW-16 is a shallow supplemental monitoring site used to monitor for chemical contaminants around the Industrial and Sanitary Waste Treatment System. If this ground water represented a credible exposure pathway, maximum dose projection assuming consumption of 730 liters per year would result in a dose that does not exceed 0.25 mrem. These levels are substantially less than the 2.00E+4 pCi/L drinking water standard. Sample collection rate for indicator/control ground water samples was 100%.

Gamma spectroscopy measurements of drinking water samples collected from Site 28 (Jenkinsville water supply) and Site 17 (Columbia Water Works 25.0 miles SE) did not indicate the presence of activated corrosion or fission product activity above the respective MDAs. Tritium analysis did not indicate the presence of tritium above the respective MDA

for indicator sites. Sample collection rate for all indicator/control surface water samples was 100%.

There were no milk samples collected in 2021. Milk sampling is required to be performed at the three highest dose locations within 5 kilometers of the plant or at 5 to 8 kilometers of the plant if doses are calculated to be greater than 1 mrem/year. Presently there are no locations meeting these criteria for indicator dairies. The closest dairy is approximately 7 kilometers from the plant (see Table 3). Milk samples will be obtained from this dairy if gaseous releases from the plant exceed 5% of quarterly organ dose limits or radionuclides (attributed to the operation of VCSNS) are detected in broadleaf vegetation, grass or air samples at concentrations greater than required LLDs.

Gamma spectroscopy measurement of supplemental grass samples collected indicated ^{137}Cs in 6 of 12 samples at Site 2 (transmission line 1.2 miles SW) at concentrations ranging from 1.31E+1 pCi/kg to 1.04E+2 pCi/kg. The maximum preoperational control activity was 3.40E+2 pCi/kg. Sample collection rate for indicator/control supplemental grass was 100%.

Gamma spectroscopy measurements were performed on supplemental grass and soil samples collected in response to a liquid effluent spill in 2011 at Site 25 (Fairfield Pump Storage Remediation Area 0.9 miles WNW). None of the grass samples collected indicated the presence of activated corrosion or fission products above the respective MDAs. A soil sample did indicate ^{137}Cs at a concentration of 3.06E+1 pCi/kg.

Gamma spectroscopy measurements of the broadleaf samples collected did not indicate the presence of activated corrosion or fission products above the respective MDAs. All required indicator/control broadleaf samples were collected.

Gamma spectroscopy measurements of all non-leafy (other vegetation) supplemental samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA.

Gamma spectroscopy measurements of fish samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA. All required indicator/control fish samples were collected.

Gamma spectroscopy measurements of sediment samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA for indicator sites. ^{137} Cs was detected in 1 of 2 control samples taken at Site 22 (Neal Shoals 26 miles NNW) at a concentration of 4.16E+1 pCi/kg. Two samples from Supplemental Site 72 (Yard Drain Outfall 0.4 miles SE) also indicated ^{137} Cs at concentrations of 1.51E+1 pCi/kg and 1.7E+1 pCi/kg. Historically ^{137}Cs levels at the control site have ranged from 1.8E+1 pCi/kg to 1.0E+3 pCi/kg. All required indicator/control sediment samples were collected.

CONCLUSION

As in previous years of VCSNS operation, the presence of fission product activity attributed to residual fallout from atmospheric weapons testing and the Chernobyl accident were detected in environmental media including sediment and grass.

No detectable fission or activation product activity attributed to VCSNS operations was observed in environmental media with the exception of:

- Tritium in supplemental ground water samples taken at Site 123 (NPDES Well GW-16 0.34 miles SSE) within the nuclear station, owner-controlled area.

The average natural background for direct exposure as determined from control locations is 73.2 mrem/year. The hypothetical calculated maximum exposure for drinking water from the NPDES well within the nuclear station owner-controlled area would be within the normal fluctuations of natural terrestrial and cosmic background. Dose at this level would not be expected to result in observable effects on the ecosystem or general public. The results of the Radiological Environmental Monitoring Program, therefore, substantiate the continuing adequacy of source control at VCSNS and conformance of station operation to 10CFR50, Appendix I design objectives.

Table 2 - Required Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
1	Borrow Pit	1.2	179.8 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	144.0 SE	DQ
6	Environmental Lab Garden	1.0	111.0 ESE	AP,RI,GA,DQ,GW
7	Environmental Lab Garden	1.0	97.8 E	AP,RI,DQ, GA
8	Monticello Res. S of Rd 224	1.5	62.0 ENE	DQ
9	Ball Park	2.3	41.6 NE	DQ
10	Meteorological Tower #2	2.5	25.5 NNE	DQ
12	Old Hwy 99	4.2	349.4N	DQ
13	North Dam	2.9	333.0 NNW	DQ
14	Dairy (Shealy)[4]	6.5	277.0 W	MK,GR
16	Dairy (Parr) [4]	20.0	275.5 W	MK,GR
16a	TLD Location	28.0	278.6W	DQ
17	Columbia Water Works	25.0	144.0 SE	AP,RI,DQ,DW
18	Pine Island Club	16.5	165.0 S	DQ
19	Residence/Little Saluda	21.0	224.0 SSW	DQ
20	Residence/Whitmire	22.0	309.5 NW	DQ
21	Parr Reservoir	2.7	199.5 SSW	SW,FH,BS
22	Neal Shoals	26.0	343.1 NNW	SW,FH,BS
23	Discharge Canal (Mont, Res.)	0.5	104.5 ESE	SW,FH,BS
26	On Site Well (P2)	460 Ft	270.0 W	GW
27	On Site Well (P5)	510 Ft	180.0 S	GW
28	Jenkinsville Post Office	2.8	170.2 SE	DW
29	Trans. Line WSW of VCSNS	1.0	260.6 WSW	DQ
30	Oak Tree North of Borrow Pit[5]	1.0 / 0.5	196.2 SSW	DQ, AP, RI
31	McCrorey-Liston School	6.6	11.5 NNE	DQ
32	Clark Bridge Road and Brooks Drive	4.6	24.0 NNE	DQ
33	Rd 48 near Hwy 213	4.2	68.0 ENE	DQ
34	Rd 419 North of Hwy 60	4.9	111.0 ESE	DQ
35	Glenn's Bridge Road	4.6	132.0 SE	DQ
36	Woods at Jenkinsville Post Office	3.1	151.0 SSE	DQ
37	Residence	4.9	304.8 NW	DQ
39	Lake Murray Water Treatment Facility	14.0	168.0 SSE	DW
40	Emergency Operations Facility[6]	11.9	157.0 SSE	GA, GR
41	Below Catwalk at Trestle	3.8	182.0 S	DQ
42	Broad River Rd (Peak Residence)	3.8	198.0 SSW	DQ
43	Hwy 176 and Rd 435	5.2	236.0 SW	DQ
44	Rd 28 at Cannon's Creek	2.8	256.6 WSW	DQ
45	Rd 33 at Pomaria	5.8	253.2 WSW	DQ
46	Rd 28 at Heller's Creek	3.7	291.5 WNW	DQ
47	Fairfield Tailrace	1.0	316.0 NW	DQ

Table 2 (cont) – Required Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
52	Monticello (Rd 11)	3.8	13.0 NNE	DQ
53	Rd 359	3.0	46.5 NE	DQ
54	Jenkinsville School	1.7	72.5 ENE	DQ
55	St. Barnabas Church	2.8	91.5 E	DQ
56	Old Jenkinsville Dinner	2.0	144.0 SE	DQ
58	Residence	2.5	157.0 SSE	DQ
59	New Nuclear Deployment	2.6	170.2 SSE	DQ, GW
60	Rd 98 near Rd 28	3.5	274.6 W	DQ
78	ISFSI - North	0.14	133 NW	DQ
79	ISFSI – North East	266 Ft	102 WNW	DQ
80	ISFSI – South East	256 Ft	61 WSW	DQ
81	ISFSI - South	0.10	63 WSW	DQ
82	ISFSI –South West	0.15	91 W	DQ
83	ISFSI – North West	0.15	104 WNW	DQ
101	Remediation Well (B-2)	300 Ft	NNW	GW
102	Remediation Well (B-6)	400 Ft	NE	GW
103	Remediation Well (DW-13)	80 Ft	NE	GW
106	Remediation Well (DW-7)	250 Ft	SE	GW
108	Remediation Well (DW-19)	250 Ft	W	GW
110	Remediation Well (B-36)	300 Ft	NW	GW
112	NPDES Well (GW-9)	0.36	331 SSE	GW
113	NPDES Well (GW-12)	0.33	332 SSE	GW
114	NPDES Well (GW-13A)	0.39	317 SE	GW

Table 2 (cont) – Required Sampling Site Locations

Footnotes

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

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

3. Sample Types:

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

4. Sites 14 and 16 are not presently in use. If conditions change, requiring a renewal of dairy sampling these sites will be reactivated.

5. Site 30 consists of two locations in the same sector. The air sampler is located 0.5 miles from the reactor to support construction of a new facility. The TLD is located 1.0 mile from the reactor in the same sector.

6. Site 40 (11.9 miles SSE) serves as a control location for garden monitoring which is the location of the Station's Emergency Operating Facility.

Table 3 - Results of the 2021 Land Use Census Verification

SECTOR	NEAREST RESIDENCE	MILES	NEAREST GARDEN	MILES	NEAREST CATTLE	No. MILKED	MILES	NEAREST GOAT	No. MILKED	MILES
N	P. Oliver	3.73								
NNE	Thomas Crumblin	2.96								
NE	Gregory Guinyard	1.5								
ENE	Bessie Gregg	1.53								
E	Roy Mcadory	1.18								
ESE	Carrie Lee Martin	1.04								
SE	Mary White	1.44	10845 SC-215 (B)	2.4						
SSE	Ronnie Mann	2.39								
S	Kelly Boulw are	3.54								
SSW	Hope Carter	3.02								
SW	William Waldrop	2.84	2307 Broad River Rd (B)	3.31						
WSW	243 Peak Rd	3.25			2068 Peak Rd (C)	0	4.82			
W	4608 Broad River Rd	2.73			4608 Broad River Rd (C)	0	2.43			
W	Meyer Windmill Rd	2.49			Graham Dairy		4.82			
WNW	C C Mann	2.59								
NW	Louise Workman	3.86								
NNW	Frank March	2.86								

(A) Change In Closest Residence
(B) Change In Closest Garden
(C) Change In Closest Beef Cattle
(D) Change In Closest Goat

Table 4 Critical Receptor Evaluation for 2021

NAME	SECTOR	MILES	PATHWAY	X/Q	D/Q	DOSE* mRem/y
P. Oliver	N	3.73	Res	2.18E-07	5.75E-10	8.09E-03
T. Crumblin	NNE	2.96	Res	4.68E-07	1.44E-09	1.75E-02
G. Guinyard, Jr.	NE	1.5	Res	2.66E-06	8.49E-09	9.96E-02
B. Gregg	ENE	1.53	Res	2.09E-06	6.20E-09	7.79E-02
Garden 7	E	1	Res, Gar	3.83E-06	1.23E-08	**3.33E+00**
R. Mcadory	E	1.18	Res	2.57E-06	8.03E-09	9.60E-02
Garden 6	ESE	1	Res, Gar	2.71E-06	8.08E-09	**2.22E+00**
C. L. Martin	ESE	1.04	Res	2.46E-06	7.29E-09	9.18E-02
M. White	SE	1.44	Res	8.03E-07	3.26E-09	3.04E-02
10845 SC-215 Residence (B) (D)	SE	2.4	Res, Gar	2.65E-07	9.48E-10	2.54E-01
R. Mann	SSE	2.39	Res	1.15E-07	8.46E-10	4.55E-03
K. Boulware	S	3.54	Res	6.23E-08	5.65E-10	2.52E-03
H. Carter	SSW	3.02	Res	7.91E-08	9.10E-10	3.29E-03
W. Waldrop	SW	2.84	Res	8.98E-08	1.25E-09	3.85E-03
2307 Broad River Rd (B)	SW	3.31	Res, Gar	6.44E-08	8.78E-10	2.17E-01
243 Peak Rd	WSW	3.25	Res	5.31E-08	5.31E-10	2.17E-03
2068 Peak Rd	WSW	4.82	Res, B	2.317E-08	2.206E-10	2.28E-02
Mayer Windmill Rd	W	2.49	Res	1.15E-07	9.02E-10	4.57E-03
Graham Dairy	W	#	Res, C/M	#	#	1.80E-01
4608 Broad River Rd	W	#	Res, B	#	#	9.85E-02
CC Mann	WNW	2.59	Res	6.88E-08	3.31E-10	2.63E-03
L. Workman	NW	3.86	Res	6.68E-08	2.41E-10	2.51E-03
F. March	NNW	2.86	Res	2.95E-07	8.22E-10	1.10E-02
ODCM Organ Dose	E	1.1	Res, Gar	3.04E-06	9.60E-09	**2.61E+00**

Pathway

Res = Residence B = Beef G = Goat

Gar = Garden C/M = Cow/Milk(Infant) G/M = Goat/Milk(Infant)

Footnotes:

[1] Maximum exposed individual.

* Hypothetical dose based on Operating License Environmental Report Source Term.

** ODCM required environmental gardens.

Multiple receptor distances/pathways used for total dose to receptor

Table 5 – 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	A) 3 Indicator samples from locations close to the site boundary, in different sectors, of the highest calculated annual average ground level D/Q or dose.[2]	Continuous sampler operation with weekly collection.	2 7 30	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	B) 1 Indicator sample to be taken close to the site boundary in the sector corresponding to the residence having the highest anticipated offsite ground level concentration or dose.[2]	Continuous sampler operation with weekly collection.	6	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	C) 1 Indicator sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A).[2,4]	Continuous sampler operation with weekly collection.	N/A	Gross beta following filter change; Quarterly 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.[2]	Continuous sampler operation with weekly collection.	17	Gross beta following filter change; Quarterly 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 7 30	Gamma Isotopic for Iodine 131 weekly.
	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 weekly.
	C) 1 Indicator sample to be taken at the location as given in I(C) above.	Continuous sampler operation with weekly canister collection.	N/A	Gamma Isotopic for Iodine 131 weekly.
	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 weekly.

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[5,7] 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 outer ring of stations in the 16 accessible sectors within 3 to 5 miles of the plant.	Monthly or quarterly exchange[5,7] two or more dosimeters at each location.	12,13,32,33, 34,35,36,37, 41,42,43,44, 46,53,55,60	Gamma dose monthly or quarterly.
	C) 11 Stations to be placed in special interest areas such as population centers, nearby residences, schools and in 4 or 5 areas to serve as controls.	Quarterly exchange[7]; two or more dosimeters at each location.	16,17,18,19, 20,31,45,52, 54,56,58	Gamma dose quarterly.
	D) 6 Stations to be placed around the ISFSI boundary.	Quarterly exchange[7]; two or more dosimeters at each location.	78,79,80,81, 82,83	Gamma & neutron dose quarterly.
WATERBORNE IV. Surface Water	A) 1 Indicator sample downstream to be taken at a location which allows for mixing a dilution in the ultimate receiving river.	Time composite samples[6] with collection every month.[5]	21[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium.[7]
	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[6] with collection every month.[5]	22[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium.[7]
	C) 1 Indicator sample to be taken in the upper reservoir of the pumped storage facility at the plant discharge canal.	Time composite samples[6] with collection every month.[5]	23[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium.[7]
V. Ground Water	A) 12 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly grab sampling.[7]	6, 26, 27, 101-103, 106, 108,110, 112-114	Gamma isotopic and tritium analyses quarterly.[7]
	B) 1 Control sample from unaffected location.	Quarterly grab sampling.[7]	59	Gamma isotopic and tritium analyses quarterly.[7]

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.[5]	28	Monthly[5] gamma isotopic and gross beta analyses and quarterly[7] composite for tritium analyses.
	B) 1 Indicator (finished water) sample from the nearest downstream water supply.	Monthly composite sampling.	17	Monthly[5] gamma isotopic and gross beta analyses and quarterly[7] composite for tritium analyses.
	C) 1 Control (finished water) sample from an unaffected water supply.	Monthly composite sampling.	39	Monthly[5] gamma isotopic and gross beta analyses and quarterly[7] composite for tritium analyses.
INGESTION: VII. Milk[4]	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.[10]	Semimonthly when animals are on pasture[8], monthly other times.[5]	To be supplied when milk animals are found in accordance with criteria VII.A.	Gamma isotopic and I-131 analysis semimonthly[8] when animals are on pasture, monthly other times.[5]
	B) 1 Control sample to be taken at the location of a dairy > 20 miles distance and not in the most prevalent wind direction.[2]	Semimonthly when animals are on pasture[8], monthly other times.[5,11]	16	Gamma isotopic and I-131 analysis semimonthly[8] when animals are on pasture, monthly other times.[5]
	C) 1 Indicator grass (forage) sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A), above, when animals are on pasture.	Monthly when available.[5]	To be supplied when milk animals are found in accordance with criteria VII.A.	Gamma isotopic.
	D) 1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly when available.[5,11]	16	Gamma isotopic.

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) 2 samples of broadleaf vegetation grown in the 2 nearest offsite locations 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 to 8 km where the doses are calculated to be greater than 1 mrem/yr.[10]	Monthly when available.[5]	6 7	Gamma isotopic on edible portion.
	B) 1 Control sample for the same foods taken at least 10 miles distance and not in the most prevalent wind direction if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5 to 8 km where the doses are calculated to be greater than 1 mrem/yr.[10]	Monthly when available.[5]	40	Gamma isotopic on edible portion.
IX. Fish	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual[9] collection.[1]	23[3]	Gamma isotopic on edible portions semiannually.[9]
	B) 1 Indicator sample to be taken at a location in the lower reservoir.	Semiannual[9] collection.[1]	21[3]	Gamma isotopic on edible portions semiannually.[9]
	C) 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[9] collection.[1]	22[3]	Gamma isotopic on edible portions semiannually.[9]
AQUATIC: X. Sediment	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual grab sample.[9]	23[3]	Gamma isotopic.
	B) 1 Indicator sample to be taken on or near the shoreline of the lower reservoir.	Semiannual grab sample.[9]	21[3]	Gamma isotopic.
	C) 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.[9]	22[3]	Gamma isotopic.

Table 5 (cont) - Radiological Environmental Monitoring Program Specifications

FOOTNOTES

1. Fish include 3 groups (Bass, Bream/Crappie, Catfish/Carp.)

2. Sample site locations are based on 5-year average meteorological analysis.

3. Though generalized areas are noted for simplicity of sample site enumeration, airborne, water and sediment sampling is done at the same location, whereas biological sampling sites are generalized areas in order to reasonably assure availability of samples.

4. Milking animal and garden survey results will be analyzed annually. If the survey should indicate new activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, site(s) will be added for additional milk sampling up to a total of three Indicator locations.

5. Not to exceed 35 days.

6. Time composite samples are samples which are collected with equipment capable of collecting an aliquot at time intervals which are short relative to the compositing period.

7. At least once per 100 days.

8. At least once per 18 days.

9. At least once per 200 days.

10. The dose shall be calculated for the maximum organ and age group, using the guidance/methodology contained in Regulatory Guide 1.109, Rev. 1 and the parameters particular to the site.

11. Milk and forage sampling at the control location is only required when locations meeting the criteria of VII(A) are being sampled.

Table 6 – Supplemental Radiological Environmental Monitoring

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
AIRBORNE: S-I. Particulate	A) 1 Indicator sample monitoring the nearest community with the highest anticipated dose or ground level concentration.	Continuous sampler operation with weekly collection.	8	Gross beta following filter change; Monthly Composite (by location) for gamma isotopic.
S-II. Radioiodine	A) 1 Indicator sample to be taken from the location of S-1(A) above.	Continuous sampler operation with weekly collection.	8	Gamma isotopic for I-131 weekly.
S-III. Direct	A) 5 stations to be placed within the exclusion boundary.	Quarterly exchange[7]; two or more dosimeters at each location.	61,62,63, 68 & 99	Gamma dose quarterly.
	B) 2 stations to be placed around VCSNS sludge lagoons.	Quarterly exchange[7]; two or more dosimeters at each location.	94,97	Gamma dose quarterly.
WATERBORNE: S-IV. Surface Water	A) 1 indicator sample to be taken of the combined wastewater discharge.	Composite samples with monthly collection.[13,5]	77	Gamma isotopic and tritium.
	B) 1 Indicator sample taken at each storm drain outfall.	Daily sample with monthly composite.	72,73	Gamma isotopic and tritium.
S-VI. Drinking Water	A) 1 Indicator (finished water) sample to be taken on site.	Quarterly.	99	Quarterly gamma isotopic, gross beta and tritium analysis.
	B) 1 Indicator (finished water) sample of public system.	Quarterly.	31	Quarterly gamma isotopic, gross beta and tritium analysis.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
INGESTION: S-VII. Milk[4]	A) 1 Sample from one of the nearest affected dairies at or beyond 5 miles.	Biweekly grab sample.[8,14,+]	14	Gamma isotopic and I-131 analysis biweekly.
	B) 1 Control sample to be taken at the location of a dairy greater than 20 miles distance and not in the most prevalent wind direction.	Biweekly grab sample.[8,14,+]	16	Gamma isotopic and I-131 analysis biweekly.
	C) 1 Indicator grass (forage) sample to be taken at the location of S-VII(A) above.	Monthly when available.[14]	14	Gamma isotopic.
S-VII. Milk[4]	D) 1 Control grass (forage) sample to be taken at the location of S-VII(B) above.	Monthly when available.[14]	16	Gamma isotopic.
	E) 2 Indicator grass (forage) samples to be taken at 2 of the locations beyond but as close to the exclusion boundary as practical where the highest offsite sectorial ground level concentrations are anticipated.	Monthly when available.	2,7	Gamma isotopic.
	F) 1 Control grass (forage) sample to be used for routine monitoring along with S-VII(E) above.	Monthly when available.	40	Gamma isotopic.
	G) 1 Indicator grass (forage) sample to be taken at location of penstock leak.	Quarterly when available.	25	Gamma isotopic.
S-VIII. Food Products	A) 1 Indicator sample of various types of foods grown in the area surrounding the plant (root, fruit, grain).	Annually during growing season.[11]	6,7	Gamma isotopic on edible portion.
	B) 1 Control sample of various types of foods grown. (root, fruit, grain).	Annually during growing season.[11]	40	Gamma isotopic on edible portion.
Corbicula	C) 1 Indicator sample of edible portions.	Semiannual.	23	Gamma isotopic.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
S-IX. Sediment/ Sludge	A) 1 Indicator sample from each storm drain outfall.	Semiannually.	72,73	Gamma isotopic.
	B) 3 Indicator sludge samples taken at sludge lagoons 006A, 006B & 008.	Semiannually.	On site	Gamma isotopic.
	C) 1 Indicator sample of topsoil from penstock spill area.	Annually	25	Gamma isotopic.
S-X. Ground Water	A) 11 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly grab sampling.[7]	107,111, 115 -123	Gamma isotopic and tritium analyses quarterly.[7]

Table 6 (cont) – Supplemental Radiological Environmental Monitoring

FOOTNOTES

1. Reserved for future use.

2. Reserved for future use.

3. Reserved for future use.

4. Milking animal and garden survey results will be analyzed annually. If the survey should indicate new activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, site(s) will be added for additional milk sampling up to a total of 3 Indicator locations.

5. Not to exceed 35 days.

6. Reserved for future use.

7. At least once per 100 days.

8. At least once per 18 days.

9. At least once per 200 days.

10. Reserved for future use.

11. At least once per 400 days.

12. Reserved for future use.

13. Weekly, when circulating water is not operational.

14. Milk and grass (forage) sampling is not required unless VCSNS gaseous releases exceed 5% of quarterly organ dose limits or radionuclides (attributed to VCSNS operation) are detected in broadleaf vegetation, grass or air samples at concentrations greater than required LLD. Sampling should continue for two months after plant releases are reduced to less than trigger levels and milk contamination levels have returned to background levels.

+ The ODCM requires semimonthly sampling when animals are on pasture, monthly at other times.

Table 7 – Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Air Particulate (pCi/m^3)	Gross Beta (309)	4.60E-3 (1.0E-2)	2.31E-2 (257/257) (8.90E-3 to 5.01E-2)	Site 30, Construction Site Gate, (0.5 miles SSW)	2.36E-2 (52/52) (1.13E-2 to 4.63E-2)	2.33E-2 (52/52) (1.11E-2 to 5.05E-2)	0
	Gamma Spec (72)						
	^{134}Cs	2.29E-3 (5.0E-2)	All < LLD			All < LLD	0
	^{137}Cs	2.57E-3 (6.0E-2)	All < LLD			All < LLD	0
Air Radioiodine (pCi/m^3)	^{131}I (309)	1.67E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] ($\mu R/hr$)	Gamma(135) Quarterly	N/A	8.22E+0 (116/116) (4.84E+0 to 1.14E+1)	Site 55, St. Barnabas, (2.8 miles E)	1.10E+1 (4/4) (1.01E+1 to 1.14E+1)	8.36E+0 (19/19) (4.54+0 to 1.19E+1)	0
	Gamma(24) Special Interest	N/A	8.75E+0 (24/24) (4.53E+0 to 1.21E+1)	Site 31, McCrory Liston, (6.6 miles NNE)	1.14E+1 (4/4) (1.08E+1 to 1.21E+1)	N/A	0
Surface Water (pCi/l)	^{3}H (36)	4.39+2 (2.0E+3)	All < LLD		All < LLD	All < LLD	0
	Gamma Spec(36)						
	^{54}Mn	1.54E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	2.08E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	3.98E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	1.66E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	3.25E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	2.84E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	1.99E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	1.50E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 7 (cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Surface Water (Continued)	^{137}Cs	1.75E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	1.54E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	3.57E+0 (1.5E+1)	All < LLD			All < LLD	0
Ground Water (pCi/l)	^{3}H (52)	4.55E+2 2.00E+3	All < LLD			All < LLD	0
	Gamma Spec (52)						
	^{54}Mn	4.51E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	3.48E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	6.06E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	5.47E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	7.52E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	6.51E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	2.76E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.92E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	4.37E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	2.10E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	4.22E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 7 (Cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Drinking Water[6] (pCi/l)	Gross Beta (36)	3.10E+0 (4.00E+0)	3.44E+0 (11/24) (2.60E+0 to 4.07+0)	Site 28, Jenkinsville Post Office, (2.8 miles, SE)	3.44E+0 (5/12) (2.60E+0 to 3.94+0)	2.31E+0 (3/12) (2.26E+0 to 2.37E+0)	0
	^{3}H (36)	4.33E+2 (2.0E+3)	All < LLD			All < LLD	0
	Gamma Spec (72)[9]						
	^{54}Mn	2.57E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	1.94E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	4.72E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.71E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	4.26E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	4.14E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	2.25E+0 (1.5E +1)	All < LLD			All < LLD	0
	^{131}I	4.85E-1 (1.0E+0)	All < LLD			All < LLD	0
	^{134}Cs	2.49E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	2.61E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	1.31E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	4.04E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 7 (Cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Broadleaf Vegetation (pCi/kg wet)	Gamma Spec (36)						
	^{131}I	1.51E+1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{134}Cs	1.42E+1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{137}Cs	1.68E+1 (8.0E+1)	All < LLD			All < LLD	0
Fish[7] (pCi/kg wet)	Gamma Spec (18)						
	^{54}Mn	1.59E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{58}Co	2.06E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{59}Fe	3.19E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{60}Co	2.27E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{65}Zn	4.11E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{134}Cs	1.79E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{137}Cs	2.01E+1 (1.5E+2)	All < LLD			All < LLD	0

Table 7 (Cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Sediment (pCi/kg)[8]	Gamma Spec (6)						
	^{54}Mn	1.31E+1 N/A	All < LLD			All < LLD	0
	^{58}Co	1.16E+1 N/A	All < LLD			All < LLD	0
	^{60}Co	1.10E+1 N/A	All < LLD			All < LLD	0
	^{134}Cs	7.38E+0 (1.5E+2)	All < LLD			All < LLD	0
	^{137}Cs	1.40E+1 (1.8E+2)	All < LLD			4.16E+1 (1/2) (4.16E+1 to 4.16E+1)	0

Table 7 (cont) - Radiological Environmental Monitoring Program Summary for 2021

Footnotes

1. Includes indicator and control analyses. Site 8, Air Particulates and Air Radioiodines are included as indicators. Does not include other supplemental samples.

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

3. Mean and range are based on detectable measurements only. The fractions of detectable measurements (i.e., number of positive results/total number of 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 ODCM, Section 1.4.1.2.

5. Detection sensitivity is approximately 10 mrem/yr (1.0 μR/hr).

6. Elevated levels of ^{214}Pb and ^{214}Bi were observed in 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. Fish include 3 groups (Bass, Bream/Crappie, Catfish/Carp.)

8. Elevated levels of ^{214}Pb and ^{214}Bi plus other ^{226}Ra daughter products and ^{228}Ac plus other ^{232}Th 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.

9. Drinking water resin prepared and counted for ^{131}I as separate sample.

Table 8– Radiological Environmental Monitoring Program 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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (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)	Site 13, North Dam, (2.9 miles, NNW)	1.3E-1 (52/52) (2.1E-2 to 5.5E-1)	1.2E-1 (153/155) (7.9E-3 to 6.1E-1)	0
			2.7E-2 (456/462)[4] (9.3E-3 to 6.6E-2)	Site 8, Mon. Res. S of Rd 224, (1.5 ENE)	3.0E-2 (42/42) (1.2E-2 to 6.0E-2)	2.8E-2 (125/126) (1.2E-2 to 5.8E-2)	
	Gamma Spec (307)						
	^{134}Cs	3.0E-3 (1.0E-2)	All < LLD			All < LLD	0
	^{137}Cs	3.1E-3 (1.0E-2)	3.2E-3 (22/241) (1.5E-3 to 5.2E-3)	Site 10, Met Tower, (2.4 miles, 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)	^{131}I (290)	3.6E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] (μR/hr) (1978-1982)	Gamma (1220) Monthly	0.5 N/A	9.9 (915/915) (6.7 to 14.7)	Site 13, North Dam, (2.9 miles, 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 N/A	10.2 (154/154) (6.8 to 14.7)	Site 55, St. Barnabas Church, (2.8 miles, E)	14.0(7/7) (13.1 to 14.7)		0
Surface Water (pCi/l) (1981-1982)	^{3}H (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 mile SE)	1.6E+3 (2/7) (1.4E+3 to1.8E+3)	1.2E+3 (6/14) (6.7E+2 to 1.6E+3)	0
	Gamma Spec (140)						
	^{54}Mn	2.7E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	2.9E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	6.0E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.4E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	7.9E-1 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	5.2E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{95}Nb	3.3E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.0E-1 (1.5E+1)	All < LLD			All < LLD	0

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
	^{137}Cs	2.2E-1 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	2.2E+0 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La (1982 only)	5.5E-1 (1.5E+1)	All < LLD			All < LLD	0
Ground Water (pCi/l) (1981-1982)	^{3}H (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)						
	^{54}Mn	3.7E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	3.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	7.8E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	3.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65Zn}	8.1E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	6.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{95}Nb	4.6E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.7E+0 (1.5E + 1)	All < LLD			All < LLD	0
	^{137}Cs	3.8E+0 (1.8E + 1)	All < LLD			All < LLD	0
	^{140}Ba	1.9E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La (1982 only)	5.0E0 (1.5E+1)	All < LLD			All < LLD	0
Drinking Water[6] (pCi/l) (1981-1982)	Gross Beta[7]	(2.0E+0)					
	^{3}H (14)	6.3E+2 (1.0E+3)	7.8E+2 (6/14) (6.8E+2 to 9.8E+2)	Site 28, Jenkinsville, (2.0 miles, SE)[7]	8.4E+2 (3/7) (7.0E+2 to 9.8E+2)		0
	Gamma Spec (44)						
	^{54}Mn	3.0E-1 (1.5E+1)	All < LLD				0
	^{58}Co	2.7E-1 (1.5E+1)	All < LLD				0

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
	^{59}Fe	9.6E0 (3.0E+1)	All < LLD				0
	^{60}Co	2.6E-1 (1.5E+1)	All < LLD				0
	^{65}Zn	3.4E-1 (3.0E+1)	All < LLD				0
	^{95}Zr	4.8E-1 (1.5E+1)	All < LLD				0
	^{131}I	3.4E-1 (1.5E+1)	All < LLD				0
	^{95}Nb	7.4E-1 (1.0E+0)	All < LLD				0
	^{134}Cs	2.2E-1 (1.0E+1)	All < LLD				0
	^{137}Cs	2.4E-1 (1.8E+1)	All < LLD				0
	^{140}Ba	2.5E0 (6.0E+1)	All < LLD				0
	^{140}La (1982 only)	4.4E-1 (1.5E+1)	All < LLD				0
Milk (pCi/l) (1981-1982)	Gamma Spec (94)						
	^{131}I	6.3E-1 (1.0E+0)	All < LLD			All < LLD	0
	^{134}Cs	3.3E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	4.6E0 (1.5E+1)	4.1E+0 (8/47) (2.8E+0 to 6.1E+0)	Site 14, Dairy, (5.1 miles, W)	4.1E+0 (8/47) (2.8E+0 to 6.1E+0)	5.7E+0 (37/47) (3.7E+0 to 9.2E+0)	0
	^{140}Ba	1.1E+1 (1.5E + 1)	All < LLD			All < LLD	0
	^{140}La	4.4E+0 (1.5E+1)	All < LLD			All < LLD	0
Grass (pCi/kg wet) (1981-1982)	Gamma Spec (82)						
	^{131}I	6.7E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{134}Cs	2.7E+1 (8.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	3.3E+1 (8.0E+1)	5.0E+1 (13/51) (1.6E+1 to 1.6E+2)	Site 14, Dairy, (5.1 miles, 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

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
Broadleaf Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (10)						
	^{131}I	3.7E+1 (6.0E+1)	All < LLD				0
	^{134}Cs	1.9E+1 (8.0E+1)	All < LLD				0
	^{137}Cs	2.1E+1 (8.0E+1)	3.1E+1 (2/7) (1.8E+1 to 3.6E+1)	Site 2, Trans. Line, (1.2 miles, SW)	3.6E+1 (1/1) (Single Value)	All < LLD	0
Other Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (32)						
	^{134}Cs	8.4E+0 (8.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	1.0E+1 (8.0E+1)	All < LLD			All < LLD	0
Fish (pCi/kg wet) (1980 - 1982)	Gamma Spec (92)						
	^{134}Cs	1.4E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{137}Cs	1.8E+1 (1.3E+2)	2.8E+1 (50/71) (1.1E+1 to 1.0E+2)	Site 24, Recreation Lake, (5.5 miles, 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
	^{58}Co	2.6E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{54}Mn	1.8E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{59}Fe	9.0E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{65}Zn	4.1E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{60}Co	1.8E+1 (1.3E+2)	All < LLD			All < LLD	0
Sediment (pCi/kg) (1980-1982)	Gamma Spec (24)						
	^{134}Cs	2.3E+1 (1.5E+2)	All < LLD			All < LLD	0
	^{137}Cs	2.4E+1 (1.5E+2)	1.7E+2 (12/18) (2.6E+1 to 4.5E+2)	Site 21, Parr Reservoir, (2.7 miles, 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

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April 27, 2022

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-001

Serial No. 22-135
LIC/TS/R0
Docket No. 50-395
License No. NPF-12

DOMINION ENERGY SOUTH CAROLINA, INC. (DESC)
VIRGIL C. SUMMER NUCLEAR STATION UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Enclosed is the DESC Annual Radiological Environmental Operating Report as required by Section 6.9.1.6 of the Virgil C. Summer Nuclear Station Technical Specifications.

If there are any questions, please call Ms. Tracey Stewart at (803) 931-5663.

Sincerely,

Michael S. Moore for

Robin R. Haselden
Director, Nuclear Station Safety and Licensing
V. C. Summer Nuclear Station

Commitments contained in this letter: None

Enclosure

cc: w/o Enclosure unless noted
G. J. Lindamood – Santee Cooper
L. Dudes – NRC Region II (w/Enclosure)
G. Miller – NRC Project Manager
NRC Resident Inspector (w/Enclosure)
ANI (w/Enclosure)
Anu Nair – SCDHEC- Bureau of Environmental Health Services (w/Enclosure)

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J. H. Hamilton – VCS
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C. D. Sly – IN2NW
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D. E. Rowe – MPS
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Kathryn Barrett – IN2NW
W. S. Blair – RS
RTS: RR 8300
File: 818.02-2
PRSF: SN-22-135 (w/Enclosure)

Concurrences:

See Correspondence Review and Approval Form

Action Plan: None

Changes to the UFSAR, USAR, QA Topical Report, or ISFSI FSAR: None

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
VIRGIL C. SUMMER NUCLEAR STATION

FOR THE OPERATING PERIOD
JANUARY 1, 2021 - DECEMBER 31, 2021

Prepared by:

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Health Physics

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Radiological Protection and Chemistry

EXECUTIVE SUMMARY

This Annual Radiological Environmental Operating Report describes the V.C. Summer Environmental Monitoring Program and the program results for the calendar year 2021.

Included are the identification of sample locations, descriptions of environmental sampling and type of analysis. Comparisons of present environmental radioactivity levels and preoperational environmental data, land use census evaluation, doses calculated from environmental measurements, and a summary of environmental radiological sampling results are presented. Quality assurance practices, sampling deviations and unavailable samples are also discussed.

Sampling activities were conducted as prescribed by the Offsite Dose Calculation Manual (ODCM) for V.C. Summer Nuclear Station (VCSNS) and applicable Health Physics Procedures. Required analyses were performed and detection limits met for required samples with deviations noted. Samples were collected comprising one thousand two hundred sixty five analyses (1,265) performed to compile the data for the 2021 Environmental Report. Supplemental samples comprising two hundred ninety-eight (298) analyses were performed on some media for additional information. Based on the results from the annual land use census, the current number of sampling sites for V.C. Summer Nuclear Station is sufficient.

Radionuclides observed in the environment in 2021 from V.C. Summer effluent releases were within the range of concentrations observed in the past. Radiation dose calculated from sample results is less than observed with normal fluctuation in natural background. It is therefore concluded that VCSNS operations have no significant radiological impact on the health and safety of the public or the environment.

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Virgil C. Summer Nuclear Station (VCSNS) utilizes a pressurized water reactor rated at 2900 MWt (990 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 feed water modifications. Steam generators were replaced in the fall of 1994. During the ninth refuel the plant was uprated to 2900 MWt (990 MWe gross). VCSNS is currently operating in the 27th fuel cycle.

VCSNS is operating in conjunction with the adjacent Fairfield Pump 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 principal 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 the 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. Non-nuclear drains are released to the CWDC. Effluent from the liquid waste processing system and processed steam generator blow down are released through the penstocks. Radioactive gaseous effluents from VCSNS are released from two points: the Main Plant Vent and the Reactor Building Purge Exhaust, all considered ground level releases.

In 2012 construction began on the Independent Spent Fuel Storage Installation (ISFSI), and concluded in January 2016. The first dry cask storage campaign began March 26, 2016 and finished in the first week of May 2016. Four casks were loaded during this evolution. Additional campaigns in the second quarter of 2019 and first quarter of 2022 have added eight casks for a total of twelve.

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 2021. Data trends, control/indicator and preoperational/operational data, inter-comparisons, 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 Dominion Energy South Carolina. 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 inter-comparisons in order to evaluate the adequacy of radioactivity source control and to realistically verify the assessment of environmental radioactivity levels and subsequent radiation dose to man.

Sample media and analysis sensitivity requirements have been established to ensure that the maximum dose pathways are monitored and sensitivities represent a small fraction of annual release limits. These required Lower Limits of Detection (LLD's) are verified to have been met by calculating Minimum Detectable Activity (MDA) for each sample based on actual counting parameters relevant to each sample. In all cases the achieved MDA was lower than the LLD. Effluent dispersion characteristics, demography, hydrology and land use have been considered in selection of environmental sampling locations. These criteria were used to establish both the preoperational and operational phases of the Radiological Environmental Monitoring Program. Elements of the program monitor the impact of both 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 below in Table 1. Requirements of the Radiological Environmental Monitoring Program are specified in the VCSNS Offsite Dose Calculation Manual (ODCM).

Table 1 - Monitoring Methods for Critical Radiation Exposure Pathways

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,
	Milk (Ingestion)	Milk Sampling, Grass (Forage) Sampling
Liquid	Fish (Ingestion)	Fish Sampling,
	Water & Shoreline Exposure (Ingestion and Immersion)	Surface Water Sampling, Ground Water Sampling, Shoreline and Bottom Sediment Sampling,
	Drinking Water (Ingestion)	Drinking Water Sampling

Monitoring sites indicative of plant operating conditions are generally located within a 5 mile radius of the plant. Table 5 provides a list of ODCM required sampling locations. Table 6 provides a list of supplemental sampling locations. Maps showing radiological environmental sampling locations within a radius of approximately 5 miles from VCSNS are presented as Figures 1-2 through 1-5. Figure 1-1 shows monitoring sites at distances greater than 10 miles from the plant. Background radiation levels vary across the monitored area of interest.

In addition to pre-operational/operational data inter-comparisons, control/indicator data inter-comparisons are utilized. This is done 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.

Environmental data is gathered through multiple types of sampling and measurements at specific locations. Several multiple sampling combinations are in use around the VCSNS. For example, all air sampling locations serve as environmental dosimetry monitoring locations. At these locations, airborne plant effluents are monitored for gamma immersion dose (noble gases), in addition to air contaminants. Monitoring locations Site 6 (1.0 mile ESE) and Site 7 (1.0 mile E) have broadleaf vegetation gardens for monitoring gaseous effluent deposition (ingestion pathway) in the two sectors having the highest deposition coefficients (D/Q) with real potential for exposure. Monitoring location Site 18 (16.5 miles S) serves as a control location for direct radiation and Site 40 (11.9 miles SSE) serves as a control location for garden monitoring.

Liquid effluents are monitored using three different monitoring media (fish, bottom sediment, and surface water) at the two most probable affected bodies of water around the plant: Site 21, Parr Reservoir (2.7 miles SSW) and Site 23, Monticello Reservoir (0.5 miles ESE). The control location for liquid effluent comparisons is at Site 22, Neal Shoals (26.0 miles NNW) on the Broad River.

Quality of analytical measurements is demonstrated by participation in a laboratory inter-comparison program. Results of the inter-comparison program with an outside vendor and VCSNS Count Room were satisfactory in 2021 with the exception of an Alpha/Beta in Liquid analysis. Results are summarized in Table 9. The results of each of these quality control checks of the Radiological Environmental Monitoring Program verify the technical credibility of analytical data generated and reported by the program.

LAND USE CENSUS

Annually a land use census is performed within a 5 mile radius of VCSNS to verify the appropriate siting of sample locations. In addition, the location of the maximum exposed individual (MEI) is identified to ensure the appropriate location is used for calculation of offsite dose impact from Summer Station gaseous effluents. The results of the land use census performed in 2021 are included in Table 3. A verification of the maximum exposed individual location is presented in Table 4. Identification of the highest offsite dose locations was performed by calculating a hypothetical dose based on source term from the Operating License Environmental Report and 2021 meteorological data. Exposure pathways modeled in the analysis were those identified during the land use census.

The location and pathway presently used in the ODCM for offsite organ dose calculations (E 1.1 miles - residence/garden) was found to have the highest calculated dose. In addition, the ODCM required environmental gardens (ESE 1.0 and E 1.0 miles) were found to have calculated doses higher than any real receptor. There were no milking animals or dairy activity found within 5 kilometers of VCSNS. Therefore, changes to the ODCM gaseous effluent calculations or garden sample locations are not indicated.

MONITORING RESULTS AND DISCUSSION

The results of the Radiological Environmental Monitoring Program for 2021 are summarized in Table 7. For comparison, preoperational data are summarized in Table 8. The Radiological Environmental Program attained a program compliance rate of approximately 99.4%. A listing of program deviations and their respective causes are included in Table 10. Analysis of the impact of these omissions verified that program quality has not been affected.

Corbicula harvest for possible human consumption was observed in Lake Monticello in 2005. Since that time Corbicula analysis has been incorporated in the Supplemental Sampling Program. Samples were collected and analyzed for gamma emitting isotopes. No gamma emitting nuclides were detected.

Gross beta activities measured in air particulate samples collected at indicator locations around VCSNS were consistent with preoperational levels and not statistically significant from control locations. The highest site-specific mean activity (2.36E-2 pCi/m^3) was measured at indicator location Site 30 (Construction Site Gate 0.5 miles SSW). The results indicate that the operation of VCSNS has not contributed to detectable increases of airborne gross beta activity in the environment.

Gamma spectroscopy measurements of composited air particulate samples and activated charcoal cartridges support the gross beta activity trend. Only natural background

activities were detected. The highest MDA values at indicator locations for ^{134}Cs, ^{137}Cs and ^{131}I were 2.29E-3, 2.57E-3 and 1.67E-2 pCi/m^3, respectively and all met program analytical requirements for detection capability. Air sample collection rate for indicator/control air samples was 99%.

Environmental dosimetry measurements did not indicate any significant increase from preoperational measurements or previous historic average. Monitoring location Site 55 (St. Barnabas Church 2.8 miles E) was the indicator location showing the highest mean exposure rate of 1.10E+1 μR/hr. This value is consistent with the highest mean exposure rate of 1.40E+1 μR/hr measured during the preoperational period.

The impact of Independent Spent Fuel Storage Installation (ISFSI) operation, located within the VCSNS Protected Area, which began cask storage on March 26, 2016, was assessed using six TLD locations monitoring the perimeter of the ISFSI site. The TLD locations were monitored for three quarters prior to fuel storage and continued to be monitored through 2021 during which fuel storage casks were stored. Analysis of monitoring results show a statistically significant increase in ISFSI perimeter dose as a result of fuel storage. The highest location shows an increase of 7.3 mrem/calendar quarter compared to pre-operation. Although the applicable limit for a member of the public applies to a real individual, a conservative analysis was used to demonstrate compliance with 40CFR190 and 10CFR72.104 by assuming an individual is located at the perimeter of the ISFSI Protected Area for 2000 hours per year. In this case, the hypothetical individual would have received 6.6 mrem. This level of exposure would be well under the 40CFR190 limit of 25 mrem.

TLD sample collection rate for all indicator/control locations was 99.4%.

Gamma spectroscopy measurements of surface water samples did not indicate the presence of activated corrosion or fission products above the respective MDA for indicator sites. Tritium analysis did not indicate the presence of tritium above the respective MDA for indicator sites. Sample collection rate for all indicator/control surface water samples was 100%.

Gamma spectroscopy measurements of the ODCM required ground water samples did not indicate the presence of activated corrosion or fission products above the respective MDAs. Tritium was detected within the site boundary at Site 123 (NPDES Well GW-16 0.34 miles SSE), in four quarterly samples at concentrations of 2.25E+3 pCi/L, 2.63E+3 pCi/L, 2.02E+3 pCi/L, and 1.99E+3 pCi/L. GW-16 is a shallow supplemental monitoring site used to monitor for chemical contaminants around the Industrial and Sanitary Waste Treatment System. If this ground water represented a credible exposure pathway, maximum dose projection assuming consumption of 730 liters per year would result in a dose that does not exceed 0.25 mrem. These levels are substantially less than the 2.00E+4 pCi/L drinking water standard. Sample collection rate for indicator/control ground water samples was 100%.

Gamma spectroscopy measurements of drinking water samples collected from Site 28 (Jenkinsville water supply) and Site 17 (Columbia Water Works 25.0 miles SE) did not indicate the presence of activated corrosion or fission product activity above the respective MDAs. Tritium analysis did not indicate the presence of tritium above the respective MDA

for indicator sites. Sample collection rate for all indicator/control surface water samples was 100%.

There were no milk samples collected in 2021. Milk sampling is required to be performed at the three highest dose locations within 5 kilometers of the plant or at 5 to 8 kilometers of the plant if doses are calculated to be greater than 1 mrem/year. Presently there are no locations meeting these criteria for indicator dairies. The closest dairy is approximately 7 kilometers from the plant (see Table 3). Milk samples will be obtained from this dairy if gaseous releases from the plant exceed 5% of quarterly organ dose limits or radionuclides (attributed to the operation of VCSNS) are detected in broadleaf vegetation, grass or air samples at concentrations greater than required LLDs.

Gamma spectroscopy measurement of supplemental grass samples collected indicated ^{137}Cs in 6 of 12 samples at Site 2 (transmission line 1.2 miles SW) at concentrations ranging from 1.31E+1 pCi/kg to 1.04E+2 pCi/kg. The maximum preoperational control activity was 3.40E+2 pCi/kg. Sample collection rate for indicator/control supplemental grass was 100%.

Gamma spectroscopy measurements were performed on supplemental grass and soil samples collected in response to a liquid effluent spill in 2011 at Site 25 (Fairfield Pump Storage Remediation Area 0.9 miles WNW). None of the grass samples collected indicated the presence of activated corrosion or fission products above the respective MDAs. A soil sample did indicate ^{137}Cs at a concentration of 3.06E+1 pCi/kg.

Gamma spectroscopy measurements of the broadleaf samples collected did not indicate the presence of activated corrosion or fission products above the respective MDAs. All required indicator/control broadleaf samples were collected.

Gamma spectroscopy measurements of all non-leafy (other vegetation) supplemental samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA.

Gamma spectroscopy measurements of fish samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA. All required indicator/control fish samples were collected.

Gamma spectroscopy measurements of sediment samples collected did not indicate the presence of activated corrosion or fission products above the respective MDA for indicator sites. ^{137} Cs was detected in 1 of 2 control samples taken at Site 22 (Neal Shoals 26 miles NNW) at a concentration of 4.16E+1 pCi/kg. Two samples from Supplemental Site 72 (Yard Drain Outfall 0.4 miles SE) also indicated ^{137} Cs at concentrations of 1.51E+1 pCi/kg and 1.7E+1 pCi/kg. Historically ^{137}Cs levels at the control site have ranged from 1.8E+1 pCi/kg to 1.0E+3 pCi/kg. All required indicator/control sediment samples were collected.

CONCLUSION

As in previous years of VCSNS operation, the presence of fission product activity attributed to residual fallout from atmospheric weapons testing and the Chernobyl accident were detected in environmental media including sediment and grass.

No detectable fission or activation product activity attributed to VCSNS operations was observed in environmental media with the exception of:

- Tritium in supplemental ground water samples taken at Site 123 (NPDES Well GW-16 0.34 miles SSE) within the nuclear station, owner-controlled area.

The average natural background for direct exposure as determined from control locations is 73.2 mrem/year. The hypothetical calculated maximum exposure for drinking water from the NPDES well within the nuclear station owner-controlled area would be within the normal fluctuations of natural terrestrial and cosmic background. Dose at this level would not be expected to result in observable effects on the ecosystem or general public. The results of the Radiological Environmental Monitoring Program, therefore, substantiate the continuing adequacy of source control at VCSNS and conformance of station operation to 10CFR50, Appendix I design objectives.

Table 2 - Required Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
1	Borrow Pit	1.2	179.8 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	144.0 SE	DQ
6	Environmental Lab Garden	1.0	111.0 ESE	AP,RI,GA,DQ,GW
7	Environmental Lab Garden	1.0	97.8 E	AP,RI,DQ, GA
8	Monticello Res. S of Rd 224	1.5	62.0 ENE	DQ
9	Ball Park	2.3	41.6 NE	DQ
10	Meteorological Tower #2	2.5	25.5 NNE	DQ
12	Old Hwy 99	4.2	349.4N	DQ
13	North Dam	2.9	333.0 NNW	DQ
14	Dairy (Shealy)[4]	6.5	277.0 W	MK,GR
16	Dairy (Parr)[4]	20.0	275.5 W	MK,GR
16a	TLD Location	28.0	278.6W	DQ
17	Columbia Water Works	25.0	144.0 SE	AP,RI,DQ,DW
18	Pine Island Club	16.5	165.0 S	DQ
19	Residence/Little Saluda	21.0	224.0 SSW	DQ
20	Residence/Whitmire	22.0	309.5 NW	DQ
21	Parr Reservoir	2.7	199.5 SSW	SW,FH,BS
22	Neal Shoals	26.0	343.1 NNW	SW,FH,BS
23	Discharge Canal (Mont, Res.)	0.5	104.5 ESE	SW,FH,BS
26	On Site Well (P2)	460 Ft	270.0 W	GW
27	On Site Well (P5)	510 Ft	180.0 S	GW
28	Jenkinsville Post Office	2.8	170.2 SE	DW
29	Trans. Line WSW of VCSNS	1.0	260.6 WSW	DQ
30	Oak Tree North of Borrow Pit[5]	1.0 / 0.5	196.2 SSW	DQ, AP, RI
31	McCrorey-Liston School	6.6	11.5 NNE	DQ
32	Clark Bridge Road and Brooks Drive	4.6	24.0 NNE	DQ
33	Rd 48 near Hwy 213	4.2	68.0 ENE	DQ
34	Rd 419 North of Hwy 60	4.9	111.0 ESE	DQ
35	Glenn's Bridge Road	4.6	132.0 SE	DQ
36	Woods at Jenkinsville Post Office	3.1	151.0 SSE	DQ
37	Residence	4.9	304.8 NW	DQ
39	Lake Murray Water Treatment Facility	14.0	168.0 SSE	DW
40	Emergency Operations Facility[6]	11.9	157.0 SSE	GA, GR
41	Below Catwalk at Trestle	3.8	182.0 S	DQ
42	Broad River Rd (Peak Residence)	3.8	198.0 SSW	DQ
43	Hwy 176 and Rd 435	5.2	236.0 SW	DQ
44	Rd 28 at Cannon's Creek	2.8	256.6 WSW	DQ
45	Rd 33 at Pomaria	5.8	253.2 WSW	DQ
46	Rd 28 at Heller's Creek	3.7	291.5 WNW	DQ
47	Fairfield Tailrace	1.0	316.0 NW	DQ

Table 2 (cont) – Required Sampling Site Locations

Site No.	Description	Distance[1] (Miles)	Direction[2]	Sample Type(s)[3]
52	Monticello (Rd 11)	3.8	13.0 NNE	DQ
53	Rd 359	3.0	46.5 NE	DQ
54	Jenkinsville School	1.7	72.5 ENE	DQ
55	St. Barnabas Church	2.8	91.5 E	DQ
56	Old Jenkinsville Dinner	2.0	144.0 SE	DQ
58	Residence	2.5	157.0 SSE	DQ
59	New Nuclear Deployment	2.6	170.2 SSE	DQ, GW
60	Rd 98 near Rd 28	3.5	274.6 W	DQ
78	ISFSI - North	0.14	133 NW	DQ
79	ISFSI – North East	266 Ft	102 WNW	DQ
80	ISFSI – South East	256 Ft	61 WSW	DQ
81	ISFSI - South	0.10	63 WSW	DQ
82	ISFSI –South West	0.15	91 W	DQ
83	ISFSI – North West	0.15	104 WNW	DQ
101	Remediation Well (B-2)	300 Ft	NNW	GW
102	Remediation Well (B-6)	400 Ft	NE	GW
103	Remediation Well (DW-13)	80 Ft	NE	GW
106	Remediation Well (DW-7)	250 Ft	SE	GW
108	Remediation Well (DW-19)	250 Ft	W	GW
110	Remediation Well (B-36)	300 Ft	NW	GW
112	NPDES Well (GW-9)	0.36	331 SSE	GW
113	NPDES Well (GW-12)	0.33	332 SSE	GW
114	NPDES Well (GW-13A)	0.39	317 SE	GW

Table 2 (cont) – Required Sampling Site Locations

Footnotes

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

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

3. Sample Types:

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

4. Sites 14 and 16 are not presently in use. If conditions change, requiring a renewal of dairy sampling these sites will be reactivated.

5. Site 30 consists of two locations in the same sector. The air sampler is located 0.5 miles from the reactor to support construction of a new facility. The TLD is located 1.0 mile from the reactor in the same sector.

6. Site 40 (11.9 miles SSE) serves as a control location for garden monitoring which is the location of the Station's Emergency Operating Facility.

Table 3 - Results of the 2021 Land Use Census Verification

SECTOR	NEAREST RESIDENCE	MILES	NEAREST GARDEN	MILES	NEAREST CATTLE	No. MILKED	MILES	NEAREST GOAT	No. MILKED	MILES
N	P. Oliver	3.73								
NNE	Thomas Crumblin	2.96								
NE	Gregory Guinyard	1.5								
ENE	Bessie Gregg	1.53								
E	Roy Mcadory	1.18								
ESE	Carrie Lee Martin	1.04								
SE	Mary White	1.44	10845 SC-215 (B)	2.4						
SSE	Ronnie Mann	2.39								
S	Kelly Boulw are	3.54								
SSW	Hope Carter	3.02								
SW	William Waldrop	2.84	2307 Broad River Rd (B)	3.31						
WSW	243 Peak Rd	3.25			2068 Peak Rd (C)	0	4.82			
W	4608 Broad River Rd	2.73			4608 Broad River Rd (C)	0	2.43			
W	Meyer Windmill Rd	2.49			Graham Dairy		4.82			
WNW	C C Mann	2.59								
NW	Louise Workman	3.86								
NNW	Frank March	2.86								

(A) Change In Closest Residence
(B) Change In Closest Garden
(C) Change In Closest Beef Cattle
(D) Change In Closest Goat

Table 4 Critical Receptor Evaluation for 2021

NAME	SECTOR	MILES	PATHWAY	X/Q	D/Q	DOSE* mRem/y
P. Oliver	N	3.73	Res	2.18E-07	5.75E-10	8.09E-03
T. Crumblin	NNE	2.96	Res	4.68E-07	1.44E-09	1.75E-02
G. Guinyard, Jr.	NE	1.5	Res	2.66E-06	8.49E-09	9.96E-02
B. Gregg	ENE	1.53	Res	2.09E-06	6.20E-09	7.79E-02
Garden 7	E	1	Res, Gar	3.83E-06	1.23E-08	**3.33E+00**
R. Mcadory	E	1.18	Res	2.57E-06	8.03E-09	9.60E-02
Garden 6	ESE	1	Res, Gar	2.71E-06	8.08E-09	**2.22E+00**
C. L. Martin	ESE	1.04	Res	2.46E-06	7.29E-09	9.18E-02
M. White	SE	1.44	Res	8.03E-07	3.26E-09	3.04E-02
10845 SC-215 Residence (B) (D)	SE	2.4	Res, Gar	2.65E-07	9.48E-10	2.54E-01
R. Mann	SSE	2.39	Res	1.15E-07	8.46E-10	4.55E-03
K. Boulware	S	3.54	Res	6.23E-08	5.65E-10	2.52E-03
H. Carter	SSW	3.02	Res	7.91E-08	9.10E-10	3.29E-03
W. Waldrop	SW	2.84	Res	8.98E-08	1.25E-09	3.85E-03
2307 Broad River Rd (B)	SW	3.31	Res, Gar	6.44E-08	8.78E-10	2.17E-01
243 Peak Rd	WSW	3.25	Res	5.31E-08	5.31E-10	2.17E-03
2068 Peak Rd	WSW	4.82	Res, B	2.317E-08	2.206E-10	2.28E-02
Mayer Windmill Rd	W	2.49	Res	1.15E-07	9.02E-10	4.57E-03
Graham Dairy	W	#	Res, C/M	#	#	1.80E-01
4608 Broad River Rd	W	#	Res, B	#	#	9.85E-02
CC Mann	WNW	2.59	Res	6.88E-08	3.31E-10	2.63E-03
L. Workman	NW	3.86	Res	6.68E-08	2.41E-10	2.51E-03
F. March	NNW	2.86	Res	2.95E-07	8.22E-10	1.10E-02
ODCM Organ Dose	E	1.1	Res, Gar	3.04E-06	9.60E-09	**2.61E+00**

Pathway

Res = Residence B = Beef G = Goat

Gar = Garden C/M = Cow/Milk(Infant) G/M = Goat/Milk(Infant)

Footnotes:

[1] Maximum exposed individual.

* Hypothetical dose based on Operating License Environmental Report Source Term.

** ODCM required environmental gardens.

Multiple receptor distances/pathways used for total dose to receptor

Table 5 – 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	A) 3 Indicator samples from locations close to the site boundary, in different sectors, of the highest calculated annual average ground level D/Q or dose.[2]	Continuous sampler operation with weekly collection.	2 7 30	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	B) 1 Indicator sample to be taken close to the site boundary in the sector corresponding to the residence having the highest anticipated offsite ground level concentration or dose.[2]	Continuous sampler operation with weekly collection.	6	Gross beta following filter change; Quarterly composite (by location) for gamma isotopic.
	C) 1 Indicator sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A).[2,4]	Continuous sampler operation with weekly collection.	N/A	Gross beta following filter change; Quarterly 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.[2]	Continuous sampler operation with weekly collection.	17	Gross beta following filter change; Quarterly 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 7 30	Gamma Isotopic for Iodine 131 weekly.
	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 weekly.
	C) 1 Indicator sample to be taken at the location as given in I(C) above.	Continuous sampler operation with weekly canister collection.	N/A	Gamma Isotopic for Iodine 131 weekly.
	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 weekly.

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[5,7] 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 outer ring of stations in the 16 accessible sectors within 3 to 5 miles of the plant.	Monthly or quarterly exchange[5,7] two or more dosimeters at each location.	12,13,32,33, 34,35,36,37, 41,42,43,44, 46,53,55,60	Gamma dose monthly or quarterly.
	C) 11 Stations to be placed in special interest areas such as population centers, nearby residences, schools and in 4 or 5 areas to serve as controls.	Quarterly exchange[7]; two or more dosimeters at each location.	16,17,18,19, 20,31,45,52, 54,56,58	Gamma dose quarterly.
	D) 6 Stations to be placed around the ISFSI boundary.	Quarterly exchange[7]; two or more dosimeters at each location.	78,79,80,81, 82,83	Gamma & neutron dose quarterly.
WATERBORNE IV. Surface Water	A) 1 Indicator sample downstream to be taken at a location which allows for mixing a dilution in the ultimate receiving river.	Time composite samples[6] with collection every month.[5]	21[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium.[7]
	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[6] with collection every month.[5]	22[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium.[7]
	C) 1 Indicator sample to be taken in the upper reservoir of the pumped storage facility at the plant discharge canal.	Time composite samples[6] with collection every month.[5]	23[3]	Gamma isotopic monthly with quarterly composite (by location) to be analyzed for tritium.[7]
V. Ground Water	A) 12 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly grab sampling.[7]	6, 26, 27, 101-103, 106, 108,110, 112-114	Gamma isotopic and tritium analyses quarterly.[7]
	B) 1 Control sample from unaffected location.	Quarterly grab sampling.[7]	59	Gamma isotopic and tritium analyses quarterly.[7]

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.[5]	28	Monthly[5] gamma isotopic and gross beta analyses and quarterly[7] composite for tritium analyses.
	B) 1 Indicator (finished water) sample from the nearest downstream water supply.	Monthly composite sampling.	17	Monthly[5] gamma isotopic and gross beta analyses and quarterly[7] composite for tritium analyses.
	C) 1 Control (finished water) sample from an unaffected water supply.	Monthly composite sampling.	39	Monthly[5] gamma isotopic and gross beta analyses and quarterly[7] composite for tritium analyses.
INGESTION: VII. Milk[4]	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.[10]	Semimonthly when animals are on pasture[8], monthly other times.[5]	To be supplied when milk animals are found in accordance with criteria VII.A.	Gamma isotopic and I-131 analysis semimonthly[8] when animals are on pasture, monthly other times.[5]
	B) 1 Control sample to be taken at the location of a dairy > 20 miles distance and not in the most prevalent wind direction.[2]	Semimonthly when animals are on pasture[8], monthly other times.[5,11]	16	Gamma isotopic and I-131 analysis semimonthly[8] when animals are on pasture, monthly other times.[5]
	C) 1 Indicator grass (forage) sample to be taken at the location of one of the dairies being sampled meeting the criteria of VII(A), above, when animals are on pasture.	Monthly when available.[5]	To be supplied when milk animals are found in accordance with criteria VII.A.	Gamma isotopic.
	D) 1 Control grass (forage) sample to be taken at the location of VII(B) above.	Monthly when available.[5,11]	16	Gamma isotopic.

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) 2 samples of broadleaf vegetation grown in the 2 nearest offsite locations 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 to 8 km where the doses are calculated to be greater than 1 mrem/yr.[10]	Monthly when available.[5]	6 7	Gamma isotopic on edible portion.
	B) 1 Control sample for the same foods taken at least 10 miles distance and not in the most prevalent wind direction if milk sampling is not performed within 3 km or if milk sampling is not performed at a location within 5 to 8 km where the doses are calculated to be greater than 1 mrem/yr.[10]	Monthly when available.[5]	40	Gamma isotopic on edible portion.
IX. Fish	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual[9] collection.[1]	23[3]	Gamma isotopic on edible portions semiannually.[9]
	B) 1 Indicator sample to be taken at a location in the lower reservoir.	Semiannual[9] collection.[1]	21[3]	Gamma isotopic on edible portions semiannually.[9]
	C) 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[9] collection.[1]	22[3]	Gamma isotopic on edible portions semiannually.[9]
AQUATIC: X. Sediment	A) 1 Indicator sample to be taken at a location in the upper reservoir.	Semiannual grab sample.[9]	23[3]	Gamma isotopic.
	B) 1 Indicator sample to be taken on or near the shoreline of the lower reservoir.	Semiannual grab sample.[9]	21[3]	Gamma isotopic.
	C) 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.[9]	22[3]	Gamma isotopic.

Table 5 (cont) - Radiological Environmental Monitoring Program Specifications

FOOTNOTES

1. Fish include 3 groups (Bass, Bream/Crappie, Catfish/Carp.)

2. Sample site locations are based on 5-year average meteorological analysis.

3. Though generalized areas are noted for simplicity of sample site enumeration, airborne, water and sediment sampling is done at the same location, whereas biological sampling sites are generalized areas in order to reasonably assure availability of samples.

4. Milking animal and garden survey results will be analyzed annually. If the survey should indicate new activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, site(s) will be added for additional milk sampling up to a total of three Indicator locations.

5. Not to exceed 35 days.

6. Time composite samples are samples which are collected with equipment capable of collecting an aliquot at time intervals which are short relative to the compositing period.

7. At least once per 100 days.

8. At least once per 18 days.

9. At least once per 200 days.

10. The dose shall be calculated for the maximum organ and age group, using the guidance/methodology contained in Regulatory Guide 1.109, Rev. 1 and the parameters particular to the site.

11. Milk and forage sampling at the control location is only required when locations meeting the criteria of VII(A) are being sampled.

Table 6 – Supplemental Radiological Environmental Monitoring

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
AIRBORNE: S-I. Particulate	A) 1 Indicator sample monitoring the nearest community with the highest anticipated dose or ground level concentration.	Continuous sampler operation with weekly collection.	8	Gross beta following filter change; Monthly Composite (by location) for gamma isotopic.
S-II. Radioiodine	A) 1 Indicator sample to be taken from the location of S-1(A) above.	Continuous sampler operation with weekly collection.	8	Gamma isotopic for I-131 weekly.
S-III. Direct	A) 5 stations to be placed within the exclusion boundary.	Quarterly exchange[7]; two or more dosimeters at each location.	61,62,63, 68 & 99	Gamma dose quarterly.
	B) 2 stations to be placed around VCSNS sludge lagoons.	Quarterly exchange[7]; two or more dosimeters at each location.	94,97	Gamma dose quarterly.
WATERBORNE: S-IV. Surface Water	A) 1 indicator sample to be taken of the combined wastewater discharge.	Composite samples with monthly collection.[13,5]	77	Gamma isotopic and tritium.
	B) 1 Indicator sample taken at each storm drain outfall.	Daily sample with monthly composite.	72,73	Gamma isotopic and tritium.
S-VI. Drinking Water	A) 1 Indicator (finished water) sample to be taken on site.	Quarterly.	99	Quarterly gamma isotopic, gross beta and tritium analysis.
	B) 1 Indicator (finished water) sample of public system.	Quarterly.	31	Quarterly gamma isotopic, gross beta and tritium analysis.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
INGESTION: S-VII. Milk[4]	A) 1 Sample from one of the nearest affected dairies at or beyond 5 miles.	Biweekly grab sample.[8,14,+]	14	Gamma isotopic and I-131 analysis biweekly.
	B) 1 Control sample to be taken at the location of a dairy greater than 20 miles distance and not in the most prevalent wind direction.	Biweekly grab sample.[8,14,+]	16	Gamma isotopic and I-131 analysis biweekly.
	C) 1 Indicator grass (forage) sample to be taken at the location of S-VII(A) above.	Monthly when available.[14]	14	Gamma isotopic.
S-VII. Milk[4]	D) 1 Control grass (forage) sample to be taken at the location of S-VII(B) above.	Monthly when available.[14]	16	Gamma isotopic.
	E) 2 Indicator grass (forage) samples to be taken at 2 of the locations beyond but as close to the exclusion boundary as practical where the highest offsite sectorial ground level concentrations are anticipated.	Monthly when available.	2,7	Gamma isotopic.
	F) 1 Control grass (forage) sample to be used for routine monitoring along with S-VII(E) above.	Monthly when available.	40	Gamma isotopic.
	G) 1 Indicator grass (forage) sample to be taken at location of penstock leak.	Quarterly when available.	25	Gamma isotopic.
S-VIII. Food Products	A) 1 Indicator sample of various types of foods grown in the area surrounding the plant (root, fruit, grain).	Annually during growing season.[11]	6,7	Gamma isotopic on edible portion.
	B) 1 Control sample of various types of foods grown. (root, fruit, grain).	Annually during growing season.[11]	40	Gamma isotopic on edible portion.
Corbicula	C) 1 Indicator sample of edible portions.	Semiannual.	23	Gamma isotopic.

Exposure Pathway and/or Sample	Criteria for Selection of Sample Number & Location	Sampling and Collection Frequency	Sample Location	Type & Frequency of Analysis
S-IX. Sediment/ Sludge	A) 1 Indicator sample from each storm drain outfall.	Semiannually.	72,73	Gamma isotopic.
	B) 3 Indicator sludge samples taken at sludge lagoons 006A, 006B & 008.	Semiannually.	On site	Gamma isotopic.
	C) 1 Indicator sample of topsoil from penstock spill area.	Annually	25	Gamma isotopic.
S-X. Ground Water	A) 11 Indicator samples to be taken within the exclusion boundary and in the direction of potentially affected ground water supplies.	Quarterly grab sampling.[7]	107,111, 115 -123	Gamma isotopic and tritium analyses quarterly.[7]

Table 6 (cont) – Supplemental Radiological Environmental Monitoring

FOOTNOTES

1. Reserved for future use.

2. Reserved for future use.

3. Reserved for future use.

4. Milking animal and garden survey results will be analyzed annually. If the survey should indicate new activity the owners shall be contacted with regard to a contract for supplying sufficient samples. If contractual arrangements can be made, site(s) will be added for additional milk sampling up to a total of 3 Indicator locations.

5. Not to exceed 35 days.

6. Reserved for future use.

7. At least once per 100 days.

8. At least once per 18 days.

9. At least once per 200 days.

10. Reserved for future use.

11. At least once per 400 days.

12. Reserved for future use.

13. Weekly, when circulating water is not operational.

14. Milk and grass (forage) sampling is not required unless VCSNS gaseous releases exceed 5% of quarterly organ dose limits or radionuclides (attributed to VCSNS operation) are detected in broadleaf vegetation, grass or air samples at concentrations greater than required LLD. Sampling should continue for two months after plant releases are reduced to less than trigger levels and milk contamination levels have returned to background levels.

+ The ODCM requires semimonthly sampling when animals are on pasture, monthly at other times.

Table 7 – Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Air Particulate (pCi/m^3)	Gross Beta (309)	4.60E-3 (1.0E-2)	2.31E-2 (257/257) (8.90E-3 to 5.01E-2)	Site 30, Construction Site Gate, (0.5 miles SSW)	2.36E-2 (52/52) (1.13E-2 to 4.63E-2)	2.33E-2 (52/52) (1.11E-2 to 5.05E-2)	0
	Gamma Spec (72)						
	^{134}Cs	2.29E-3 (5.0E-2)	All < LLD			All < LLD	0
	^{137}Cs	2.57E-3 (6.0E-2)	All < LLD			All < LLD	0
Air Radioiodine (pCi/m^3)	^{131}I (309)	1.67E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] ($\mu R/hr$)	Gamma(135) Quarterly	N/A	8.22E+0 (116/116) (4.84E+0 to 1.14E+1)	Site 55, St. Barnabas, (2.8 miles E)	1.10E+1 (4/4) (1.01E+1 to 1.14E+1)	8.36E+0 (19/19) (4.54+0 to 1.19E+1)	0
	Gamma(24) Special Interest	N/A	8.75E+0 (24/24) (4.53E+0 to 1.21E+1)	Site 31, McCrory Liston, (6.6 miles NNE)	1.14E+1 (4/4) (1.08E+1 to 1.21E+1)	N/A	0
Surface Water (pCi/l)	^{3}H (36)	4.39+2 (2.0E+3)	All < LLD		All < LLD	All < LLD	0
	Gamma Spec(36)						
	^{54}Mn	1.54E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	2.08E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	3.98E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	1.66E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	3.25E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	2.84E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	1.99E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	1.50E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 7 (cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Surface Water (Continued)	^{137}Cs	1.75E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	1.54E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	3.57E+0 (1.5E+1)	All < LLD			All < LLD	0
Ground Water (pCi/l)	^{3}H (52)	4.55E+2 2.00E+3	All < LLD			All < LLD	0
	Gamma Spec (52)						
	^{54}Mn	4.51E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	3.48E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	6.06E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	5.47E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	7.52E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	6.51E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	2.76E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.92E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	4.37E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	2.10E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	4.22E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 7 (Cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Drinking Water[6] (pCi/l)	Gross Beta (36)	3.10E+0 (4.00E+0)	3.44E+0 (11/24) (2.60E+0 to 4.07+0)	Site 28, Jenkinsville Post Office, (2.8 miles, SE)	3.44E+0 (5/12) (2.60E+0 to 3.94+0)	2.31E+0 (3/12) (2.26E+0 to 2.37E+0)	0
	^{3}H (36)	4.33E+2 (2.0E+3)	All < LLD			All < LLD	0
	Gamma Spec (72)[9]						
	^{54}Mn	2.57E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	1.94E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	4.72E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.71E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	4.26E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	4.14E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Nb	2.25E+0 (1.5E +1)	All < LLD			All < LLD	0
	^{131}I	4.85E-1 (1.0E+0)	All < LLD			All < LLD	0
	^{134}Cs	2.49E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	2.61E+0 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	1.31E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La	4.04E+0 (1.5E+1)	All < LLD			All < LLD	0

Table 7 (Cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Broadleaf Vegetation (pCi/kg wet)	Gamma Spec (36)						
	^{131}I	1.51E+1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{134}Cs	1.42E+1 (6.0E+ 1)	All < LLD			All < LLD	0
	^{137}Cs	1.68E+1 (8.0E+1)	All < LLD			All < LLD	0
Fish[7] (pCi/kg wet)	Gamma Spec (18)						
	^{54}Mn	1.59E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{58}Co	2.06E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{59}Fe	3.19E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{60}Co	2.27E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{65}Zn	4.11E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{134}Cs	1.79E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{137}Cs	2.01E+1 (1.5E+2)	All < LLD			All < LLD	0

Table 7 (Cont.) - Radiological Environmental Monitoring Program Summary for 2021

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[3] (#/total #) (Range)	Number of Nonroutine Reported[4] Measurements
				Name (Distance & Direction)	Mean[3] (#/total #) (Range)		
Sediment (pCi/kg)[8]	Gamma Spec (6)						
	^{54}Mn	1.31E+1 N/A	All < LLD			All < LLD	0
	^{58}Co	1.16E+1 N/A	All < LLD			All < LLD	0
	^{60}Co	1.10E+1 N/A	All < LLD			All < LLD	0
	^{134}Cs	7.38E+0 (1.5E+2)	All < LLD			All < LLD	0
	^{137}Cs	1.40E+1 (1.8E+2)	All < LLD			4.16E+1 (1/2) (4.16E+1 to 4.16E+1)	0

Table 7 (cont) - Radiological Environmental Monitoring Program Summary for 2021

Footnotes

1. Includes indicator and control analyses. Site 8, Air Particulates and Air Radioiodines are included as indicators. Does not include other supplemental samples.

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

3. Mean and range are based on detectable measurements only. The fractions of detectable measurements (i.e., number of positive results/total number of 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 ODCM, Section 1.4.1.2.

5. Detection sensitivity is approximately 10 mrem/yr (1.0 μR/hr).

6. Elevated levels of ^{214}Pb and ^{214}Bi were observed in 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. Fish include 3 groups (Bass, Bream/Crappie, Catfish/Carp.)

8. Elevated levels of ^{214}Pb and ^{214}Bi plus other ^{226}Ra daughter products and ^{228}Ac plus other ^{232}Th 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.

9. Drinking water resin prepared and counted for ^{131}I as separate sample.

Table 8– Radiological Environmental Monitoring Program 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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (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)	Site 13, North Dam, (2.9 miles, NNW)	1.3E-1 (52/52) (2.1E-2 to 5.5E-1)	1.2E-1 (153/155) (7.9E-3 to 6.1E-1)	0
			2.7E-2 (456/462)[4] (9.3E-3 to 6.6E-2)	Site 8, Mon. Res. S of Rd 224, (1.5 ENE)	3.0E-2 (42/42) (1.2E-2 to 6.0E-2)	2.8E-2 (125/126) (1.2E-2 to 5.8E-2)	
	Gamma Spec (307)						
	^{134}Cs	3.0E-3 (1.0E-2)	All < LLD			All < LLD	0
	^{137}Cs	3.1E-3 (1.0E-2)	3.2E-3 (22/241) (1.5E-3 to 5.2E-3)	Site 10, Met Tower, (2.4 miles, 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)	^{131}I (290)	3.6E-2 (7.0E-2)	All < LLD			All < LLD	0
Direct (TLD)[5] ($\mu R/hr$) (1978-1982)	Gamma (1220) Monthly	0.5 N/A	9.9 (915/915) (6.7 to 14.7)	Site 13, North Dam, (2.9 miles, 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 N/A	10.2 (154/154) (6.8 to 14.7)	Site 55, St. Barnabas Church, (2.8 miles, E)	14.0(7/7) (13.1 to 14.7)		0
Surface Water (pCi/l) (1981-1982)	^{3}H (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 mile SE)	1.6E+3 (2/7) (1.4E+3 to1.8E+3)	1.2E+3 (6/14) (6.7E+2 to 1.6E+3)	0
	Gamma Spec (140)						
	^{54}Mn	2.7E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	2.9E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	6.0E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	2.4E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	7.9E-1 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	5.2E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{95}Nb	3.3E-1 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.0E-1 (1.5E+1)	All < LLD			All < LLD	0

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
	^{137}Cs	2.2E-1 (1.8E+1)	All < LLD			All < LLD	0
	^{140}Ba	2.2E+0 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La (1982 only)	5.5E-1 (1.5E+1)	All < LLD			All < LLD	0
Ground Water (pCi/l) (1981-1982)	^{3}H (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)						
	^{54}Mn	3.7E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{58}Co	3.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{59}Fe	7.8E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{60}Co	3.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{65}Zn	8.1E+0 (3.0E+1)	All < LLD			All < LLD	0
	^{95}Zr	6.8E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{95}Nb	4.6E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{134}Cs	3.7E+0 (1.5E + 1)	All < LLD			All < LLD	0
	^{137}Cs	3.8E+0 (1.8E + 1)	All < LLD			All < LLD	0
	^{140}Ba	1.9E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{140}La (1982 only)	5.0E0 (1.5E+1)	All < LLD			All < LLD	0
Drinking Water[6] (pCi/l) (1981-1982)	Gross Beta[7]	(2.0E+0)					
	^{3}H (14)	6.3E+2 (1.0E+3)	7.8E+2 (6/14) (6.8E+2 to 9.8E+2)	Site 28, Jenkinsville, (2.0 miles, SE)[7]	8.4E+2 (3/7) (7.0E+2 to 9.8E+2)		0
	Gamma Spec (44)						
	^{54}Mn	3.0E-1 (1.5E+1)	All < LLD				0
	^{58}Co	2.7E-1 (1.5E+1)	All < LLD				0

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
	^{59}Fe	9.6E0 (3.0E+1)	All < LLD				0
	^{60}Co	2.6E-1 (1.5E+1)	All < LLD				0
	^{65}Zn	3.4E-1 (3.0E+1)	All < LLD				0
	^{95}Zr	4.8E-1 (1.5E+1)	All < LLD				0
	^{131}I	3.4E-1 (1.5E+1)	All < LLD				0
	^{95}Nb	7.4E-1 (1.0E+0)	All < LLD				0
	^{134}Cs	2.2E-1 (1.0E+1)	All < LLD				0
	^{137}Cs	2.4E-1 (1.8E+1)	All < LLD				0
	^{140}Ba	2.5E0 (6.0E+1)	All < LLD				0
	^{140}La (1982 only)	4.4E-1 (1.5E+1)	All < LLD				0
Milk (pCi/l) (1981-1982)	Gamma Spec (94)						
	^{131}I	6.3E-1 (1.0E+0)	All < LLD			All < LLD	0
	^{134}Cs	3.3E+0 (1.5E+1)	All < LLD			All < LLD	0
	^{137}Cs	4.6E0 (1.5E+1)	4.1E+0 (8/47) (2.8E+0 to 6.1E+0)	Site 14, Dairy, (5.1 miles, W)	4.1E+0 (8/47) (2.8E+0 to 6.1E+0)	5.7E+0 (37/47) (3.7E+0 to 9.2E+0)	0
	^{140}Ba	1.1E+1 (1.5E + 1)	All < LLD			All < LLD	0
	^{140}La	4.4E+0 (1.5E+1)	All < LLD			All < LLD	0
Grass (pCi/kg wet) (1981-1982)	Gamma Spec (82)						
	^{131}I	6.7E+1 (6.0E+1)	All < LLD			All < LLD	0
	^{134}Cs	2.7E+1 (8.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	3.3E+1 (8.0E+1)	5.0E+1 (13/51) (1.6E+1 to 1.6E+2)	Site 14, Dairy, (5.1 miles, 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

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] (#/total #) (Range)	Location with Highest Annual Mean		Control Locations Mean[2] (#/total #) (Range)	Number of Nonroutine Reported[3] Measurements
				Name (Distance & Direction)	Mean[2] (#/total #) (Range)		
Broadleaf Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (10)						
	^{131}I	3.7E+1 (6.0E+1)	All < LLD				0
	^{134}Cs	1.9E+1 (8.0E+1)	All < LLD				0
	^{137}Cs	2.1E+1 (8.0E+1)	3.1E+1 (2/7) (1.8E+1 to 3.6E+1)	Site 2, Trans. Line, (1.2 miles, SW)	3.6E+1 (1/1) (Single Value)	All < LLD	0
Other Vegetation (pCi/kg wet) (1980-1982)	Gamma Spec (32)						
	^{134}Cs	8.4E+0 (8.0E+1)	All < LLD			All < LLD	0
	^{137}Cs	1.0E+1 (8.0E+1)	All < LLD			All < LLD	0
Fish (pCi/kg wet) (1980 - 1982)	Gamma Spec (92)						
	^{134}Cs	1.4E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{137}Cs	1.8E+1 (1.3E+2)	2.8E+1 (50/71) (1.1E+1 to 1.0E+2)	Site 24, Recreation Lake, (5.5 miles, 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
	^{58}Co	2.6E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{54}Mn	1.8E+1 (1.3E+2)	All < LLD			All < LLD	0
	^{59}Fe	9.0E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{65}Zn	4.1E+1 (2.6E+2)	All < LLD			All < LLD	0
	^{60}Co	1.8E+1 (1.3E+2)	All < LLD			All < LLD	0
Sediment (pCi/kg) (1980-1982)	Gamma Spec (24)						
	^{134}Cs	2.3E+1 (1.5E+2)	All < LLD			All < LLD	0
	^{137}Cs	2.4E+1 (1.5E+2)	1.7E+2 (12/18) (2.6E+1 to 4.5E+2)	Site 21, Parr Reservoir, (2.7 miles, 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 8 (Cont.)- Radiological Environmental Monitoring Program 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 non-routine measurement is any confirmed measured level of radioactivity in an environmental medium that exceeds the reporting requirements of VCSNS ODCM, Section 1.4.1.2.

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.

Table 9 - Results of 2021 Environmental Inter-Comparison Program with Independent Lab, Eckert & Ziegler Analytics, Inc.

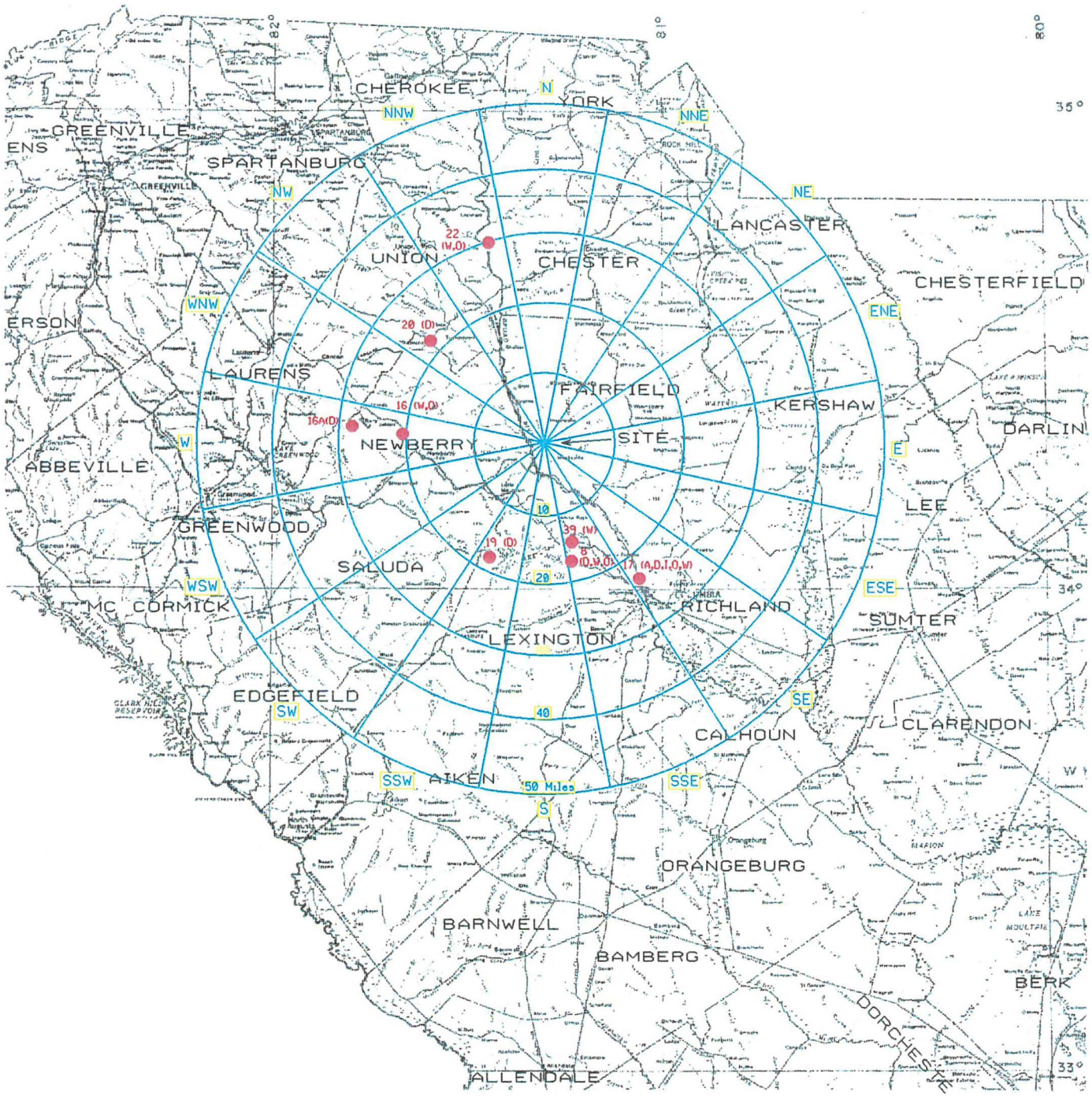
Comparison Study (Measurement Unit)	Date	Nuclides	Vendor Lab Results	Env Lab Results	Agreement
Gamma Isotopic Liquid 1 Liter (pCi/l)	3/18	^{131}I	87.9	98.7	Yes
		^{141}Ce	124	124	Yes
		^{51}Cr	239	246	Yes
		^{134}Cs	150	142	Yes
		^{137}Cs	109	112	Yes
		^{58}Co	126	130	Yes
		^{54}Mn	111	116	Yes
		^{59}Fe	108	120	Yes
		^{65}Zn	208	241	Yes
		^{60}Co	152	156	Yes
Gamma Composite Filter (pCi)	9/30	^{141}Ce	92.8	94.5	Yes
		^{51}Cr	192	187	Yes
		^{134}Cs	75.5	66.6	Yes
		^{137}Cs	90.7	99.8	Yes
		^{58}Co	95.5	108	Yes
		^{54}Mn	104	123	Yes
		^{59}Fe	82.7	107	Yes
		^{65}Zn	124	146	Yes
		^{60}Co	117	126	Yes
Alpha/Beta Water (pCi/l)	4/14	Alpha	232	60.9	No *
		Beta	209	107	No *
Gamma Isotopic Pulverized Soil (pCi/kg)	3/25	^{141}Ce	227	247	Yes
		^{51}Cr	439	431	Yes
		^{134}Cs	274	250	Yes
		^{137}Cs	199	218	Yes
		^{58}Co	232	235	Yes
		^{54}Mn	203	217	Yes
		^{59}Fe	198	253	Yes
		^{65}Zn	382	411	Yes
		^{60}Co	279	287	Yes
I-131 Solid (pCi)	3/17	^{131}I	87.9	93.1	Yes

Comparison Study (Measurement Unit)	Date	Nuclides	Vendor Lab Results	Env Lab Results	Agreement
Tritium (pCi/l)	4/7	^{3}H	14800	15400	Yes
Gross Beta Filter (pCi)	9/21	^{241}Am ^{137}Cs	93.2 247	94.4 212	Yes
Charcoal Cartridge (pCi)	9/15	^{131}I	90.9	93.6	Yes
Gamma Isotopic Liquid 4 Liter (pCi/l)	9/15	^{131}I ^{141}Ce ^{51}Cr ^{134}Cs ^{137}Cs ^{58}Co ^{54}Mn ^{59}Fe ^{65}Zn ^{60}Co	247 151 312 123 148 156 170 135 202 191	283 175 373 129 163 170 197 158 237 209	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes

*Sample provided from the independent laboratory contained a particulate contaminant that interfered with the Alpha/Beta analysis. The particulate was unusual in that it didn't adhere to the sample planchette and would easily slide if the planchette was tilted. The activity of the of the sample was confirmed with a gamma spec analysis with Cs- 137 activity of 213 pCi/L agreeing with the vendor laboratory Cs-137 of 209 pCi/L. The acid reagent used in the sample preparation at the VCSNS Laboratory was not found to be contaminated with the particulate material. An additional Alpha/Beta sample has been obtained from the independent laboratory for further study.

Table 10 – 2021 Environmental Sampling Program Deviations

Media	Sample Location	Month (Week No.)	Cause for Deviation
TLD	Site 17	Jan (02)	Fence TLD located on torn down
TLD	Site 45	Jan (02)	Missing / damaged
TLD	Site 47	Mar (13)	Damaged
TLD	Site 17	Oct (41)	Missing due to construction
Air Samples	Site 8	Mar (09)	Sampler vandalized
	Site 6	Aug (33)	Loss of power
	Site 2	Sep (36)	Loss of power



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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.

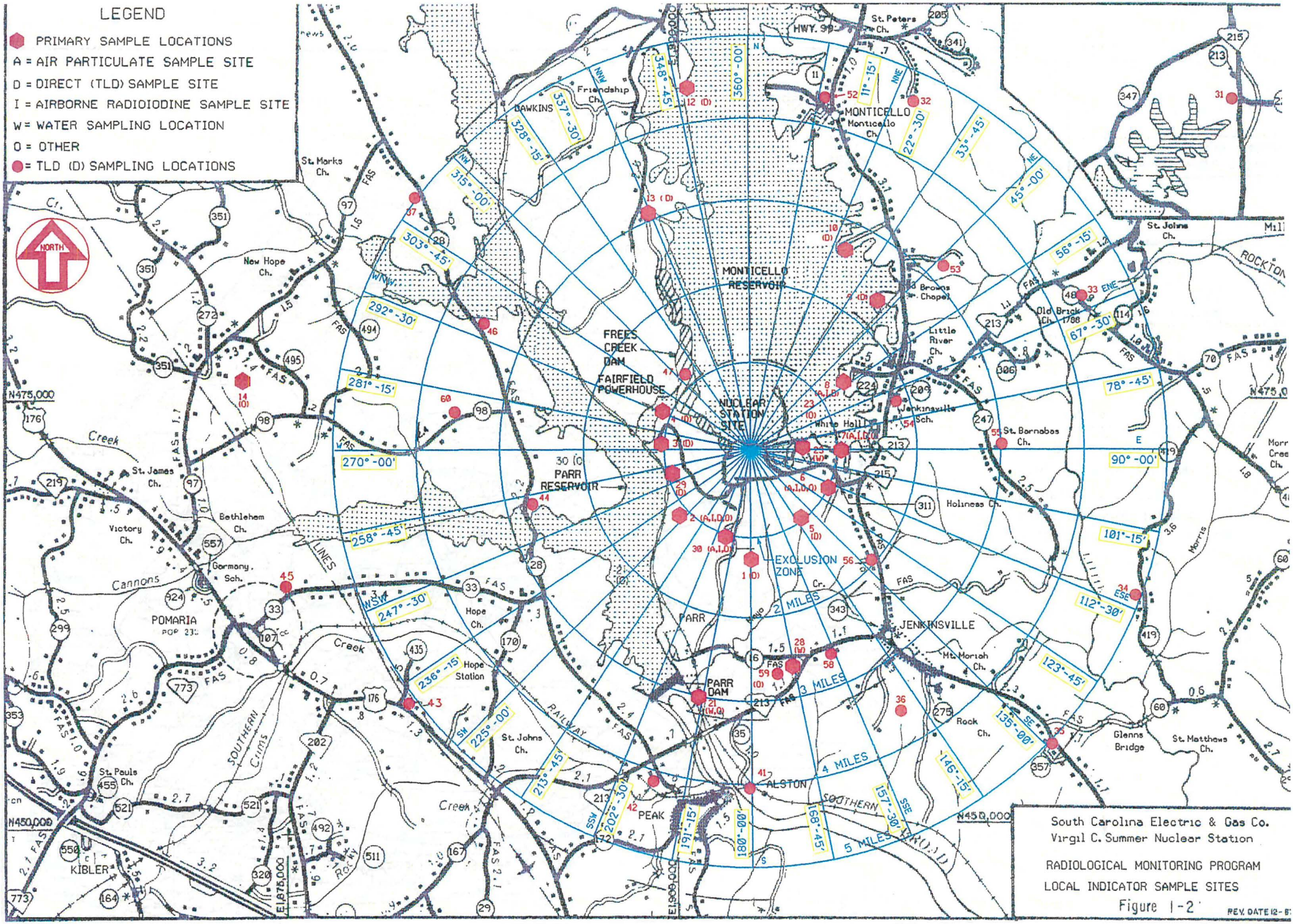
STATUTE MILES
10 0 10 20

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

Regional Location Map

Figure 1-1

REV. DATE 12-8

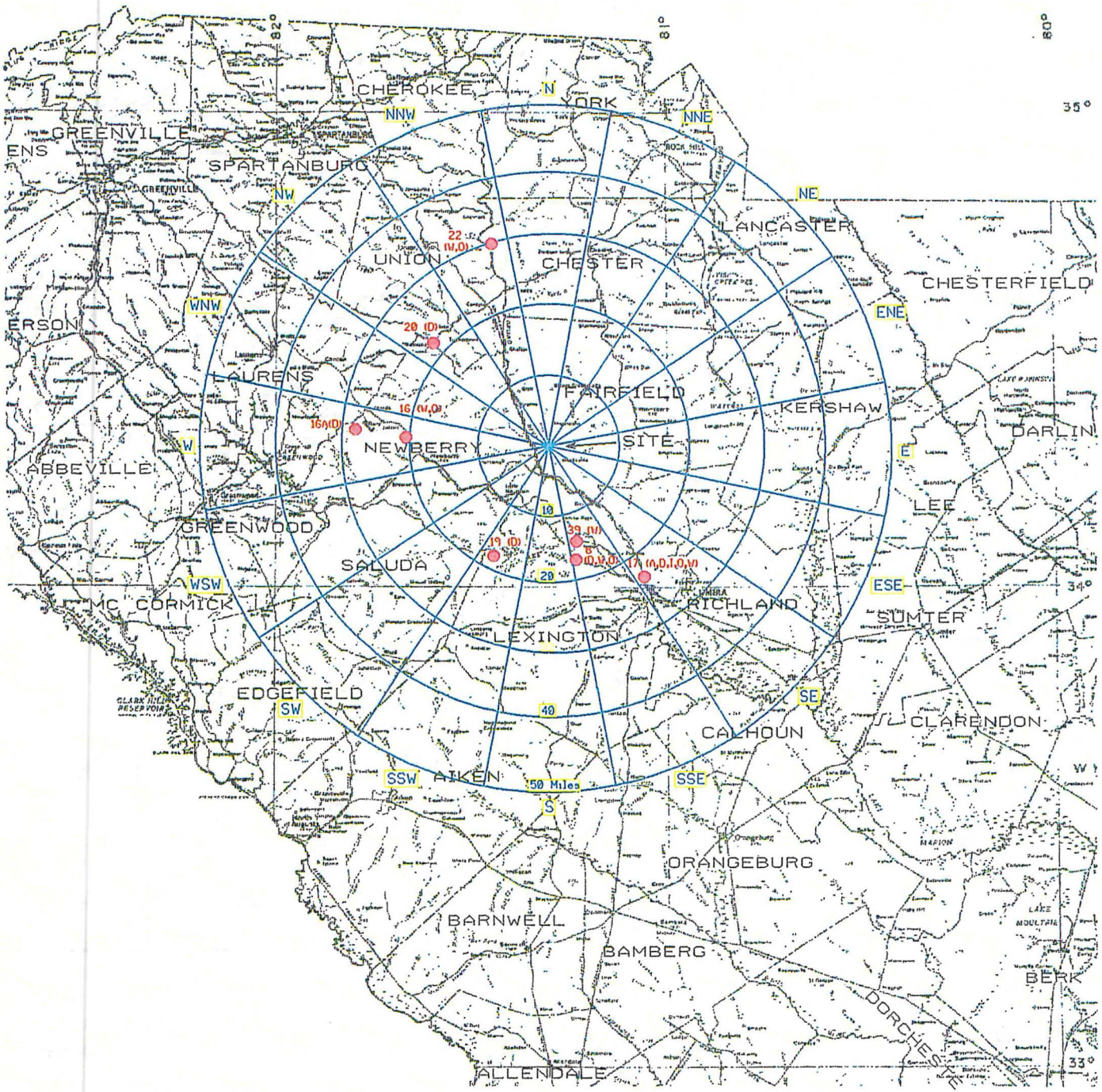


South Carolina Electric & Gas Co.
Virgil C. Summer Nuclear Station

RADIOLOGICAL MONITORING PROGRAM
LOCAL INDICATOR SAMPLE SITES

Figure 1-2

REV. DATE 12-6



LEGEND

- CONTROL SAMPLE LOCATIONS
- A=AIR PARTICULATE SITE
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REFERENCE:
THE BASE FOR THIS MAP WAS PREPARED FROM A PORTION OF USGS STATE OF GEORGIA, 1970.

STATUTE MILES
10 0 10 20

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

Regional Location Map

Figure 1-1

REV. DATE

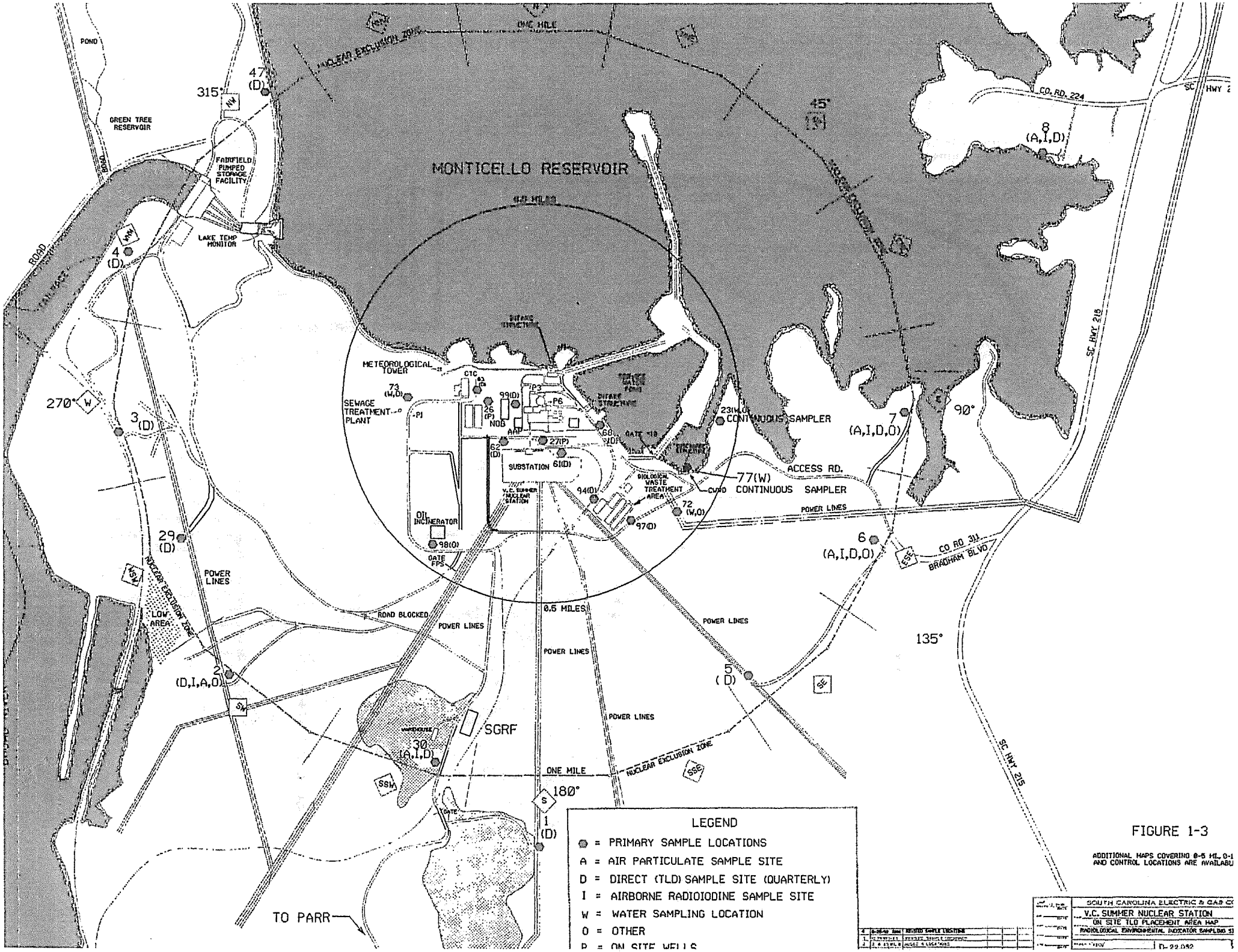

FIGURE 1-3

ADDITIONAL MAPS COVERING 0-5 MI. O-1
AND CONTROL LOCATIONS ARE AVAILABL

SOUTH CAROLINA ELECTRIC & GAS C
V.C. SUMMER NUCLEAR STATION
ON SITE TLD PLACEMENT AREA MAP
RADIOLOGICAL ENVIRONMENTAL INDICATOR SAMPLING SI

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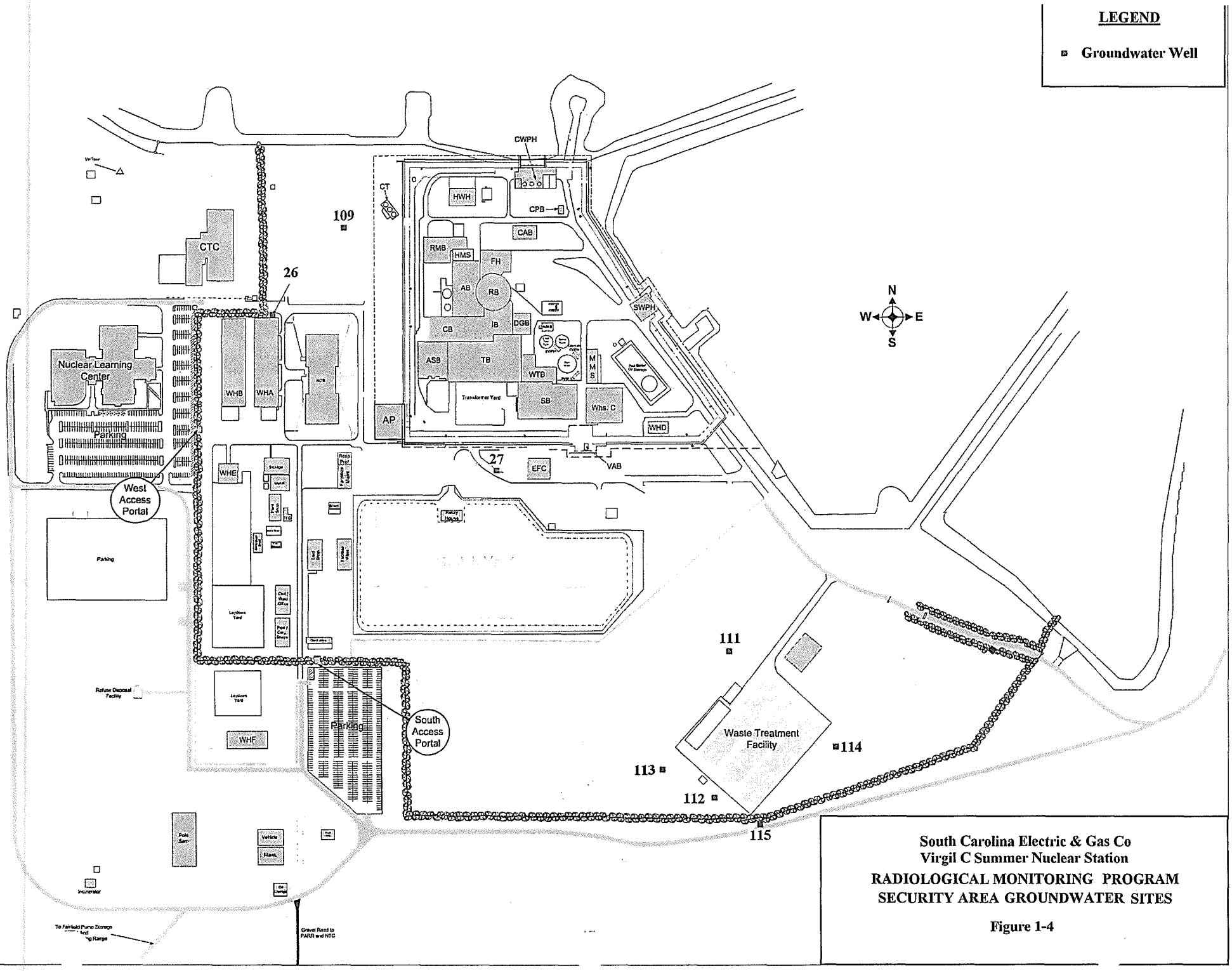
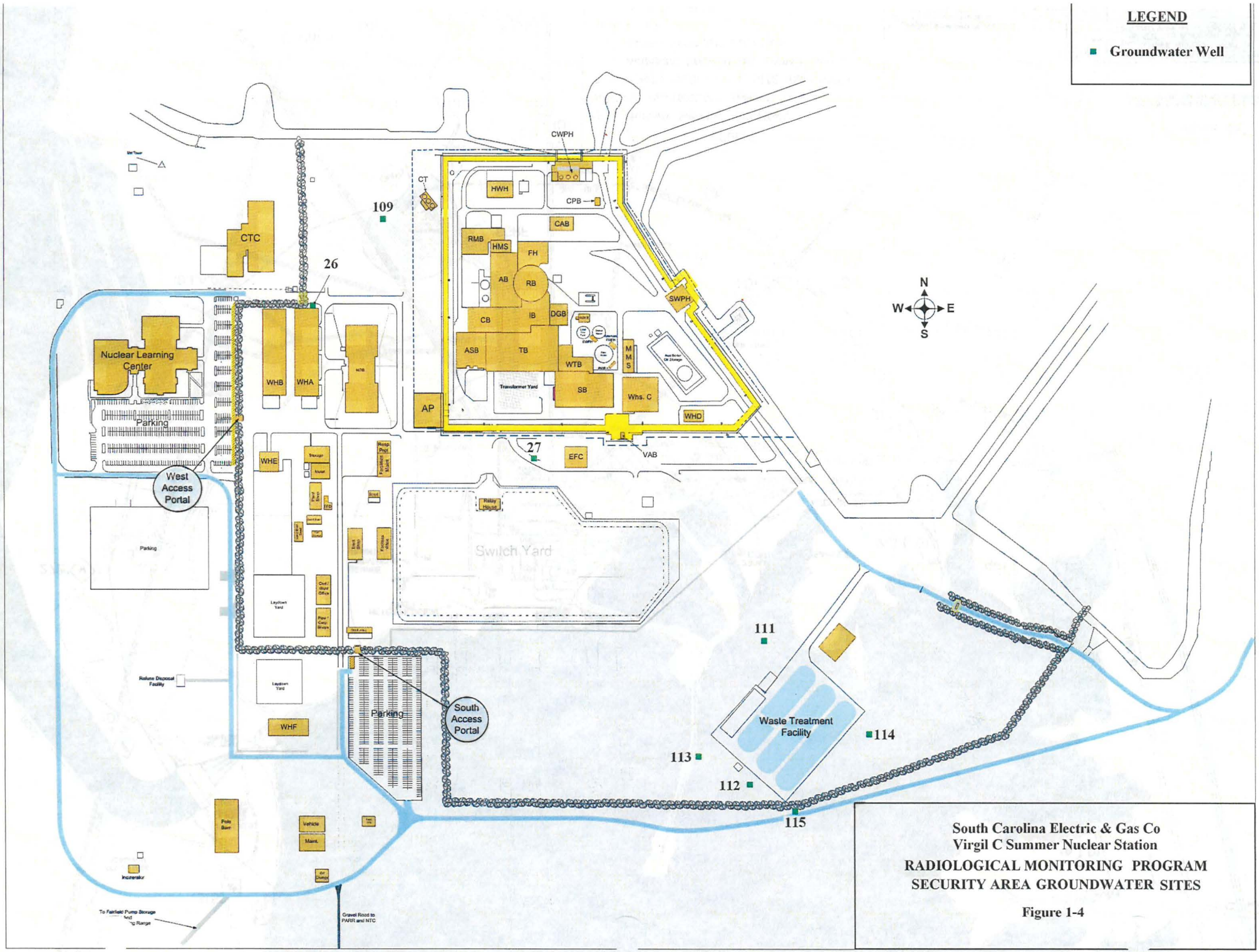


South Carolina Electric & Gas Co
Virgil C Summer Nuclear Station
RADIOLOGICAL MONITORING PROGRAM
SECURITY AREA GROUNDWATER SITES

Figure 1-4



South Carolina Electric & Gas Co
Virgil C Summer Nuclear Station
RADIOLOGICAL MONITORING PROGRAM
SECURITY AREA GROUNDWATER SITES

Figure 1-4

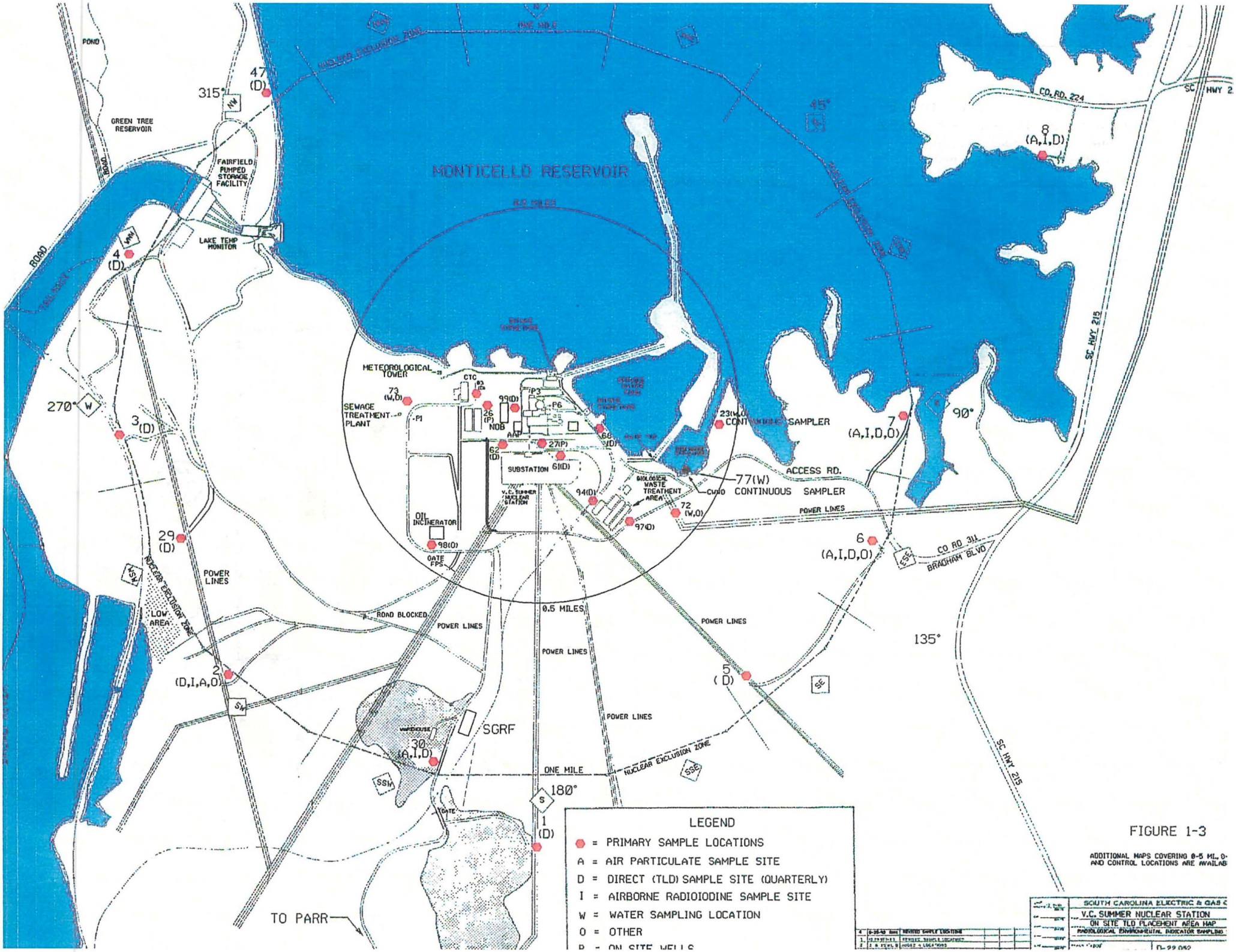


FIGURE 1-3

ADDITIONAL MAPS COVERING 0-5 MI., 0-
AND CONTROL LOCATIONS ARE AVAILAB

SOUTH CAROLINA ELECTRIC & GAS C
V.C. SUMMER NUCLEAR STATION
ON SITE TLD PLACEMENT AREA MAP
RADIOLOGICAL ENVIRONMENTAL INDICATOR SAMPLING

South Carolina Electric & Gas Co
Virgil C Summer Nuclear Station

RADIOLOGICAL MONITORING PROGRAM
PROTECTED AREA GROUNDWATER SITES

Figure 1-5